Table of Contents

**PUMP CURVE**  
1

**COMPLIANCE TESTING REQUIREMENTS**  
2

**TECHNICAL SPECIFICATION**

1.0 STANDARDS  
7

2.0 MATERIALS & FITTINGS  
7

3.0 MISCELLANEOUS ISSUES COMMON TO SEVERAL WORK ITEMS  
8

4.0 SITE ESTABLISHMENT / DISESTABLISHMENT  
10

5.0 ENVIRONMENTAL MANAGEMENT  
12

6.0 PROTECTION / RELOCATION OF SERVICES  
13

7.0 DESIGN BY CONTRACTOR  
13

8.0 WATER RETICULATION  
14

9.0 SEWERAGE RETICULATION  
16

10.0 PROTECTIVE COATING OF CONCRETE SURFACES  
18

11.0 SEWAGE PUMP STATION  
25

12.0 RISING MAIN  
35

13.0 CONNECTION OF ERGON POWER SUPPLY  
36

**OPERATIONS AND MAINTENANCE MANUAL GUIDE FOR DEVELOPMENT**  
37

**CONCRETE SPECIFICATION**  
58
## SPECIFICATION

<table>
<thead>
<tr>
<th>LOCATION OF TEST</th>
<th>TESTING REQUIRED</th>
<th>APPLICABLE STANDARDS</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrical &amp; SCADA</strong> Technical Specifications of this Contract</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Place of Manufacture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pump Test</td>
<td>AS2417</td>
<td>Refer to Clause 77 of the technical specifications of these Works.</td>
</tr>
<tr>
<td></td>
<td>Motor Performance Test</td>
<td>AS1359</td>
<td>Refer to Clause 77 of the performance specifications of these Works.</td>
</tr>
<tr>
<td>Switchboard (If Ordered)</td>
<td>Megger Testing and Continuity Testing</td>
<td>AS3000</td>
<td>Every LV cable and control cable.</td>
</tr>
<tr>
<td><strong>Coating Works</strong></td>
<td>pH testing of prepared concrete surface</td>
<td>None applicable</td>
<td>Testing of the complete surface of each structure.</td>
</tr>
<tr>
<td>Structure to be coated</td>
<td>Surface cleanliness</td>
<td>N/A (visual test only)</td>
<td>One (1) test after surface preparation and cleaning.</td>
</tr>
<tr>
<td></td>
<td>Residual Dust</td>
<td>AS3894.6 Method C (to suit concrete substrate)</td>
<td>Two (2) tests per work lot</td>
</tr>
<tr>
<td></td>
<td>Residual Moisture</td>
<td>ASTM F2170</td>
<td>One (1) test prior to application of coating.</td>
</tr>
<tr>
<td><strong>S5  Water Reticulation</strong></td>
<td>Maximum Dry Density</td>
<td>AS 1289</td>
<td>1 test per material type.</td>
</tr>
<tr>
<td>Pipework</td>
<td>Density Index/Field Density</td>
<td>AS 1289</td>
<td>1 test per road crossing, 1 test per 50 m length of pipe, or part thereof.</td>
</tr>
<tr>
<td></td>
<td>Pressure</td>
<td>FNQROC Clause S5.28</td>
<td>All components to be tested once. Pressure pipes to be tested to a minimum of 1200kPa.</td>
</tr>
<tr>
<td>Suction Mains</td>
<td>Pressure</td>
<td>FNQROC Clause S5.28</td>
<td>All components to be tested once. Suction mains to be tested to a minimum of ¾ of their pressure class.</td>
</tr>
<tr>
<td></td>
<td>Bacteriological</td>
<td>WSA03-2002 19.5</td>
<td>All pipework to be tested once. Samples may be collected by the Contractor.</td>
</tr>
<tr>
<td><strong>G15 Concrete Works</strong></td>
<td>Concrete in Structures</td>
<td>Slump</td>
<td>Minimum of one test per batch</td>
</tr>
</tbody>
</table>
**WOORABINDA ABORIGINAL SHIRE COUNCIL**  
**CONTRACT B1817-001**  
**ATTACHMENT E - SCHEDULE OF COMPLIANCE ASSESSMENT TESTING**

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>LOCATION OF TEST</th>
<th>TESTING REQUIRED</th>
<th>APPLICABLE STANDARDS</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>(incl. concrete kerb)</td>
<td>Strength (excl. batches of less than ½ cubic metres).</td>
<td>AS 1012</td>
<td>Minimum of four matched test cylinders (from the same batch) for each 15m³ or part thereof, poured per day, for each grade of concrete. One cylinder will be tested at 7 days, two at 28 days and one spare.</td>
<td></td>
</tr>
</tbody>
</table>

**Notes**
- “Tested once” means one test where pipework passes successfully i.e. one test only where pipework fails will not be sufficient.
- All sampling of stockpile lots for aggregate or pavement materials will be to Test Method Q060 and supported by a NATA endorsement.
Technical Specification

Construction of Sewage Pump Station (SPS) and Rising Main
Table of Contents

1.0 STANDARDS 7
2.0 MATERIALS & FITTINGS 7
   2.1 General 7
   2.2 Concrete Works 8
3.0 MISCELLANEOUS ISSUES COMMON TO SEVERAL WORK ITEMS 8
   3.1 Shoring 8
   3.2 Construction Water 8
   3.3 Over Excavation 8
   3.4 Restoration 8
   3.5 Excavation in Rock ‘extra over’ (provisional) 9
   3.6 Maintenance of Roads 9
4.0 SITE ESTABLISHMENT / DISESTABLISHMENT 10
   4.1 General 10
   4.2 Establishment 10
   4.3 Contractor’s Accommodation 10
   4.4 Disestablishment 10
5.0 ENVIRONMENTAL MANAGEMENT 12
6.0 PROTECTION / RELOCATION OF SERVICES 13
   6.1 General 13
7.0 DESIGN BY CONTRACTOR 13
   7.1 General 13
   7.2 Design Requirements 13
   7.3 Compliance Certification 14
   7.4 Design Documentation 14
   7.5 Measurement and Payment 14
8.0 WATER RETICULATION 14
   8.1 Water Mains - DN100 14
   8.2 Valves and Hydrants 15
   8.3 Connections to Existing Mains 15
9.0 SEWERAGE RETICULATION 16
   9.1 Gravity Sewers DN150 16
   9.2 Connection to Existing Manhole 16
   9.3 Sewer Manholes 16
10.0 PROTECTIVE COATING OF CONCRETE SURFACES 18
   10.1 Surface Preparation 18
   10.2 Materials application 18
   10.3 Design and Documentation 21
   10.4 Quality Assurance & Quality Control (QA & QC) 22
   10.5 Identification and Traceability 23
   10.6 Compliance Inspections and Testing 23
   10.7 Treatment Record 23
   10.8 Inspection and QA Auditing 24
   10.9 Hold and Witness Points 24
11.0 SEWAGE PUMP STATION 25
   11.1 General 25
   11.2 Site Works 26
   11.3 Wet Well, Valve Chamber and Vent 27
   11.4 Well Washer 28
   11.5 Switchboard and Fittings 28
   11.6 Sewage Pumps 32
   11.7 Pump Hoisting Gantry 33
   11.8 Screenings Basket Lifting Gantry 34
   11.9 Water Service 34
   11.10 Alternative Bedding 35
12.0 RISING MAIN
    12.1 Rising Main
13.0 CONNECTION OF ERGON POWER SUPPLY
    13.1 General
1.0 STANDARDS

Unless specified differently, carry out the work in accordance with the Capricorn Municipal Development Guidelines (CDMG) standards, specifications and drawings, generally and the following standard specifications. Refer:

- CMDG Standard D11 – Water Reticulation
- CMDG Standard D12 – Sewerage Reticulation
- CMDG Standard CP1 – Construction Procedures
- CMDG Standard C211 – Control of Erosion and Sedimentation
- CMDG Standard C212 – Clearing and Grubbing
- CMDG Standard C213 – Earthworks
- CMDG Standard C220 – Stormwater Drainage
- CMDG Standard C265 – Boundary Fencing
- CMDG Standard C271 – Minor Concrete Works
- CMDG Standard C273 – Landscaping

No separate payment will be made for the Contractor complying with this clause but rather full compensation will be provided in the scheduled rates generally.

2.0 MATERIALS & FITTINGS

2.1 General

All materials and equipment used in the works will be the best of their respective kinds and in accordance with the current specifications of the Standards Association of Australia for those particular classes of material, where such specifications are applicable and do not conflict with this specification. If there is no Australian Standard Specification, then the relevant British Standard Specification or others approved by the joint committee, if any, will apply.

The Superintendent may require samples of any or all of the materials nominated to be submitted for their review prior to their use on the job. Whether the Superintendent has called for samples or not, all materials used in the work will be subject to the Superintendent’s review.

All valves and fittings will be “Rilson” coated (or approved equivalent).

All materials and protective coatings will comply with Category E-M of AS 2312 – 2002.

All items that may need to be replaced or serviced will be able to be removed and replaced by normal tools without the need to cut pipes or fittings.

Equipment, pipe and fittings will be suitable for operation in an environment where relative humidity of 95% and shade temperatures of 40°C can occur simultaneously (conditions inside tanks etc. may exceed these figures).

Electrical equipment and instrumentation to be mounted outdoors will have an enclosure protection rating of IP65 (unless noted otherwise) to AS1939. Protection will be provided by encapsulation and/or varnish impregnation using non-hydroscopic materials which do not age and are unaffected by sunlight.

No separate payment will be made for the Contractor complying with this clause but rather full compensation will be provided in the lump sum amount generally.
2.2 Concrete Works

The Standard Specification G15 – Concrete 1, as amended by this Job Specification and the drawings, will apply to and form part of this Contract. Concrete used in the works will have the following 28 day compressive strengths, unless noted otherwise on the Job Drawings or in this specification:

- Reinforced concrete: N25
- Mass concrete: N20
- Lean mix concrete; flowable backfill: 1MPa (not greater than 5MPa); slump > 100mm.

The Contractor will carry out sampling during concrete construction. Sampling and testing of concrete for compliance will be in accordance with AS 1379. Slump tests and projected assessment of each strength grade will be undertaken in accordance with AS 1379.

No separate payment will be made for the Contractor complying with this clause but rather full compensation will be provided in the lump sum amount generally.

3.0 MISCELLANEOUS ISSUES COMMON TO SEVERAL WORK ITEMS

3.1 Shoring

During the excavation and construction of the works of the Contract, the Contractor is to comply with workplace health and safety requirements, provide all materials, plant and labour and carefully execute at their own cost, adequate shoring and in sandy or loose soil, close timbering and other work that maybe required to prevent earth or other material at sides of excavation from being shaken, slipping or falling in.

The Contractor will utilize shoring as required, in order to limit the width of disturbance. As applicable, the maximum width of disturbance for trenching will be 2.0 metres.

No separate payment will be made for the Contractor complying with this clause but rather full compensation will be provided in the lump sum amount generally.

3.2 Construction Water

The Contractor may source construction water from the existing reticulation network. The Contractor will liaise with the Woorabinda Aboriginal Shire Council (WASC) to determine an appropriate location to source construction water. The Contractor will submit details of the location to the Superintendent. The Contractor will allow to pay any Council fees and charges should they be applicable.

No separate payment will be made for the Contractor complying with this clause but rather full compensation will be provided in the lump sum amount generally.

3.3 Over Excavation

Over-excavation in the bottom of excavations will be backfilled with lean mix concrete. Over-excavation on the sides of trenches will be backfilled as per Standard Specifications and Drawings.

In-situ soil may be used for “approved surround” provided it meets the requirements of the Standard Specification. In-situ soils may require screening to comply with the Standard Specification. Otherwise, import all material required for pipe bedding.

No separate payment will be made for the Contractor complying with this clause but rather full compensation will be provided in the lump sum amount generally.

3.4 Restoration

Refer to Specification D12 - Sewerage Network Design & Construction.
The Contractor will document, with photographs or video, the existing site conditions prior to commencing the works on site.

The Contractor will not unreasonably destroy or damage any existing infrastructure, property, fences, gardens, walls, paved areas, concrete surfaces, paths, trees, roads, gravelled areas & grassed / landscaped areas. Items, vegetation or surfaces disturbed will be restored to the same or better condition than before commencement of the work.

Where existing grassed areas are disturbed during construction, the soil will be graded, prepared, and then seeded in accordance with the CMDG Construction Specification C273. The Contractor will fertilise, water and maintain such areas in accordance with CMDG Construction Specification C273 to ensure the regrowth of grass.

Backfilling will be completed by the end of each work day. As soon as practicable, remove off-site surplus spoil, construction materials and cleared waste. As soon as practicable, make good disturbed areas to the satisfaction of the Superintendent. Failure to complete cleaning up and restoration will not be considered a minor omission. The Superintendent may withhold portions of intermediate payments and the issuance of the Certificate of Practical Completion until restoration is complete.

No separate payment will be made for the Contractor complying with this clause but rather full compensation will be provided in the lump sum amount generally.

3.5 Excavation in Rock ‘extra over’ (provisional)

3.5.1 Rock Excavation

Rock will be defined as material which cannot be broken or removed by a 20 Tonne excavator fitted with a single ripping tyne. The extent of rock and the volume excavated during each day of the contract will be agreed with the Superintendents Project Site Representative following a joint inspection on a daily basis of active work areas.

3.5.2 Payment for Rock

An “Excavation in Rock ‘extra over’ (provisional)” cubic metre rate for the excavation of rock is included in the Schedule of Rates for all excavation in rock.

Rock will be paid at a cubic metre ‘extra over’ rate based on the widths and depth of excavations as defined by the specification, standard drawings or project specific drawings as applicable. The upper surface of the rock-layer in any excavation will be agreed with the Superintendent’s Site Representative. Daily logs will be required for payment.

The scheduled rate for “Excavation in Rock ‘extra over’ (provisional)” will include full compensation for all labour, plant and equipment necessary for excavating in rock, over and above that required in the relevant section for excavation and for all other costs incurred in executing and completing the works in accordance with the Contract.

3.6 Maintenance of Roads

The Contractor will make all reasonable efforts not to damage any roads traversed in the course of undertaking the works. The Contractor will make every effort to minimize the number of roads traversed in the course of executing the Contract. No tracked machinery will be permitted to travel on paved roads without suitable protection for the road.

The Contractor will maintain roads used in the course of carrying out the Contract. The Contractor will manage dust generation, making every effort to suppress dust.

The Contractor will make good damage to roads.

No separate payment will be made for the Contractor complying with this clause but rather full compensation will be provided in the lump sum amount generally.
4.0 SITE ESTABLISHMENT / DISESTABLISHMENT

4.1 General
The scheduled lump sum for “Site Establishment / Deseaseblishment” will not be more than 20% of the total Contract amount.

4.2 Establishment
The Contractor will arrange for and provide such transport of employees and plant to the Site, establish accommodation, shelters, storage facilities and the like as are required for the Contractor’s establishment on the Site and execution of the work under the Contract.

The scheduled lump sum for “Establishment” will include full compensation for all transport, establishment of accommodation, shelters and the provision of facilities and for all costs incurred in the Contractor fully establishing on site including construction of the contractor’s camp.

25% of the scheduled lump sum for “Establishment” will be paid once the Contractor has fully established on site and has substantially commenced construction work. The balance of the lump sum will be paid progressively throughout the duration of the Contract.

4.3 Contractor’s Accommodation
Throughout the project the Contractor will be required to maintain and manage accommodation for employees, subcontractors and workers on an ongoing basis.

Where a Contractor’s Camp is provided the Contractor will be responsible for payment of water and sewerage services, electrical supply as well as all other ongoing costs of providing accommodation, food and entertainment for all employees under the Contract.

The Contractor shall inform the Superintendent of water requirements for the camp as water on the island is limited during the dry season. The Contractor may connect the sewer to the reticulated networks where they are available at each site. Otherwise, the Contractor shall install a septic tank.

If any services are limited during the construction phase or any fees are charged to connect into the existing system the Contractor is responsible for all associated costs and no additional payment shall be made for the Contractor complying with the Contract.

Notwithstanding whether the Principal has nominated a suitable site for the Contractor’s camp, the Contractor shall liaise with the Traditional Owners and the Prescribed Body Corporate to confirm that the land is available and whether any rental costs apply for its use.

The Contractor shall establish and maintain a lockable, fenced compound for the camp and site office, for storage of all materials for the duration of the Contract, and for storage of plant when not in use for significant periods. Within 24 hours of delivery to the island, all the Contractor's materials shall be transported to the compound for storage, unless approved otherwise by the Superintendent.

Suitable erosion and sedimentation controls shall be provided for the compound by the Contractor. Refuse arising from the execution of work under the Contract shall be removed from the island; however household wastes may be disposed of at Council’s dump.

The scheduled lump sum for “Contractor’s Accommodation” will include full compensation for all ongoing costs of maintaining the contractor’s accommodation (including provision of a contractor’s camp where deemed necessary by the Contractor and any rental costs for the site) and will be deemed to cover all costs associated with maintaining the Contractor’s workforce on site. The lump sum will be paid progressively throughout the duration of the Contract.

4.4 Deseaseblishment
The Contractor will arrange for and provide such transport of employees and plant away from site and will reinstate any land used for the contractor’s camp, accommodation, shelters and other facilities. All
plant and equipment will be removed from site and the site reinstated to pre-establishment condition or better.

The scheduled lump sum for “Disestablishment” will include full compensation for all transport, disestablishment of accommodation, shelters and facilities, reinstatement of land used and for all other costs incurred in the Contractor fully disestablishing from site. The schedule lump sum for “Disestablishment” will not be paid until the Superintendent is satisfied that the Contractor has returned the project site to pre-establishment condition.
5.0 ENVIRONMENTAL MANAGEMENT

The Contractor will submit to the Superintendent for direction as to its suitability an Environmental Management Plan including (but not limited to) consideration of the items included in Clause 14.7 of this Job specification – Non Technical.

The plans will be prepared by a professional experienced in the field of environmental management, and will be amended to the satisfaction of the Superintendent prior to commencement of work on site.

The Environmental Management Plan will contain/address:

- A description of the project and existing environment;
- The Contractor’s environmental policy and the objectives to be attained
- A listing of applicable licences and their conditions
- A statement of the role and responsibilities of supervisory personnel, with particular reference to responsibility for dealing with environmental incidents
- The process for dealing with incidents, including clean-up and mitigations
- Procedures for training and awareness of all site personnel
- Construction procedures to minimise the risk of environmental harm
- A management plan for each environmental element
- A monitoring program. The monitoring program will identify each issue, the action and parameter to be monitored and the frequency of monitoring, and the reporting mechanism for monitoring results
- Revegetation of the site after construction, including grass and plant types, application method (e.g., turfing, hydromulch, seagrass etc.) and watering methods and schedule
- Pruning and clearing of vegetation (native and re-growth)
- Weed and pest invasion
- Storage and handling of chemicals
- Soil contamination
- Noise, dust and air quality
- Flora and fauna
- Cultural Heritage
- Bank stabilisation
- Waste management
- Storage and handling of fuels, including dealing with fuel spills
- Treatment, management and disposal of Acid Sulphate Soils (ASS) and Potential Acid Sulphate Soils (PASS).

The Environmental Management Plan will also incorporate an Erosion and Sedimentation Control Plan that will detail temporary works proposed by the Contractor to prevent erosion from the site and deposition of eroded sediments in any adjacent watercourse.

Environmental management records will be made available to the Superintendent for auditing on request.

Full compensation for preparation and amendment of the Environmental Management Plan and in complying with its requirements (except where specifically allowed for elsewhere in the Contract) will
be deemed to be included in the scheduled lump sum for “Environmental Management”. No work will be allowed on site until this plan is reviewed by the Superintendent.

6.0 PROTECTION / RELOCATION OF SERVICES

6.1 General

Refer to Clause 15.5 of the Job Specification – Non Technical.

This clause describes the Contractor’s responsibilities as they relate to the relocation and / or adjustment of the various utility services necessary for construction of the works. Known services are indicated on the drawing, however, the exact position and nature of the existing utility services will be determined by the Contractor in consultation with the relevant services authorities. Note that the locations of some services are not known to any authority or local residents. Many of the services will be at depths at variance to the standard design depths for such services.

The Contractor will have full responsibility for all co-ordination work required in regard to the relocation and / or adjustment of the various utility services within the works area. Such co-ordination will be deemed to comprise the programming of the relocation and / or adjustment work in consultation with the service authorities for such work to commence, with due advance notice having been given as agreed to by the Contractor and the service authorities concerned. Any request to service authorities for work to commence will be given in writing. A copy of any such request will be forwarded simultaneously to the Superintendent for their information.

The Principal reserves the right to accept the need for service relocation or to undertake alternative means of service protection.

7.0 DESIGN BY CONTRACTOR

7.1 General

The Contractor shall design all temporary works, structural steelwork, gantries, concrete slabs to resist uplift of the new pump station and zero manhole, pump discharge pipework, and any other part of the work that is not fully detailed in the Drawings and Specification.

The Contractor shall measure the relative levels of the incoming sewer and the ground level at the pump station to establish the height of the pump station required and location of penetrations.

7.2 Design Requirements

The design of all items shall be undertaken in accordance with relevant Australian Standards including but not limited to the following:

- AS/NZS1170 Structural design actions – all parts
- AS1418 Cranes, hoists and winches – all parts
- AS1657 Fixed platforms, walkways, stairways and ladders – Design, construction and installation
- AS 3600 Concrete structures
- AS4100 Steel structures

Wind loadings shall be in accordance with AS1170.2 for Region A terrain category 4.

The Contractor shall note that all electrical works shall be designed by the Contractor. It shall be the Contractor’s responsibility to ensure that all Electrical works are completed under this contract in accordance with AS3000, AS3008 and relevant local government regulations. Any requirements of the electricity supply authority shall also be adhered to.
7.3 Compliance Certification

Compliance of Designs by Contractor with Australian Standards shall be certified by a Registered Professional Engineer of Queensland.

7.4 Design Documentation

The Contractor shall supply to the Superintendent for his comment, copies of all drawings and compliance certification for all items designed by the Contractor prior to any construction or manufacturing works taking place.

In addition to the drawings and compliance certification the Contractor shall provide copies of all calculations if requested by the Superintendent.

7.5 Measurement and Payment

Full compensation for Design by Contractor including investigations, calculations, preparation of drawings, documentation and for all other costs incurred in the design in accordance with the Contract shall be included in the rates included in the Schedule.

8.0 WATER RETICULATION

8.1 Water Mains - DN100

8.1.1 General

The contractor will undertake the work in accordance with CMDG Specification D11 – Water Reticulation unless otherwise required by this Job Specification.

Water mains will be constructed in the locations identified on the project drawings.

Pipework will be backfilled in accordance with CMDG Standard Drawing CMDG-W-040 “Bedding and Backfill for Water Main Construction”.

8.1.2 Pipework

Test installed pipework to a test pressure of 1200 kPa, unless noted otherwise. Pipe restraints, including thrust blocks, will be designed to accommodate a test pressure of 1200 kPa safely.

Valves and fittings will be suitable for a minimum working pressure of 1200 kPa. Flanged or lugged valves and fittings will be compatible with AS 2129, Table C.

Water Mains will be DN100 mPVC rubber-ring, jointed water pipe as shown on the design drawings with a minimum pressure rating of PN16.

Fittings for mPVC pipe will be DICL. DICL fittings will comply with AS 2280 and be minimum class PN16.

Provide galvanised steel backing plates compatible with AS 2129 Table C, where required. Bolts, nuts and washers will be galvanised.

8.1.3 Measurement and Payment

The scheduled rate for “Water Mains - DN100” will include: bends, fittings (excluding valves and hydrants which are measured separately), appurtenances, materials, clearing and grubbing, excavation in all materials excluding rock, removal and disposal of surplus excavated material, dewatering, shoring, supply, placement and compaction of bedding material, supply, laying and jointing of pipe and pipe surround, concrete stops, anchor and thrust blocks, backfill, restoration / reinstatement, testing and disinfection, traffic management, marker posts and for all other works and materials incurred in executing and completing the works in accordance with the Contract.
8.2 Valves and Hydrants

8.2.1 General


Markers for valves in the travelled way will be by painting. Outside the travelled way, they will be by marker post appropriately off-set from the main.

8.2.2 Sluice Valves

Refer CMDG Standard Drawing CMDG-W-060, CMDG-W-061A and CMDG-W-041. Sluice valves will be installed in the locations indicated on the drawings.

The Scheduled Rate for “Sluice Valves” will include: excavation in all materials except rock, removal and disposal of surplus excavated material, asbestos management, cutting into existing main, connections, dewatering, backfill, compaction, valve, valve box, actuator, pipe, fittings and appurtenances, marker posts, disinfection, and all other works and materials incurred in executing and completing the works in accordance with the Contract.

8.2.3 Hydrants

Refer CMDG Standard Drawing CMDG-W-060, CMDG-W-061A and CMDG-W-062. Fire hydrants will be installed in the locations indicated in the project drawings.

The Scheduled Rate for “Hydrants” will include: including excavation in all materials except rock, removal and disposal of surplus excavated material, dewatering, backfill, compaction, valves, valve box, concrete surround, pipe, and appurtenances, marker posts, disinfection, traffic management, pavement reinstatement and all other works and materials incurred in executing and completing the works in accordance with the Contract.

8.3 Connections to Existing Mains

8.3.1 General

The Contractor will be required to connect the new water mains to Council’s existing distribution system. Connections will be constructed in the locations indicated on the Drawings.

Prior to commencing work at each connection the Contractor will submit a plan for the coordination of the connection to the Superintendent. The plan must demonstrate how the connection will be constructed so as to cause the shortest disruption of service practicable.

The Contractor will liaise with Council and the Superintendent regarding the timing of the proposed cut-ins and will be flexible with respect to the cut-ins such that it minimises the interruptions to the town’s water supply.


8.3.2 Items Pertinent to All Connections

Thoroughly flush new and replaced pipe work and fittings; swab with a 20% hypochlorite solution before closing up the pipe work.

Flanged fittings immediately outside all chambers will be covered with Denso paste and wrapped with Denso wrap, as per the manufacturer’s specifications.

8.3.3 Measurement and Payment

The Scheduled Lump Sum for “Connections to Existing Mains” will include: potholing/hand excavation to find the existing pipe and connection point and exposing the entire point, excavation, bedding, removal and disposal of surplus excavated material, dewatering, pipework, bends, fittings, joints, thrust blocks/anchors including: reinforcing bars, formwork supply and placement of concrete; marker posts, backfill, compaction, reinstatement and for all other works and materials necessary to execute the works to provide a complete connection in accordance with the Contract.
9.0 SEWERAGE RETICULATION

9.1 Gravity Sewers DN150

Refer CMDG Specification D12 – Sewerage Reticulation. Gravity sewer mains will be constructed according to the Drawings and backfilled in accordance with CMDG Standard Drawing CMDG-S-090.

Over excavation (whether in soil or rock) in the bottom of excavations will be backfilled with N20 concrete. Over-excavation on the sides of trenches will be backfilled as per Standard Specifications and drawings.

Sewers will be installed with geofabric around the approved bedding as directed by the Superintendent (likely to be any areas where the surrounding ground is fine mud).

The Contractor may use in-situ soils for “approved filling” provided it meets the requirements of the Standard Specification. The Contractor may need to screen in-situ soils so that they comply with the Standard Specification. Otherwise, the Contractor will import all material required for “approved filling”.

The Scheduled Rate for “Gravity Sewers DN150” will include full compensation for the supply of all materials and the construction complete including excavation, dewatering, installation and removal of shoring, bedding, laying and jointing, concrete stops, backfill and testing, geofabric surround, restoration, and for all other costs incurred in executing and completing the works in accordance with the Contract.

9.2 Connection to Existing Manhole

Before commencing any work that is to be connected to an existing manhole as shown on the drawings, the Contractor will inspect the existing manhole as may be necessary and will verify the locations, lines, levels and dimensions.

If the Contractor discovers any discrepancy between the locations, lines, levels and dimensions with that shown on the drawings the Contractor will notify the Superintendent of the discrepancy and will not proceed with work affected by the discrepancy until the Superintendent has directed the action, if any, which is to be taken.

The contractor will connect to the existing manhole as shown on the drawings and in accordance with standard drawing CMDG-S-070. The contractor will break into the existing manhole, make the connection, reseal and rebench the manhole.

The Scheduled Rate for “Connection to Existing Manhole” will include full compensation for supply of all labour and materials, for excavation, dewatering, backfilling, connectors, restoration, breaking into the existing manhole, connection to, making good the manhole and for all costs incurred in executing and completing the works in accordance with the Contract.

9.3 Sewer Manholes

Sewer manholes shall be constructed in accordance with Standard Drawing CMDG-S-022, the CMDG Specification D12 – Sewerage Reticulation and as indicated on the Drawings.

9.3.1 General

Refer to CMDG Specification D12 – Sewerage Reticulation unless otherwise amended by this Job Specification.

Manholes may be cast in-situ or pre-cast / proprietary units manufactured from materials suitable for exposure to raw sewage internally, and the ground conditions to be experienced at Woorabinda externally, subject to the approval of the Superintendent.

Over excavation (whether in soil or rock) in the bottom of excavations shall be backfilled with grade N20 concrete. Over excavation on the sides of manholes shall be backfilled as per the requirements of this clause, given below.

Manhole connectors shall be compatible with PVC-o Class SN8 sewer pipe. Where connectors are detailed in manhole walls to provide for future extension of sewers, they shall include an external
removable plug or other suitable seal to allow pipe extension to be fitted directly into the connectors set in the manhole wall and to provide a water tight seal. These are labelled as ‘Future 150’ on the Drawings.

Tops of manholes shall be constructed to a maximum 150 mm and minimum 100 mm above natural surface, except in paved surfaces where they shall finish flush with the surface, unless otherwise shown on the drawings. The Contractor shall backfill from the edge of tops of manholes at a 1 in 4 slope to meet the adjacent natural surface.

Backfill to manholes shall be placed in maximum 150 mm layers and compacted to 95% RDD (standard compaction) or, for cohesionless material, to a density index of not less than 70%. The aim of this requirement is to achieve compaction similar to that of the surrounding ground and to minimise settlement. Select fill shall be used for backfill material and shall consist of naturally occurring sandy soil, gravelly soil, loam or other approved material.

Manholes shall be provided with covers and frames in accordance with traffic and pedestrian loadings and sealing requirements. Manholes shall be constructed complete with vertical drops, short slope drops, spillway drops and benching as applicable for all new and future branch sewers.

Restoration of property and existing surfaces shall be carried out in accordance with Clause 3.4 of this Job Specification.

All manhole covers shall be circular. Where the invert depth of the manhole below the surrounding natural surface is <1425 mm the manhole shall be extended above the surrounding natural surface to ensure a minimum manhole depth of 1425 mm is achieved. Additional fill shall be placed around these extended manholes to provide a minimum 1V:4H batter to the surrounding natural surface.

9.3.2 Zero Manhole

The zero manhole shall be constructed in accordance with Clause 9.3.1 and as indicated on the Drawings.

Hinged lockable aluminium covers with a small slot for the lifting chain with Teflon surround to the slot is to be provided to the zero manhole. Handrails shall be provided to the top of the zero manhole.

The zero manhole shall be provided with two screenings baskets (one in the manhole and one spare).

The Scheduled Rate for “Zero Manhole” shall include full compensation for supply of all labour, plant and materials, for excavation, dewatering, backfilling, bases, walls, tops, covers, house drain connectors, benching, manhole drops (including pipework), temporary slabs, screenings baskets, restoration and for all costs incurred in executing and completing the works in accordance with the Contract.

9.3.3 Discharge Manhole

The discharge manhole is an existing manhole receiving sewage from the pump station. The discharge manhole shall have an air vent installed as per the drawings.

The Scheduled Rate for the “Discharge Manhole” shall include full compensation for the supply of all labour, plant and materials for the air vent and the rising main connection to the existing manhole.

9.3.4 Painting of Manholes

The following manholes are required to be coated:

- Zero manhole
- Discharge manhole

The base, walls, top slab soffit, and all internal concrete surfaces of the identified manholes shall be coated in accordance with clause 10.0.

Over excavation and backfilling shall not be paid for separately, rather the Scheduled Rate for “Sewer Manholes” of each classification shall be deemed to provide full compensation for any over excavation and additional backfilling required.

The Scheduled Rate for “Sewer Manholes” shall include full compensation for supply of all labour, plant and materials, for excavation, dewatering, backfilling, bases, walls, tops, covers, benching,
10.0 PROTECTIVE COATING OF CONCRETE SURFACES

The purpose of a protective coating system applied to concrete surfaces is to provide a smooth, continuous, chemical resistant lining that is free from porosity and other flaws that allow aggressive fluids and gasses to come in contact with the concrete substrate.

10.1 Surface Preparation

All concrete surfaces that are to receive a protective coating system shall be prepared by wet or dry abrasive blast cleaning in order to remove all laitance and uniformly roughen the concrete substrate and any exposed aggregate. Care shall be taken to ensure that the method of preparation does not cause weakness of the interface due to fracture of aggregate or loosening of its bond or remove excessive concrete.

Sharp edges shall be rounded or trimmed by chipping, wire brushing, or other acceptable methods. If large bug holes are exposed by the abrasive blasting process, they must be filled with suitable epoxy filler prior to rendering of the full surface.

Fillers in expansion joints shall be cut or ground flush with the adjacent concrete surfaces.

All surfaces are to be clean and free of dust and other contaminants immediately prior to applying the first coat in the specified system.

All surfaces shall be dry prior to application of the render and all surfaces to be coated shall pass ASTM D 4263 moisture test.

10.1.1 Residual Dust

Upon completion of abrasive blast cleaning and removal of the bulk of spent abrasive, all surfaces that are to be coated shall be cleaned by means of blowing down with clean compressed air followed by final vacuum cleaning or washing down in order to remove all residual dust and spent abrasive. Attempts to remove dust surfaces by blowing down with compressed air only will not be accepted. Residual dust shall be tested in accordance with ISO 8502-3 at a frequency of 1 test per work lot. The test shall return a “Rating 1” or better for dust sizes 3, 4 and 5. All access equipment, shrouding and scaffold planks shall be made dust free prior to any coating application in order to prevent contamination of freshly painted surfaces.

10.1.2 Prior to Rendering/Coating

All surfaces to be coated shall be dry and dust free prior to application of the first coat. The first coat should be applied as soon as possible and in any case before any visible deterioration of the substrate occurs. If ambient conditions indicate that the humidity and/or temperature are likely to fall outside the specified perimeters, no coating application shall be conducted.

10.2 Materials application

10.2.1 Application Methods

The Contractor shall select an appropriate application method for all materials that are to be applied. Different materials require different application methods in order to achieve the intended integrity of the film layer that is applied.

Low viscosity primers: Although spray application is generally preferred for steel primers, low to medium viscosity primers for concrete shall be applied by brush and/or roller. Primer application shall ensure that the entire surface receives a reasonably even film on both peaks and depressions in the concrete substrate. This cannot be achieved by roller only, particularly if the substrate is excessively rough.
**Patch materials and renders:** Shall be applied by trowel in order to achieve a smooth, even surface free from pinholes and bare spots. May initially be applied by spray to increase application speed but shall always be finished by trowel.

**Finish coats:** Shall be applied by airless spray using a set up and pump pressure that allows for appropriate control over the material delivery rate. If the contractor is of the opinion that the specified coating material cannot be applied in accordance with the specification or the manufacturer’s recommendations, the Contractor shall request written instructions and site assistance from the coating manufacturer. Solvents shall NOT be added to solvent free epoxies.

### 10.2.2 Application Procedure

The Contractor shall ensure that copies of all relevant product data sheets, MSDS’s and specifications are immediately available to the person(s) responsible for surface preparation and application of the specified protective system.

Before use of any coating material, reference shall be made to the product data sheet for details regarding mixing, thinning, induction times, application, curing and re-coating. The instructions outlined in the datasheets shall be adhered to. **NOTE:** Varying substrate temperature and/or relative humidity will affect the minimum and maximum recoat times (refer to the product data sheet).

Deviation from guidelines and parameters outlined in the product data sheets is not permissible without prior written approval from the coating manufacturer.

Each material in the protective system shall be of a significantly different colour than the previously applied coat in order to enable the applicator to establish whether the coated surface has been adequately and evenly covered. The colour of the first coat shall be in contrast with the cleaned substrate. The coating manufacturer shall supply factory-tinted materials only in original packaging containing a label that states the colour of the coating material. The Contractor shall not facilitate tinting of the coating materials.

Any contamination, including dry spray, dust and inclusions, which occur on the substrate prior to coating application, shall be removed. The applicator shall prevent contamination from boots, clothing, hoses or other equipment from entering the designated work lot area.

The Contractor shall ensure that clean dry air is continuously flowing in the work area during surface preparation, cleaning, application and curing of the coating system. This may require the installation of forced ventilation equipment. Sufficient air flow within the work area shall be maintained from completion of abrasive blast cleaning to a minimum of 24 hrs after application of the last coat in the system. Natural airflow or the capacity of the ventilation equipment shall be such that the LEL is maintained at less than the maximum allowable 10% within the work area. If ambient conditions are such that condensation is likely to precipitate onto the prepared surface or applied coatings that have not yet cured, the Contractor shall supply and install adequate dehumidification equipment.

### 10.2.3 First Coat - Primer (Omission subject to approval)

Once a thorough visual inspection of the prepared surfaces has revealed that the specified cleanliness standard has been achieved and assessment of surface roughness and testing of residual dust contamination is complete, the Contractor shall ensure that any climatic control system is working adequately. If natural ambient conditions are adequate during surface preparation, coating application and curing, climatic control equipment such as dehumidification is not required.

Before mixing of any material, reference shall be made to the product data sheets for details regarding mixing, application, pot life and application guidelines.

Upon cure of the first coat, all surfaces shall be subjected to a thorough visual inspection and all areas showing insufficient coverage, poor film formation, porosity or other discontinuities in the coating film shall receive an additional application of the material that was used for the first coat in order to rectify these imperfections. The minimum and maximum recoat times should be observed before the subsequent coat is applied.

### 10.2.4 Second Coat - Render.

Before application of the render material to (primed) concrete surfaces, reference shall be made to the product data sheet for details regarding mixing, application guidelines and pot life. The contractor shall
satisfy himself that the consistency of the render is such that it can be applied evenly and smoothly whilst sufficiently wetting the substrate. Wetting of the substrate is particularly important if the render is applied to bare concrete rather than a primed surface. The finished rendering film shall hide the original roughness and porosity of the substrate.

Upon sufficient cure of the render, all surfaces shall be subjected to a thorough visual inspection and all areas showing insufficient coverage, poor film formation, porosity or other discontinuities in the film shall be marked with a compatible paint marker approved by the coating manufacturer.

Inclusions, runs, sags, rough patches, excessive trowel marks, embedded foreign objects and other obvious coating imperfections shall be removed by sanding or grinding and the repaired area marked. Grinding shall not penetrate the rendering layer.

All areas marked for repair (insufficient coverage, poor film formation, sanded areas, porosity or other discontinuities) shall receive an additional application of the material that was used for the second coat in order to ensure film integrity and improve aesthetics. The minimum recoat time should be observed before the subsequent coat is applied.

After repair of all marked areas, the marker should be removed by sanding or wiping with thinners prior to application of the topcoat material.

10.2.5 Third and Fourth Coat

Before application, reference shall be made to the product data sheet for details regarding mixing, application, pot life and recommended tip sizes and pump pressures.

The applicator shall ensure that there is a colour contrast between the second last coat and the last coat.

The second last coat and the last coat shall not be applied wet-on-wet and the minimum recoat time between the two coats shall be observed.

During application, the applicator shall ensure that the final coat is applied evenly and to full opacity, ensuring a completely closed film.

Upon sufficient cure of the final coat, all surfaces shall be subjected to a thorough visual inspection and all areas showing insufficient coverage, poor film formation, porosity, or other discontinuities in the coating film shall be marked with coloured chalk.

Grit inclusions, runs, sags, dust, embedded foreign objects and other obvious coating imperfections shall be removed by careful sanding with fine sandpaper and the sanded area marked with chalk.

Areas marked for repair (insufficient coverage, poor film formation, sanded areas, porosity or other discontinuities) shall receive an additional application of the material that was used for the final coat in order to ensure film integrity and improve aesthetics. The minimum recoat time should be observed before the subsequent coat is applied.

All masking shall be removed by the contractor as soon as possible after application or once the render has set or the coating is touch-dry. If touch-up repairs are required, removal of masking materials may be postponed until completion of repairs. Removal of masking materials includes the removal of adhesive residue and tape remnants.

10.2.6 Colours

Only factory tinted materials shall be used for all coating materials.

The colour of the second last coat shall contrast the colour of the finish coat but shall be such that it will be hidden by a single application of the specified top coat. The contractor shall satisfy himself that the pigmentation in the topcoat allows for sufficient opacity to hide the previous coat in one application at the thickness nominated by the coating manufacturer. The Superintendent will not entertain claims for application of additional coats as a result of insufficient opacity after one application.

The colour of the final coat shall be white or light grey.
10.2.7 Finish

The aesthetic finish of the coated surfaces shall be free from excessive runs, sags, bubbling and other obvious imperfections. The finish shall furthermore be free from any inclusions (such as grit, dirt, dust and insects) as well as pinholes and blisters. Any such imperfections shall be repaired as per the coating manufacturer’s directions and to the satisfaction of the Superintendent or their representative. A small degree of orange peeling, shallow brush marks, small localised runs, a slight rippling texture and a minimum of dry spray may be tolerated in the finish.

10.2.1 Coating System – Concrete Surfaces

The contractor shall include in their bid, a coating system that conforms to below descriptions.

1st coat: Low viscosity, 100% volume solids epoxy resin / primer.

2nd coat (render): 100% volume solids epoxy resin extendible with aggregate to prepare a mortar to the applicator’s preferred consistency. Mixed material must be suitable for application to infinite thickness.

3rd and 4th coat: High solids epoxy with chemical resistance properties required for service in sewerage manholes and pumping wells.

Omission of the first coat may be acceptable provided that the wetting properties of the render are such that the substrate is sufficiently covered by resin and that the resin is able to penetrate the substrate in order to form a strong bond. The applicator has full control over these properties when preparing the render mix to their preferred consistency. If the primer is to be omitted, this shall be reflected in the manufacturer’s endorsement (refer clause 10.3.1) and approved in writing by the superintendent.

10.2.2 Approved Manufacturers

The contractor shall select a coating system from one of the following manufacturers:

- BASF
- EpiMax
- Parchem
- Sika

10.3 Design and Documentation

10.3.1 Materials Manufacturer’s Endorsement

The Contractor shall contact their preferred materials manufacturer and request a materials recommendation in accordance with the requirements for the above protective treatments. Together with the materials recommendation, the manufacturer shall also provide written confirmation that the system they nominate is fit for its intended purpose (to offer concrete and corrosion protection for a period of 15 years in the exposure conditions that prevail in sewerage manholes and pumping wells if the surfaces are prepared and materials applied in accordance with this scope of work and specification). In this statement, the coating manufacturer shall confirm that all necessary surface preparation, application, testing and inspection criteria as outlined in this specification are deemed sufficient and appropriate for the service in which the protective system is expected to perform.

If the manufacturer is of the opinion that this contract specification is incorrect, incomplete or unsuitable for its intended purpose or that additional work procedures are required or that procedures or practices as outlined in this document are not complete, correct or appropriate, the manufacturer shall confirm this in their statement and include the required variations and corrections deemed necessary.

The Contractor shall satisfy himself that the minimum and maximum acceptance criteria of the aspects of the work are realistic and practically achievable.

The contractor shall make 2 hard copies and 1 electronic copy of the manufacturer’s endorsement available to the Superintendent prior to the coatings pre-start meeting. The coatings pre-start meeting
shall take place a minimum of 2 weeks prior to commencement of the work outlined in this specification. All parties shall be notified in writing as to the time and location of the coatings pre-start meeting within 4 weeks of commencement of the works.

10.3.2 Maintenance Specification

The contractor shall request from their preferred materials manufacturer, a detailed maintenance regime (including maintenance specification) that is to be used for all maintenance work that is likely to be required to the protective system over a period of 15 years. The maintenance specification shall accompany the materials manufacturer’s endorsement (Refer Clause 10.3.1).

10.3.3 Method Statements

The Contractor shall provide a Method Statement for each stage of each element of the Works. Detail in the Method statement shall include, inter alia, the following:

- Specifications of all materials used, including assessment of durability in a severe Hydrogen Sulphide (H2S) and Sulphuric Acid (H2SO4) environment is it prevails in said assets
- Endorsement of the contractor’s Method Statement and fit for purpose statement from the manufacturer(s) of the materials used
- Details of proposed preparation and application equipment, access, temporary work and formwork;
- Method of compliance with OH&S, environmental and other Authority requirements
- Method of cleaning and decontamination
- Method of surface preparation
- Methods for installation and application
- Details of inspection and testing methods
- Pro-forma drawings and forms for recording of measurements and test results
- Details of the Contractor’s site supervisor who has a demonstrated previous experience with surface preparation and protective coating system installation on concrete surfaces
- Names of all personnel who are to carry out the works and certify (via log books, journals, qualifications, etc.) that the concrete repair personnel are experienced and competent in such work and have completed satisfactory work in similar capacities elsewhere
- A summary of the inspection and test plan in the form of a list where all inspections and tests by the Contractor, hold points, witness testing and all inspections by the Superintendent are identified

All Work Method Statements shall be submitted to the Superintendent at least two weeks before the planned start of work to which it relates. With this information the contractor shall supply Manufacturer endorsed system specifications, product datasheets, and fit for purpose statements for all materials that the Contractor proposes to install/apply.

10.4 Quality Assurance & Quality Control (QA & QC)

General Requirement

All work under this contract shall be inspected and documented by the Contractor in accordance with a non-rejected Inspection and Testing Plan (ITP) to provide evidence of compliance with the technical specifications. For this purpose, the Contractor shall subdivide all items to be treated into distinct work lots or work items.

All compliance inspections and tests shall be based on work lots (Refer Clause 10.5). The costs for all inspections, tests and documentation shall be borne by the Contractor and shall be allowed for in any submitted tender. The Contractor shall document all equipment used in the project and all inspection and testing results in a Works Inspection Report. Such a document may be the contractor’s own standard QA documentation subject to non-rejection by the Superintendent.
The Contractor shall nominate a member of their staff as a designated QA/QC representative. The QA/QC representative shall have current qualifications recognized by ACA, NACE, SSPC or FROSIO in relation to inspection and testing of surface preparation and applied protective coatings. Furthermore, the Contractor’s QA/QC representative must be able to satisfy the Superintendent that he/she has a good understanding of QA/QC principles and all procedures and techniques related to Concrete repair, preferably with qualifications recognized by ACRA.

10.5 Identification and Traceability

All work under this contract shall be subdivided into distinct work lots or work items. Work lots shall be chosen by the Contractor, consistent with any specified testing and inspection requirements. Each work lot shall be assigned a unique identification number, and the Contractor shall maintain a register of all allocated work lot numbers. The Contractor shall follow the non-rejected Inspection and Testing Plan for each work lot based on the various tasks to be conducted. The Contractor shall ensure that traceability is maintained throughout all documented records under this contract. All test results where applicable under this contract shall be positively identified with their respective work lot number.

10.6 Compliance Inspections and Testing

The Contractor shall himself conduct sufficient inspection and testing work (and subsequent repair work where necessary) in order to satisfy himself that each work lot complies with the specification. The Contractor shall ensure that all aspects of the specification have been met prior to notifying the Superintendent or any other QA/QC auditors to test and verify that the work conforms to the specification. The Contractor shall notify the Superintendent of any QA/QC testing scheduled for each work lot in order to verify that acceptance criteria have been met and that the relevant documentation is completed accurately. Upon detection of a non-conformance, the Contractor shall immediately notify the Superintendent or their representative and subsequently submit a written non-conformance report and a proposal for corrective action that has been approved by the manufacturer of the repair materials or corrosion protection system in writing. No further work in the work lot location affected by the non-conformance shall be permitted until the Superintendent or their representative has non-rejected the corrective action. All compliance testing and reporting shall be in accordance with the minimum requirements listed in the Inspection & Testing Plan unless the Superintendent has reason to demand more rigorous testing in specific work lots. The Contractor shall present all completed QA documents within 24 hours of completion of the work lot, for verification. A complete treatment record as per Clause 10.7 including all relevant documents must be submitted to the Superintendent within 2 days upon practical completion of the works. The Contractor’s quality system shall include sufficient quality records to provide objective evidence that the requirements of the contract have been met. This shall include sub-contractors and suppliers records relevant to this contract.

10.7 Treatment Record

Upon completion of the works, the Contractor shall submit all completed QA/QC documentation to the Superintendent as a complete record of treatment of the surfaces in each structure. This treatment record consists of:

- The non-rejected ITP
- The all marked-up and completed pro-forma drawings
- The completed table outlining area and type of repair at each structure.
10.8 Inspection and QA Auditing

The Superintendent reserves the right to engage a suitably qualified and experienced Inspector in order to verify and document that all requirements of the specification are met. The Inspector shall conduct all aspects of their work in accordance with the NACE code of professional conduct.

The Inspector shall be the sole judge of whether compliance with the specification, the materials manufacturer’s datasheets, relevant International Standards or good work practices in general are being adhered to. Issues of non-compliance shall be addressed with the Contractor upon detection. The Contractor shall be given an opportunity to conduct rework within 24 hours in order to meet the specified criteria.

The Inspector shall immediately notify the Superintendent of any non-conformance issues and keep the Superintendent informed of the progress of rectification work. If rectification of the detected non-compliance is not carried out to the satisfaction of the Inspector or the Superintendent, the Inspector shall submit a written non-conformance report to the Superintendent and the Contractor.

In case of doubt about any aspects of the Contractor’s work or in the absence of relevant guidance in the specification, the certified Inspector shall nominate a suitable international standard in consultation with the Superintendent, the materials manufacturer and the Contractor in order to create clarity on any such matters.

The Contractor shall provide the Inspector with safe access to all treated steelwork and all QA/QC documentation at any time for the duration of the project.

The Contractor shall not rely on any inspection and testing that is conducted by the Superintendent and the Superintendent’s Inspector is under no circumstances obliged to disclose inspection and testing results. No party conducting inspections or audits shall produce non-conformance reports without notifying the Contractor that a non-conformance has been detected.

The Contractor is at all times responsible for their own QA/QC testing and documentation and is obliged to supply suitably qualified and experienced staff and suitably calibrated inspection equipment to fulfil their QA/QC obligations as outlined herein.

10.9 Hold and Witness Points

During the execution of the Works the Contractor shall undertake formal inspections of the works at the following stages to determine the extent and the quality of works to be undertaken:

- Upon surface preparation of concrete surfaces in accordance with Clause 10.1
- Where any inspection during the Works identifies an element of the structure that does not meet the minimum requirements of the Specification.

All above points shall be witnessed by the Superintendent or their representative.

The Contractor shall advise the Superintendent a minimum of 24 hours prior to reaching a hold point. The Superintendent shall be notified 24 hours prior to any pull off bond strength testing. All hold points can only be released via written advice from the Superintendent.

Standards and Technical Documents

The works shall be performed in accordance with Australian Standards and technical documents as set out in below table.

Table 1 Relevant codes and standards relevant to this Specification
11.0 SEWAGE PUMP STATION

11.1 General

Refer to:

- CMDG Specification C213 - Earthworks
- CMDG Specification C271 – Minor Concrete Works
- Specification G24 - Precast Concrete Elements
- CDMG Specification D12 – Sewerage Reticulation

The pump station shall generally comprise:

- Site works (clearing, earthworks, concrete slab, security fencing)
- Packaged pump station, including wet well, valve chamber, pipework and fittings
- Vent and safety grate
- Switchboard and generator outlet
- Submersible sewage pumps
- Pump hoisting and Screenings basket lifting gantry
- Security
- Water Service

All steelwork shall be Grade 316 stainless steel unless noted otherwise.
11.2 Site Works

11.2.1 Clearing, Earthworks and Pavement

The Contractor shall clear the sewage pump station site as required for construction of the works. Earthworks shall be completed to lines and levels as indicated on the Drawings.

Excavation shall be in all classes of material except “Rock” as defined in Clause 3.5.1 above.

Following installation and construction of the pump station, the Contractor shall place compacted fill to the level of the underside of the concrete slab.

The compacted fill beneath the concrete slab shall be a select fill compacted to 98% RDD (standard compaction) or, for cohesionless materials to a density index of not less than 70%.

If there is insufficient spoil available from other parts of the works for use as a select fill, the Contractor shall be required to import the additional fill from elsewhere. The Principal does not guarantee that any additional fill can be sourced locally. Winning and transporting of the fill will be the sole responsibility of the Contractor.

11.2.2 Concrete Slab

The Contractor shall construct a concrete slab to the full extent indicated on the Drawings. The slab shall have a lightly broomed finish, and shall be constructed complete with trimmer bars, isolation joints and construction joints as indicated on the Drawings.

11.2.3 Customer Service pole

The pump station shall have a customer’s service pole installed, in accordance with the drawings. This pole shall be installed complete including all conduits, cabling and the like to supply power to the pump station.

11.2.4 Security Fence

The Contractor shall erect a security fence and lockable double gate at the station site as detailed on the drawings and in accordance with AS 1725 and Standard Drawing CMDG-G-011. The fence shall be 1.8 metres high and have a double gate as indicated on the drawings to allow access for Council’s service vehicles.

All barbed wire shall be made of material to be corrosion free or coated with corrosion resistant material such as hot dip galvanising.

The security fencing shall have the following upgrades over that shown on the standard drawing:

- Gates shall be constructed from hot dipped galvanised members as shown on the standard drawing.
- Tensioning wires shall be stainless steel, double twisted.
- Tie wire shall be stainless steel.
- All other wire used in fencing, including chain wire, shall be PVC coated.
- All fastenings shall be stainless steel.

11.2.5 Measurement and Payment

The Scheduled Lump Sum for “Site Works” shall include full compensation for all labour, plant and materials necessary for clearing the site, preparation for filling, placement of fill, construction of the compacted fill platform and gravel access track, construction of the concrete slab, supply of fencing and gate materials (posts, chain and wire etc.), concrete, installation of fencing and gates, customer pole, electrical conduits and for all other costs incurred in carrying out our site works in accordance with this clause and the Contract generally.
11.3 Wet Well, Valve Chamber and Vent

11.3.1 Wet Well

The wet well shall be fitted out complete for two pumps and shall have a minimum inside diameter of 1800 mm as indicated on the Drawings.

The Contractor shall supply and install a wet well type packaged pump station. The pump station shall include an integral internal valve chamber and be installed complete with guide rail and discharge elbow mounted pumps and motors, lifting chain, discharge pipework, a non-return valve and isolation valve on each pump discharge and access hatches on both pump and valve chambers. The wet well shall have minimum dimensions shown on the drawings.

The package pump station arrangement shall be designed to withstand all earth loads, including saturated and unsaturated ground conditions and uplift forces for all operating conditions.

The Contractor shall construct a concrete slab around the pump station to the plan dimensions shown on the drawings. Footings for the pump hoisting gantry may be incorporated into this slab as shown in the drawings. The top of the slab shall be level with the top of the pump station.

The Contractor shall check the pump station for buoyancy and if necessary increase the thickness of the concrete slab to provide a minimum factor of safety of 1.5 against uplift with the ground fully saturated.

The Contractor shall submit details, including certified design drawings and floatation calculations, of the package pump station proposed in their tender. The Contractor shall obtain the Superintendent's direction as to whether the details are suitable or not suitable before commencing work.

Excavation shall be carried out to the lines and levels indicated on the drawings. The Contractor shall dewater excavations if required. Over excavation at the base of the wet well shall be backfilled with grade N20 concrete.

Excavation shall be in all classes of material except “Rock” as defined in Clause 3.5.1.

The packaged pump station shall be installed in accordance with the manufacturers specifications.

Backfill to the pump station well shall be placed in maximum 150 mm layers and compacted to 98% RDD (standard compaction) or, for cohesionless material, to a density index of not less than 70%. The aim of this requirement is to achieve compaction similar to that of the surrounding ground and to minimise settlement. Backfill material shall be select fill consisting of naturally occurring sandy soil, gravely soil, loam or other approved material.

The Contractor shall supply and install sealed, lockable, hinged marine grade aluminium cover(s) to the wet well with two part aluminium safety grates, as indicated on the Drawings. Each cover shall not exceed 25 kg in weight.

The Contractor shall install suitably robust pump guide rails and lifting chains as per the pump manufacturer’s recommendations. Guide rails shall be chemically anchored to the pump station walls at a maximum of 1500 mm centres, as indicated on the Drawings. The pump guide bars and chains, shackles etc. shall be Grade 316 stainless steel.

11.3.2 Valve Chamber

The valve chamber shall be integral to the pump well with a drain back into the wet well as indicated on the drawings. Sluice valves shall be anticlockwise closing and provide drop-tight shutoff.

The Contractor shall supply and install sealed, lockable, hinged marine grade aluminium cover(s) to the wet well with two part aluminium safety grates, as indicated on the Drawings. Each cover shall not exceed 25 kg in weight.

11.3.3 Vent

The Contractor shall construct a pump station vent as indicated on the Drawings. The vent shall be complete with all pipework between the eductor and the wet well, concrete footings, and wind driven eductor. Details of the size, type, and materials of the eductor shall be submitted to the Superintendent for approval prior to ordering.
Where the vent is not enclosed by the pump station compound the final location shall be as directed by the Superintendent.

11.3.4 Measurement and Payment

The Scheduled Lump Sum for “Wet Well, Valve Chamber and Vent” shall include full compensation for all labour, plant and materials necessary for the supply and installation complete of all works as described under this Clause 11.3 and all sub-clauses therein.

No separate payment shall be made for over-excavation and additional backfilling required, but rather full compensation for these items shall be included in the Scheduled Lump Sum for “Wet Well, Valve Chamber and Vent”.

11.4 Well Washer

11.4.1 General

The Contractor shall supply and install a well washer in the pump station wet well. The well washers shall wet the walls of the pump station such that it washes the scum off the pump well walls. The washers shall start automatically once the well has drawn down to a preset level and operate for a preset time. The metalwork for the well washer shall be constructed from marine grade aluminium or 316 stainless steel and shall be mechanically fastened to the inside walls using a method approved by the Superintendent. The electrical pipe work and water pipe work shall be installed such that no pipe work or conduits are above the concrete slab.

The well washer shall be connected to reticulated water supply with a minimum 32OD PN12.5 PE100 service. A DN20 hose cock shall be provided at the edge of the concrete slab with hose cock a minimum of 900 mm above slab level and supported by a DN80 galvanised pipe post with end cap.

11.4.2 Measurement and Payment

The rate in the Schedule for Well Washer shall include full compensation for supply and installation of a well washer, connection to reticulated water supply and hose cock as described in this Clause and on the drawings and for all other costs incurred in carrying out the works in accordance with the Contract.

11.5 Switchboard and Fittings

11.5.1 General

The Contractor shall supply and install a switchboard and associated fittings at the sewage pump station. The switchboard shall comply with the attached electrical & SCADA Works Specification.

All electrical work and workmanship shall comply with the relevant Local Authority requirements and the latest relevant Australian Standards including AS 3000.

All cabling shall be installed within heavy duty rigid PVC-u to AS 2053 for underground and heavy duty seamless galvanised steel screwed type to AS 2052 for above ground. All conduits shall be sealed with a permanent plastic waterproof compound. All above ground conduit shall be suitably secured in place.

11.5.2 Switchboard Cubicle

The pump station switchboard cubicle shall be weather proof and vandal proof as shown on the drawings. The cubicle shall be suitable for outdoor use. Cubicles shall be manufactured from either 1.6 mm Grade 316 stainless steel or 3.0 mm marine grade aluminium.

Cubicles shall be ventilated using approved style louvers with stainless steel gauze retained by metal framing, to prevent the ingress of insects and vermin, and achieve a degree of protection equal to IP56.

All cables shall enter the control panel through the base, and shall be glanded via a removable gland plate. Direct entry of conduits into the control panel will not be accepted.
11.5.3 **Switchboard**

The switchboard shall be suitable for connection to 415 volt three phase power supply. The Contractor shall provide surge diverters on the incoming consumer mains within the control panel. Enclose the surge diverters in a metallic enclosure to achieve complete segregation from the remainder of the board. All power and control wiring shall be neatly laid out and tied / grouped together (by item of plant or other suitable grouping) for ease of maintenance.

A 15 amp weather proof (IP56) 3-phase power outlet shall be provided on the external side or back wall of the switchboard, with dedicated 30mA RCD protection. A connection to the power outlets at the pump station and the manhole shall be provided. The outlet shall be capable of withstanding the electrical loads from the pumps and the electric winches to be connected to the power outlets.

An outlet suitable for connection of a generator to the switchboard shall be provided. The outlet shall be capable of withstanding the electrical loads from the generator necessary to maintain the pump station operation in the event of a power outage.

The following electrical components shall be used:

<table>
<thead>
<tr>
<th>Item</th>
<th>Make &amp; Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contactors</td>
<td>Sprecher &amp; Schuh CA7</td>
</tr>
<tr>
<td>Thermal Overloads</td>
<td>Sprecher &amp; Schuh CEP7</td>
</tr>
<tr>
<td>Thermistor Input</td>
<td>Sprecher &amp; Schuh RT3</td>
</tr>
<tr>
<td>Control Relays</td>
<td>Finder 55 series</td>
</tr>
<tr>
<td>Timing Relays</td>
<td>Clipsal 60 NDP 240R</td>
</tr>
<tr>
<td>Phase Failure / UV Relays</td>
<td>Clipsal 60 DRA 415</td>
</tr>
<tr>
<td>Push Buttons</td>
<td>Sprecher &amp; Schuh D5M Series</td>
</tr>
<tr>
<td>Selector Switches</td>
<td>Sprecher &amp; Schuh D5M Series</td>
</tr>
<tr>
<td>Isolators</td>
<td>K &amp; N or Clipsal 56 Series</td>
</tr>
<tr>
<td>Indication lamps</td>
<td>Sprecher &amp; Schuh D5M Series with LED Cluster</td>
</tr>
<tr>
<td>Ammeters &amp; Voltmeters</td>
<td>IME RQ 72E – AAC</td>
</tr>
<tr>
<td>Terminal Strips</td>
<td>Sprecher &amp; Schuh VU4-25 Series</td>
</tr>
<tr>
<td>Wire Identification</td>
<td>Legrande</td>
</tr>
<tr>
<td>Circuit Breakers</td>
<td>Terasaki DINT6 series</td>
</tr>
<tr>
<td>Main Switch</td>
<td>Terasaki DTMS</td>
</tr>
<tr>
<td>RCD/MCB</td>
<td>Terasaki DS MCB 2030</td>
</tr>
<tr>
<td>Transient Protection</td>
<td>Novaris SD Series</td>
</tr>
<tr>
<td>Cable Glands</td>
<td>Utilux Chrome Plated Brass</td>
</tr>
<tr>
<td>GPO Outlets</td>
<td>Clipsal 2000 series</td>
</tr>
<tr>
<td>Plug and Switched Socket Outlets</td>
<td>Clipsal 2000 series</td>
</tr>
<tr>
<td>Light Switches</td>
<td>Clipsal 2000 series</td>
</tr>
</tbody>
</table>

Motor starters shall be of a type approved for use at the site. Variable speed drive motors shall be installed. Where a motor size greater than 2.5 kW is required, the current shall be limited to no more than 30% of the direct-on-line starting current using VSDs. The Contractor shall comply with Ergon’s requirements with respect to electric motor sizing/starting as per the attached Guidelines for Electrical Systems in Isolated Locations.

All equipment shall be neatly and logically laid out on the internal hinged escutcheon of the control panel. The following minimum equipment shall be provided:
• One main switch rated for the total connected load of the installation
• ‘Run’, ‘Overload Fault’ and ‘Motor Thermistor Fault’ indicators for each pump
• Well high level indicator
• Ammeter for each pump
• Voltmeter and 7 position selector switch
• Hours run and number of starts counter for each pump
• Start, stop and fault reset pushbutton for each pump
• Switch for selection of automatic or manual pump operation
• Switch for selection of the duty pump for automatic operation
• Lamps test pushbutton.

The above items shall be clearly labelled with suitable permanent labels (stickers shall not be used).

Indicating lights shall be industrial type with transformers and extra low voltage lamps. Three spare lamps shall be provided in a suitably labelled container inside the switchboard.

The Contractor shall provide a visual alarm consisting of a weatherproof, amber wall glass fitting with inbuilt flashing relay, mounted on top of the control panel, and provided with a vandal proof cage. The light shall be visible from the adjacent road and shall be not less than 100 mm high. The light shall begin flashing if the sewage level in the wet well rises to the “Standby Pump” start level. The light shall remain flashing until the level drops below the alarm level and resets automatically.

The Contractor shall also provide an audible alarm consisting of a 100 mm dome bell, equal to ‘Wattmaster’ type, mounted within the control panel immediately behind a purpose made louvers (screened with gauze to the same standard as for ventilation louvers) to ensure audibility outside the cubicle, and protect the bell from vandalism. The audible alarm shall not be excessively loud, as pump stations are in residential areas, and shall have a simple “on / off” switch located within the switchboard and clearly labelled. The audible alarm shall be linked to the flashing light such that both operate in tandem.

It is a condition of the Environmental Licence that the alarms are operable without power. The Contractor shall design, supply and install an uninterruptible power supply (UPS) to the switchboards of both pump stations to enable the flashing light and audible alarm to operate automatically for a minimum of 12 hours without mains power. The switchboards shall be designed to allow sufficient space for the UPS and the UPS shall be readily removed. The UPS shall be integrated into the electrical system such that it is trickle fed from mains power and is always at full charge. Full details of the UPS design and power loadings of the alarms shall be provided to the Superintendent for comment prior to commencement of fabrication.

The switchboard and control panels shall include all relays, rectifiers, transformers and other equipment including conduit and wiring necessary for completing the control and power circuits between the incoming mains terminals and the motors including earthing of the installation.

11.5.4 Control Circuitry

Control circuitry shall be designed for ‘fail safe’ operation, and sufficient space shall be allowed within the cubicle for all equipment to be accommodated in a neat and logical manner, with a minimum of 25% spare space for future use.

Wiring shall be run without crossovers to ensure final wiring arrangement remains easily traceable. All wiring shall be numbered and all equipment labelled using machine engraved traffolyte labels coded to match the “as-constructed” wiring diagrams.

The Contractor shall supply and install all underground cabling in conduits to the relevant Australian Standards, to supply power to the pumps and security light, as indicated on the Drawings.

The power control system shall automatically restart the duty pumps and equipment, subject to the specified controls, on resumption of power following a power supply failure. Standby pumps and
equipment shall have an adjustable 0 - 10 minute delay timer incorporated to prevent simultaneous starting of units.

No two motors shall be capable of starting simultaneously, and no more than ten (10) pumps / drives shall be able to operate simultaneously.

11.5.5 SCADA Interface

The Contractor shall provide a numbered terminal strip within the control panel and wire volt free signals for future SCADA interface. Signals shall include:

- Pump Run Signal
- Pump Fault Signal
- Pump Inhibit Signal
- Remote Fault Reset
- Well High Level Alarm
- Magnetic Flow Meter Output.

11.5.6 Level Controls

Within the wet well, the Contractor shall provide a multiple sensor level electrode equal to ‘Multitrode’ with proprietary suspension / cleaning bracket, fixed to the face of the access opening using stainless steel masonry anchors.

Within the control panel, the Contractor shall provide all necessary liquid level control relays to respond to the wet well level sensor.

Level sensors shall be capable of detecting changes in sewage level in 100 mm increments.

11.5.7 Pipework and Fixtures

The Contractor shall supply and install pipework, valves and fittings at the sewage pump station complete as indicated on the Drawings and described herein, from the outlet from the zero manhole to the connection point (tee) to the rising main where the two pressure discharge pipes merge into one.

All pipework, valves, and fittings shall be adequately braced and supported as required for dead loads and unbalanced pressure forces. On completion of installation all holes shall be sealed and all fluid retaining structures shall be waterproof.

The Contractor shall install and build-in all bolts, pipes, equipment and fastenings as necessary using an approved shrink resistant grout or mortar.

Flanged Ductile Iron Cement Lined (DICL) pipework shall be class PN35 in accordance with AS 2280 and shall be suitable for exposure to raw sewage. Exposed DICL pipework shall be factory primed with tar epoxy. Before the final coat the Contractor shall power wire brush the surface to AS 1627. Within two hours the Contractor shall paint the exposed pipework with two coats of an approved tar epoxy. The minimum total dry film thickness shall be 0.4 mm. Other coating systems for exposed DICL pipework may be considered if offered.

All valves shall be supplied either in materials suitable for long term exposure to sewage (e.g. Grade 316 stainless steel, EPDM) or shall be internally and externally coated, suitable for long term exposure to sewage (e.g. fusion bonded epoxy).

11.5.8 Security Lighting

The Contractor shall supply and install a weatherproof security light at the station as indicated on the Drawings. Security lighting shall be sufficient to illuminate the furthest end of the pump station compound and allow maintenance personnel to access the pump station compound safely on a dark night.

Security lights shall be fitted with a suitable shade to prevent nuisance to neighbouring residents, and a vandal proof cage. Security lights shall operate via a photovoltaic cell or similar that switches the light on and off at dusk and dawn respectively. There shall also be an on/auto/off switch for this light. The security lighting shall be mounted on the consumer pole which shall be hot dip galvanised.
11.5.9 Testing and Commissioning

Unless otherwise detailed, site testing of equipment (including pumps) shall be required for “running in” and checking that all equipment sensibly performs in accordance with the Specification, the tender and the guarantees.

Requirements regarding temperature rise, vibration and mechanical operation shall be met in all circumstances.

After the plant has been erected, electrical connections completed and the plant ready to run, the Contractor shall notify the Superintendent accordingly. Thereafter, if desired, the Contractor shall be given four (4) days within to carry out preliminary tests and make any necessary adjustments.

When the installation of the equipment is complete the Contractor shall fill the pump well with water and the Contractor shall carry out further testing under full hydraulic conditions to confirm that the equipment performs in accordance with the Specification, the tender and the guarantees.

After preliminary running of the units the plant shall be subjected to the following tests during which no adjustment shall be made unless by permission of the Principal or the Superintendent. These tests shall be conducted by the Contractor at their sole expense, and no previous tests at the work or elsewhere nor any approval for dispatch issued by the Principal shall in any way waive the responsibility of the Contractor for the performance of the erected plant up to the full specified duties and to the guarantees offered by them in their tender or elsewhere.

Pumps shall be tested for operation with duty only, duty and standby combined, and standby only. During these tests, and details of the pressure and flow performance of the sewage pumps shall be recorded by the Contractor and furnished to the Superintendent.

The pump manufacturer’s technical information and commissioning instructions shall be made available to the Superintendent prior to testing and commissioning.

11.5.10 Defective Plant

Should the equipment after installation not perform in accordance with the requirements of this Job Specification and the guarantees offered, then the Contractor shall alter, repair or replace the equipment or any part thereof, so that it shall conform in every respect with the Specification and the guarantees.

Such further tests as may be necessary to prove the conformance of the equipment with the Specification and guarantees after it has been altered, amended or replaced shall be made, the cost of which shall be borne by the Contractor.

11.5.11 Measurement and Payment

The Scheduled Lump Sum for “Switchboard and Fittings” shall include full compensation for all labour, plant and materials necessary for the supply and installation complete of all works as described under this Clause 11.4 and all sub-clauses therein.

11.6 Sewage Pumps

11.6.1 General

The Contractor shall supply and install duplicate submersible pumps in the pump well, complete with all cabling and ancillary equipment.

Pumps shall be suitable for pumping domestic raw sewage. Pumps shall be Flygt submersible pumps with integral grinder cutter, pump model MP 3069 HT with 40 mm outlet and 144 mm diameter impeller.

Each complete submersible pump unit shall be readily removable from the pump well, without disconnecting the delivery pipework, for normal inspection. Each unit shall be capable of being removed and reinstalled in a flooded well, complete with all mechanical and electrical connections, without the need to enter the well. The installed position of the pumps shall minimise the amount of sewage left in the bottom of the well when pumped down completely, in order that the well bottom may be cleaned.
Pumps shall be ‘soft’ wired to allow removal and replacement without the need to disconnect wires from the switchboard. That is, there shall be an all weather three pin socket and switch mounted on a galvanised steel post at the location indicated on the drawings. The three pin plug and socket, when fitted together shall have an enclosure rating of IP66.

The socket shall also be fitted with a hinged (or similar) cover such that when not connected to the three pin plug, the socket enclosure rating remains at IP66. The connection shall also be spring loaded to provide for instant disconnection of power. The connection shall be such that the plug cannot be dropped into the wet well.

Bearings shall be ball or roller type, sealed and independent of the pump glands. For sealed bearings the lubricant system shall be designed so that the plant will run continuously and satisfactorily for at least 1500 hours without attention.

The weight of the rolling elements of the pump and motor plus the unbalanced downward thrust shall be taken by a thrust bearing immediately above the pump casing.

The pump shall be compatible with brackets, guide bars, chains, pipework etc. Pumps making up the duplicate set shall be identical and shall be capable of being installed in either pump position. Duplicate pumps shall be capable of operating simultaneously without damage when operating in accordance with this Specification.

The Contractor shall submit graphs of resistance curves with pump curves and efficiency curves overlaid to the Superintendent with their pump selection for approval.

11.6.2 Minimum Pumping Flow Rates Required

Minimum Flow Rate of 1.9 (L/s) at duty head, single pump.

The Contractor shall guarantee to achieve flow rates.

11.6.3 Measurement and Payment

The Scheduled Lump Sum for “Sewage Pumps” shall include full compensation for the supply and installation of pumps as specified, including pump selection calculations and design, and electrical connections and cabling for soft wiring and all other costs incurred in completing the works in accordance with the Contract.

11.7 Pump Hoisting Gantry

The Contractor shall design, fabricate, galvanise and install a pump hoisting gantry across the pump well as indicated on the Drawings, including gantry trolley, block and tackle and spare lifting chain from the gantry trolley to the lid of the pump station. Footings for pump hoisting gantry may be incorporated in the pump station slab.

The gantry shall have a minimum height of 3 m from the underside of the monorail beam to the top of the concrete slab.

The lifting lug on the block and tackle shall be able to fit within the links of the lifting chain, otherwise, D shackles shall be utilised at suitable increments such that the pump can be lifted and held in position with a separate lifting chain, whilst the block and tackle is lowered for another “lift”.

Gantry trolley and block and tackle shall be constructed of corrosion resistant material or coated with a corrosion inhibitor per superintendent’s approval. All lifting chains shall be stainless steel and appropriately rated for the SWL of the gantry. The Contractor shall confirm to the Superintendent, the SWL of both pump station gantries prior to fabrication. The block and tackle may have a hot dipped galvanised lifting chain should a stainless steel lifting chain not be available. The gantry shall be supplied with 7 additional appropriate stainless steel (grade 316) shackles.

The gantry shall be hot dipped galvanised to minimise corrosion. Cutting and / or welding of members after galvanising will not be permitted. Minor damage to galvanising shall be made good with zinc-rich paint.
The gantry safe working load shall be sufficient to safely remove the motors and pumps supplied, with a minimum safe working load of 500 kg. The Contractor shall mark the Safe Working Load on each side of the monorail beam in accordance with Section 11 AS 1418.3.

The Contractor will submit Registered Professional Engineer of Queensland certified design drawings adequate for construction of the pump hoisting gantry, designed in accordance with the relevant Australian Standards. Refer to clause 7.0.

The Contractor will submit certification for the safe bearing load for the chain.

The Scheduled Lump Sum for “Pump Hoisting Gantry” shall include full compensation for all labour, plant and materials necessary for the design, supply and installation of the gantry, gantry trolley, chain, shackles and block and tackle complete as indicated on the Drawings, described in this Clause and for all other costs incurred in carrying out the works in accordance with the Contract.

11.8 Screenings Basket Lifting Gantry

The Contractor shall design, fabricate, galvanise and install a screenings basket lifting gantry (including baskets x2) adjacent to the zero manhole at the pump station as detailed on the drawings. Footings for pump hoisting gantry may be incorporated in the zero manhole slab.

The gantry shall have a minimum height of 3 m from the underside of the monorail beam to the top of the concrete slab.

The gantry shall be hot dipped galvanised to minimise corrosion. Cutting and / or welding of members after galvanising will not be permitted. Minor damage to galvanising shall be made good with zinc-rich paint.

The Contractor shall supply and install a trolley and electric chain hoist with sufficient chain to reach the installed screenings basket. The chain hoist shall have helical gearing, disk type electromagnetic brake system, 360 degrees swivelling hook with safety latch and over load limiter. Hitachi chain hoists comply with this specification. A chain bucket shall be provided suspended from the chain hoist to prevent the unloaded section of chain from hanging down.

The Contractor shall connect the electric chain hoist to a power supply including catenary on the hoisting gantry, controls for the operation of the electric chain hoist located on a power support bracket adjacent to the column of the hoisting gantry and an isolation switch in the secured section of the electric cubicle.

The contractor shall install a roof over the gantry in order to provide protection from direct sunshine and rainfall to the electric chain hoist.

The gantry and chain hoist shall have a minimum safe working load of 250 kg. The Contractor shall mark the Safe Working Load on each side of the monorail beam in accordance with Section 11 AS 1418.3.

Registered Professional Engineer of Queensland certified design drawings adequate for construction of the screenings basked lifting gantry and roof, designed in accordance with the relevant Australian Standards. Refer to clause 7.0.

The Contractor will submit certification for the safe bearing load for the chain.

The Scheduled Lump Sum for “Screenings Basket Lifting Gantry” shall include full compensation for all labour, plant and materials necessary for the supply and installation of the gantry, winch, pulley, cable, baskets and snap shackle complete as indicated on the Drawings, described in this Clause and for all other costs incurred in carrying out the works in accordance with the Contract.

11.9 Water Service

The Contractor shall construct a DN32 PE100 SDR13.6 polyethylene water service.

The water service to the pump station shall be fed off the existing water service on Munns Drive.

The water service shall be constructed with a minimum 600 mm cover and in accordance with the manufacturer’s recommended installation practice and Specification W6 “Pipework”.
Underground copper water mains (Type A) DN25 are to be installed under concrete slab connecting the water service to the HDPE past the edge of the concrete slab.

The water service riser shall be securely fastened to a stainless steel support post.

A 20 m long wash water hose and retractable reel shall be provided. The hose shall be at least 20 mm nominal bore, high pressure grade and UV resistant with a 20 mm hose reel nozzle attached.

The Water Service shall be fitted with an approved reduced pressure backflow prevention device (RPZ) valve and isolating valves for both the wash water hose and the hosecock. Details of the backflow prevention device shall be provided to the Superintendent for approval.

The Scheduled Lump Sum for “Water Service” shall include full compensation for all labour, plant and materials necessary for the provision and installation complete of the water service in accordance with this clause, including pipework, connections, hose reel supports, reduced pressure backflow prevention device (RPZ) valve and isolating valves, hose reel, hose, and for all other costs incurred in carrying out the works in accordance with the Contract.

11.10 Alternative Bedding

The alternative bedding shall be 20 mm open graded gravel, placed in a 350 mm layer adjacent to the pump station wet well and to a diameter of 1000 mm.

The alternative bedding detail shall be used only with the approval of the Superintendent and only to assist with the dewatering of the excavation where standard dewatering techniques such as spears have failed.

Full compensation for all additional costs incurred by the Contractor in providing and installing the alternative bedding shall be included in the Scheduled Rate (provisional, if ordered) for “Alternative Bedding”.

12.0 RISING MAIN

12.1 Rising Main

Refer CMDG Specification D12 – Sewer Reticulation.

Refer CMDG Standard Drawing CMDG-S-005

The Contractor shall construct the rising main as indicated on the Drawings, including valves, marker posts and fittings complete. Excavation shall be in all classes of material except “Rock” as defined in Clause 3.5.1.

Rising mains shall be generally PE100 SDR11 as indicated on the Drawings. Intermediate HDPE joints in the rising mains shall be electrofusion welded in accordance with AS 4129-2000.

For HDPE flanged joints, backing rings and bolts to flanges shall be Grade 316 stainless steel; nuts shall be Grade 304 stainless steel.

Rising mains shall be pressure tested to a pressure of 600 kPa. Disinfection of rising mains is not required. Rising mains shall be tested in accordance with the constant pressure test for visco-elastic pipes of AS 2566.2-2002.

Concrete stops shall be installed in locations as indicated on the Drawings and in accordance with Standard Drawing CMDG-S-091.

Sewage rising mains shall be clearly identified by way of an appropriate marking tape labelled “Danger Buried Sewer Main Below” above the sewer rising main. The tape shall be in accordance with AS/NZS 2648.1-1995 and AS/NZS 4275 Part 0 1995. Tape shall be 150 mm wide.

Rising mains shall be measured as the length in metres of pressure pipe satisfactorily completed, measured from where the pipework changes from DICL, to the inlet into the downstream discharge manhole.
The Scheduled Rates for “Rising Main” shall include full compensation for the supply of all pipe, fittings, and materials and for construction complete including clearing and grubbing, excavation in all materials encountered, removal and disposal of surplus excavated materials, dewatering, bedding, laying and jointing, geofabric surround, concrete stops, anchor blocks, backfill, restoration, marker posts and for all other costs incurred in executing and completing the works in accordance with the Contract.

13.0 CONNECTION OF ERGON POWER SUPPLY

13.1 General

The Contractor shall make all arrangements and pay all Ergon fees and charges for the connection of mains electricity (provided by Ergon) to the sewage pump station site.

The scheduled lump sum for “Connection of Ergon Power Supply” shall be deemed to include all of the Contractor’s costs associated with:

- Lodgement of a Form A to Ergon Energy (prepared by a licenced electrical contractor) and payment of the statutory authority fees and charges;
- Liaison with Ergon Energy to coordinate the electricity connection, including any meeting, site inspections, etc. required; and
- Any other costs deemed required by the Contractor to ensure electricity is connected to the site.
A Guide for the Development of Operations and Maintenance Manuals
Foreword:

The following “guide for the development of Operations and Maintenance manuals” is intended as a guide only, and is not to replace any requirements under the terms of any contract or tender documents.

Many ideas presented in this guide have been developed through dealings with the remote area regions of Far North Queensland where manuals are required to be understood by not only highly skilled operators, but also semi-skilled and non-skilled trainees alike.

A well written and presented O & M Manual not only supports the operator but also has the potential to save many thousands of dollars in terms of the life cycle costs of the infrastructure or equipment.
The following is a table of suggested headings listed in priority from top to bottom:

- **Introduction**
- **Table of contents**
- **System Overview**
- **Glossary of terms**
- **Operation Instructions**
- **Maintenance Schedule**
- **Workplace Health and Safety**
- **Contact List**
- **Navigation**
- **Operation & Maintenance Cost**
- **Maintenance Instructions (bound and removable)**
- **Component identification (Quick reference)**
- **Fault finding and Trouble shooting**
- **Schedule of equipment**
- **Drawings**
- **Spare parts**
- **Approvals, Warranties and Certificates**
- **Manufactures Technical Literature**
  - Mechanical
  - Electrical
- **Index**
NB: The introduction is not only to introduce the plant and equipment to the reader but should also outline the project history giving the reader a complete project and system overview.

- Outline the history of the project (who funded it, why, who did the work, who designed it and who supervised it)
- Include the project contract number
- Give a geographical location of the installation site (location plan of key facilities, pipelines, etc)
- What does the plant / system / equipment contained in this manual do (A good descriptive)
- What should the plant / system / equipment achieve (Quantity and Quality)
- Are there any special Qualifications/Certifications required by the operator (Typed in bold)
- Include a bold mention that this manual should be read in full and understood prior to the plant / system / equipment being operated
- Include the name of the manufacturers, component suppliers and their contact details
The table of contents shall include:

A statement of the scope of the contents (example 1) of the manual together with alphabetical index to its contents and the page number i.e.: - (example 2)

The 'statement of the scope of contents' is a paragraph that outlines the extent of information that is covered in this manual, this information may need to include references to other equipment O & M manuals or technical literature which may have an impact on the operational environment of the system.

Example 1

Statement of the scope of contents, This manual will cover all the aspects of the new installation, however the new part or system being installed and covered in this manual might only form part of a larger existing system, in this case a paragraph or two of the scope of contents will alert operators and the like, to how this new part impacts on the bigger picture.

Example 2

Introduction ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ......
System overview

System overview should offer the following:

- A detailed description of how the system works
- Why is the equipment required (what condition existed that necessitated implementing this equipment?)
- What are the possible results (consequences/risks) if the equipment is not installed
- What are the environmental requirements (risks) for the equipment to function properly (if any)
- Are there special licenses / qualifications required by the operator (this should be repeated in each section of the manual if any exist)
- Hazards and safety overview (including reference to risk management procedures)
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Word or Sentence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADWF</td>
<td>Average Dry Weather Flow</td>
<td>The average flow measured over a period of seven consecutive days when the rainfall is less than 0.25 mm/day, infiltration of stormwater into the sewerage system is at a minimum and any abnormal influences such as public holidays are excluded.</td>
</tr>
<tr>
<td>Activated Carbon</td>
<td>Adsorptive particles or granules which possess a high capacity to remove trace and soluble components from solution</td>
<td></td>
</tr>
</tbody>
</table>

**NB:** All technical words and abbreviations should be listed in the 'glossary of terms', including any used in this 'Operations and Maintenance Manual' and any used in the 'Contract Specification Documents'.

---

The glossary of terms should be a detailed list (dot-point) table consisting of the acronym, the full word or sentence and the description.

Example:

- **(ADWF)** Average Dry Weather Flow – The average flow measured over a period of seven consecutive days when the rainfall is less than 0.25 mm/day, infiltration of stormwater into the sewerage system is at a minimum and any abnormal influences such as public holidays are excluded.

- Activated Carbon: - Adsorptive particles or granules which possess a high capacity to remove trace and soluble components from solution.
Operating Instructions

Operation Instructions, includes the full instructions on the operation of the plant, start-up and shut-down procedures, emergency and standby facilities, fault diagnosis, warning systems and recommended procedures to ensure the safe, economic and satisfactory performance of the plant and or equipment. (Useful to include consequences of failure to maintain)

- Purpose of Plant and a general description of plant components, their workings and their relationship to other parts of the plant.
- Start-up and shut-down and stand-by sequences (normal and Emergency)
- A detailed step-by-step instructional guide that CLEARLY instructs the operator on all operational requirements 'that is' from pre start-up inspection to 'running' to shut down and post shut down requirements
- Fault diagnosis (include and reference to the 'fault finding and trouble shooting' section of this manual)
- Warning and alarm systems (include and reference to the 'fault finding and trouble shooting section of this manual)
- Recommended operational, (and) maintenance procedures
- All start-up and shut-down procedures and these instructions should also reference the 'component identification (quick reference)' section of the manual where necessary, this assists with the location of the equipment or parts to be operated and prevents mistakes
- A full list of normal operating conditions including pressures, flow rates, chemical strengths, physical appearance
- Monitoring (Recording Performance). Performance trends that predict malfunctions
- Alarm tables detailing location, identification, initiating conditions for all alarms
Maintenance Schedules

Copies of manufactures information does not constitute as a maintenance schedule. The schedules should be one document which summarises the technical information supplied by each of the manufactures and/or contractors. This information should be written in plain English and formatted into easy to follow schedules broken into daily, weekly, monthly, 6 monthly and annual maintenance tasks for each component of the infrastructure system.

- Regular servicing requirements (these instructions should be duplicated, 1. book copy and 2. a removable copy [preferably laminated]) + Recording who, when, what and “sign-off”
- The schedules should indicate who carries out the tasks, ie in the event that the task should be carried out by a licensed electrician
• **Workplace Health and Safety**

The Workplace Health and Safety section should not only outline all working and environmental hazards but also include a full list of hazardous chemicals and their ‘Manual Safety Data Sheets’.

The Workplace Health and Safety section should include but not be limited to the following:

- All Environmental hazards and what equipment is to be worn for protection in each hazardous area
- All chemical and hazardous substances with special notes alerting operators to any chemicals that require health surveillance should the operator come into contact with
- Emergency procedures including chemical spills and clean-up
- All MSDS (Manual Safety Data Sheets) for all chemicals
- A list of required safety protective clothing (PPE) and equipment
- A full list of any Australian Standards or policy’s that need to be purchased to form part of the ‘safe working conditions’ for this equipment, i.e. ‘Safe Working in a Confined Space AS 2865 - 1995’ ...
- A list of any special skills, qualifications, licenses or training that are required before operating this equipment
- Documented Induction Course Details
- List all pressure equipment details
- A full list and contact details of the suppliers of all chemicals and hazardous substances
- A full list of any special First Aid equipment
Contact List

Should include but not be limited to Schedules and lists of manufactures and suppliers of equipment and components, including contact phone numbers, addresses and after-hours numbers i.e.

Principal

**Principal Engineers, 48 Cluster RD, Cairns 4879**  
Phone: (07) 123456789  Fax: (07) 1213456789  e-mail ########
Phone A/H (07)1234546789

Contact

**Drew Dribble**

Contract Manager

**Feeble Consulting, 478 Nonreturn Drive, Cairns, 4879**  
Phone: (07) 123456789  Fax: (07) 1213456789  e-mail ########

Contract consultants

Client

Manufacturer

Installation

Mechanical Supplier

Electrical Supplier

Civil Works

Site Superintendent

Others
Navigation

Navigation is the way in which the manual is bound, tabulated and referenced. For ease of use the manual should be compiled in order of priority as described in page 3, i.e. Safety instructions and operating procedures should be positioned at the front of the manual with advanced technical electrical / mechanical literature to the rear.

- Location of copies of the manual, (in the Plant Room or office + off-site copy for security)
- All sections are to be tabulated with alphabetical index to its contents
- All pages are to be numbered
- All language is to be in clear English and easily understood by a relativity unskilled operator (any foreign language contained in the manufactures technical literature should also be removed)
- All concepts are to be explained clearly and in detail
- Any manufactures literature or brochures that contains equipment that does not form part of this system should be removed (commonly manufactures literature will contain the full range of parts or equipment which can be misleading when using an O & M manual) only include literature of the equipment that has been installed and ensure it can be easily identified.
- The whole document should be bound in a hard plastic cover and supported with quality binding clips that allows the document to be folded flat and remain flat when open
- The finished manual should be no greater than 75% full when complete to allow the insertion of extra information at a later date
- When referring to a part or component clearly identify the manufactures make, model and part ID number
- The whole document should be capable of being readily reproduced in a clear readable fashion using a photocopier or similar process
- Amendments or upgrades to any part or component of the system need to be reflected in the operations and maintenance manual. Any modifications require the installer / service person to ensure that the part / component specification data is added / inserted into the O & M Manual and a field note is made. This will allow the manual to be updated annually
NB: The maintenance instructions should be developed in two forms, one being a bound copy that remains with the manual and the second copy should be laminated and be able to be removed from the manual. This allows the operator to carry the maintenance instructions (laminated copy) to the equipment needing the service, which when finished with, can be cleaned and returned to the manual.

- A full list of safety warnings, special equipment (if required), reference to ‘tag – outs’ and ‘lock – outs’ and machinery electrical / start and isolation procedures
- Full instructions on routine maintenance, daily, weekly, monthly and annual servicing
- Comprehensive equipment data schedules summarising information required for maintenance, repair, adjustment and replacement
- Recommended lubrication type and frequency
- Protective treatments
- The do’s and don’ts for all parts and equipment (reference is to be made to the manufacture’s technical literature where necessary)
- Fault finding with reference to the relevant drawing and Manufacture’s technical literature (include a reference to the fault finding and trouble shooting guide of the manual)
- Fault finding guidelines and diagnostic procedures
- References should be made to the ‘component identification (quick reference)’ part of you’re manual to ensure the correct location of equipment and parts to be serviced
- Develop templates for daily, weekly and monthly ‘maintenance check sheets’
Component Identification (quick reference)

The ‘component identification’ segment of the O & M Manual may need to completed at the end of practical completion or final installation (for accuracy of pictures and photo’s).

Each and every part and or piece of equipment should be easily identified in either an engineering drawing or photograph in this section.

For this reason the component identification part of the manual may have to be a removable section that is inserted into the manual at a later date. (The contract may require that the bulk of the manual is to be completed prior to practical completion of the contract)

If during manufacture, detailed schematic drawings Figure 1.01 are produced, these make an excellent tool for the identification of system parts, if engineering drawings are not available the use of an electronic camera and easy to use software as in Figure 1.02. will do.

Note :

(In some installations (with duplicate components) it may be necessary to letter-stamp the actual components (and spares) with their allotted identification number.)
Figure 1.01 (The picture shown is a sample only, all pictures supplied in O & M manuals are to be clear, including any numbers or references), some pictures may need to be in A3 size. The attached picture is a bubble-Rom and each number will relate to a detailed description of that component.
In figure 1.02 the text boxes should include the identification of the pump set, part description and manufacturer by the use of number references example is attached below.

<table>
<thead>
<tr>
<th>Asset number</th>
<th>Component</th>
<th>Description</th>
<th>Manufacturer</th>
<th>mm</th>
<th>stock</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS########</td>
<td>butterfly valve</td>
<td>1/4 turn flange - flange</td>
<td>TurnFlo</td>
<td>50</td>
<td>ea</td>
<td>2</td>
</tr>
<tr>
<td>WS########</td>
<td>Check valve</td>
<td>1/2&quot; B.S.P.T</td>
<td>A.R.I</td>
<td>1/2&quot;</td>
<td>ea</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: - Always allow space for asset numbers in any equipment table, this allows the client to insert asset numbers and codes at a latter date. (Space for 8 – 10 digits will do)
Fault Finding and Trouble Shooting

“Fault finding and trouble shooting” should contain an extensive table of fault-finding guidelines described in detail with reference to drawings.

Example:

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible cause</th>
<th>Suggested Remedy</th>
<th>Location</th>
<th>Drawing Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Lift pump - Mono KNF 43 – 11 does not run</td>
<td>1. The fuses are blown</td>
<td>1. Inspect fuses</td>
<td>1. Main electrical cabinet – fuses 13, 14, 15</td>
<td>1. MO20 – 03 - Control board (equipment layout)</td>
</tr>
<tr>
<td></td>
<td>2. The ELCB has tripped</td>
<td>2. Inspect ELCB and reset</td>
<td>2. Main electrical cabinet – ELCB - 17</td>
<td>2. MO20 – 03 - Control board (equipment layout)</td>
</tr>
<tr>
<td></td>
<td>3. No electricity</td>
<td>3. Check reset buttons</td>
<td>3. Front door main electrical cabinet – pump reset</td>
<td>3. MO20 – 03 - Control board (equipment layout)</td>
</tr>
<tr>
<td></td>
<td>4. Starter device is defective</td>
<td>4. Check reset buttons</td>
<td>4. Front door main electrical cabinet – pump reset</td>
<td>4. MO20 – 03 - Control board (equipment layout)</td>
</tr>
</tbody>
</table>

The fault-finding guide will need to clearly identify the:

- The part or component
- Possible cause of fault
- Suggested remedy (alternative actions)
- The geographical location of the equipment displayed in the ‘suggested remedy’
- A reference to the specific drawing number that is relevant to the component at fault
The schedule of equipment is a table, listing ALL components that make up this system, it is almost a bill of materials (to this table you may wish to add Date of installation >> Asset Register)

Example:

<table>
<thead>
<tr>
<th>Asset Number</th>
<th>Component</th>
<th>ID / Cat Number</th>
<th>Description</th>
<th>Unit</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ABS Pipe-Fittings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WS #######</td>
<td>50mm Elbow</td>
<td>ABS-1254-pt</td>
<td>90° ABS Elbow</td>
<td>30</td>
<td>L7 Press Manifold</td>
</tr>
<tr>
<td>WS #######</td>
<td>40mm Elbow</td>
<td>ABS-1354-pt</td>
<td>90° ABS Elbow</td>
<td>30</td>
<td>L7 Press Manifold</td>
</tr>
<tr>
<td>WS #######</td>
<td>25mm Elbow</td>
<td>ABS-1054-pt</td>
<td>90° ABS Elbow</td>
<td>10</td>
<td>L7 Press Manifold</td>
</tr>
<tr>
<td></td>
<td>PVC Pipe-Fittings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WS #######</td>
<td>100mm Elbow</td>
<td>(class-18) 35440</td>
<td>90° PVC Elbow</td>
<td>10</td>
<td>Filter discharge</td>
</tr>
<tr>
<td>WS #######</td>
<td>100mm Socket</td>
<td>(class-18) 35850</td>
<td>100mm Socket</td>
<td>15</td>
<td>Filter discharge</td>
</tr>
<tr>
<td>WS #######</td>
<td>100mm Elbow</td>
<td>(class-18) 35260</td>
<td>45° PVC Elbow</td>
<td>5</td>
<td>Filter discharge</td>
</tr>
<tr>
<td></td>
<td>Transfer Pumps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WS #######</td>
<td>Transfer Pump</td>
<td>Onga 0-43</td>
<td>Onga KNF 43</td>
<td>3</td>
<td>Filter feed</td>
</tr>
<tr>
<td></td>
<td>High Lift Pumps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WS #######</td>
<td>High Lift Pumps</td>
<td>1500 series AGR</td>
<td>Mono Motor Rotor Y</td>
<td>2</td>
<td>Product water to bulk storage reservoir</td>
</tr>
<tr>
<td></td>
<td>Dosing Pumps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WS #######</td>
<td>Chlorine dosing pump</td>
<td>Acromet – DL LIS/E</td>
<td>Acromet – e series</td>
<td>1</td>
<td>Chlorine dosing</td>
</tr>
<tr>
<td>WS #######</td>
<td>Flocculant dosing pump</td>
<td>Acromet – DLMA</td>
<td>Acromet – e series</td>
<td>1</td>
<td>Flocculant dosing</td>
</tr>
</tbody>
</table>
All drawings are to be clear A3 or A4 size and clearly reproduced, all drawings that are inserted into O & M manuals are to be registered for “As constructed” drawings by an engineer including site instructions and any changes made to the equipment during installation.

- Any digital drawings shall be provided on a 3 ½” floppy disc formatted for an IBM PC and the data shall be supplied in an “AutoCAD” drawing format.
- The positions of all structures shall be referenced to the horizontal and vertical datum.
- Any floppy disc's are to be place inside a sturdy plastic sleeve contained in the drawing section of the manual.
This section should contain a detailed table of suggested spare parts, including the address and contact details of the suppliers.

- Any specialist parts that may have to be imported into Australia should be itemised and listed separately to allow the client the opportunity to purchase extra parts for security and reduce the risk of prolonged downtime.
- A full list of recommended spares and their make, model and part numbers
- The table should include how many of each component is installed in this system

i.e.:-

<table>
<thead>
<tr>
<th>Recommended Spare Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset number</td>
</tr>
<tr>
<td>WS #</td>
</tr>
<tr>
<td>WS #</td>
</tr>
<tr>
<td>WS #</td>
</tr>
</tbody>
</table>
The Manufacturers ‘Technical Literature section’ should contain all brochures, technical bulletins and equipment specifications on the parts and equipment used and installed only.

- All manufactures literature should be scanned for non English material and any non-English material removed.

- The manufactures literature should only contain parts, components and equipment used in this installation, anything not used or installed should not be included in this manual.

- Only originals should be used in O & M manuals unless the manufactures literature can be reproduced with all drawings, pictures and text being clear and easily understood.

- If it is not practical to modify the manufactures technical literature (removing non-English or components not used in this installation) clearly label the components that are installed and rule a line through the others.
Concrete 1
Specification G15 – Table of Contents

<table>
<thead>
<tr>
<th>Page No.</th>
<th>1 General</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.1 Scope of Specification</td>
</tr>
<tr>
<td></td>
<td>1.2 Standards</td>
</tr>
<tr>
<td></td>
<td>1.3 Inspection</td>
</tr>
<tr>
<td>2</td>
<td>Formwork</td>
</tr>
<tr>
<td></td>
<td>2.1 General</td>
</tr>
<tr>
<td></td>
<td>2.2 Project Documentation Information</td>
</tr>
<tr>
<td></td>
<td>2.3 Surface Finishes</td>
</tr>
<tr>
<td></td>
<td>2.4 Structural Design and Documentation</td>
</tr>
<tr>
<td></td>
<td>2.5 Construction</td>
</tr>
<tr>
<td></td>
<td>2.6 Tolerances of Formed Surfaces</td>
</tr>
<tr>
<td>3</td>
<td>Reinforcement</td>
</tr>
<tr>
<td></td>
<td>3.1 General</td>
</tr>
<tr>
<td></td>
<td>3.2 Storage</td>
</tr>
<tr>
<td></td>
<td>3.3 Fabrication and Placement</td>
</tr>
<tr>
<td></td>
<td>3.4 Cover</td>
</tr>
<tr>
<td></td>
<td>3.5 Supports</td>
</tr>
<tr>
<td></td>
<td>3.6 Splices</td>
</tr>
<tr>
<td></td>
<td>3.7 Welding and Heating</td>
</tr>
<tr>
<td></td>
<td>3.8 Fixing Tolerances</td>
</tr>
<tr>
<td></td>
<td>3.9 Testing</td>
</tr>
<tr>
<td>4</td>
<td>Concrete Supply and Placement</td>
</tr>
<tr>
<td></td>
<td>4.1 General</td>
</tr>
<tr>
<td></td>
<td>4.2 Materials</td>
</tr>
<tr>
<td></td>
<td>4.3 Concrete Mix Design</td>
</tr>
<tr>
<td></td>
<td>4.4 Recording Temperature Readings</td>
</tr>
<tr>
<td></td>
<td>4.5 Site Mixed Concrete</td>
</tr>
<tr>
<td></td>
<td>4.6 No Fines Concrete</td>
</tr>
<tr>
<td></td>
<td>4.7 Grout</td>
</tr>
<tr>
<td></td>
<td>4.8 Mixing and Placing</td>
</tr>
<tr>
<td></td>
<td>4.9 Sampling and Testing</td>
</tr>
<tr>
<td></td>
<td>4.10 Unformed Surface Finishes</td>
</tr>
<tr>
<td></td>
<td>4.11 Curing and Protection</td>
</tr>
</tbody>
</table>
4.12 Rejection of Concrete
4.13 Repairs of Concrete
5 Measurement and Payment
Concrete 1
Specification G15

1.0 General

1.1 Scope of Specification
This Specification applies to plain and reinforced concrete work.

1.2 Standards
Subject to this Specification:
- the construction of concrete structures and members shall satisfy the requirements of AS 3600, "Concrete Structures";
- the design, fabrication, erection and stripping of formwork shall satisfy the requirements of AS 3610, "Formwork for Concrete".

1.3 Inspection
The Contractor shall give the Superintendent not less than 1 working day's notice so that an inspection can be made of the following work:
- foundations;
- completed formwork;
- reinforcement fixed in place;
- placing of concrete.

2.0 Formwork

2.1 General
The Contractor shall design, fabricate, erect and strip formwork.

2.2 Project Documentation Information

2.2.1 General
Refer to Section 2 of AS3610.

2.2.2 Minimum Formwork Stripping Times
Refer to Clause 2.5.4 of this Specification.

2.2.3 Stacked Materials
Stacked material shall not be placed on newly placed concrete work without the prior knowledge of the Superintendent.
The loading from stacked materials shall not exceed 4.0 kPa.
Materials shall not be stacked on newly placed concrete in the following circumstances:
- in multistorey construction where the lowest level of formwork has been stripped;
- stacked materials consisting of sand, pallets, etc. which can cause deformation between the shores;
- stacked materials which can induce concentrated loads on the concrete surface remote from the support shores.
2.2.4 Multistorey Formwork
Refer to Clause 2.5.2 of this Specification.

2.2.5 Restraint of Formwork
Formwork shall not be braced against previously cast concrete. Framed bracing shall be constructed between formwork supports.

2.2.6 Sequence of Pours
Refer to Clause 4.8.4 of this Specification.

2.2.7 Construction Joints
Refer to Clause 4.8.7 of this Specification.

2.2.8 Propping Requirements Composite Construction
Refer to Section 11 of AS 2327.1, “Composite Structures, Part 1: Simply Supported Beams”.

2.2.9 Cambers for Slabs and Beams
Refer to the Drawings for details of cambers.

2.2.10 Design Loads for Permanent Structure
Refer to the Drawings for design loads for permanent structures.

2.2.11 Inserts and Penetrations
Inserts or penetrations not specifically detailed on the Drawings shall not be made without the approval of the Superintendent.

2.2.12 Foundation Information
Geotechnical information held by the Principal associated with the foundation design for the permanent structure shall be made available by the Superintendent to the Contractor on request. The Contractor shall be responsible for his interpretation of this information.

2.2.13 Permanent Formwork
Formwork that is required to remain permanently in the structure shall be incombustible and shall be free from calcium chloride.

2.2.14 Critical Face of Elements
The critical face shall be the surface exposed to view.

2.3 Surface Finishes

2.3.1 General
Refer to Section 3 of AS 3610.

2.3.2 Classes of Surface Finish
The following surface finishes shall be achieved:
- areas subject to close scrutiny (ie complete building facades, visible areas of bridgeworks etc) - 2C;
- areas viewed as a whole (eg carparks, basement walls, bridgework not readily visible etc) - 3;
- areas concealed from view (backs of retaining walls, insides of tanks or surfaces with an applied finish) - 4;
- totally concealed areas where the only requirement is structural adequacy (ie footings etc) - 5.

2.3.3 Colour Control of Untreated Surfaces
The concrete shall be grey in colour and shall comply with the tonal variations of AS 3610. Concrete designated to be with colour control shall comply with the following requirements:
- cement shall always be the same type;
- cement content shall not be less than 330 kg/m³;
- aggregates shall come from the same source;
- pozzolans, used as additives, shall come from the same source.

2.3.4 Test Panels

Refer to Clause 3.6 of AS 3610.

Each test panel shall be a minimum of 2 metres by 1 metre with construction details that contain an accurate representation of the finished work.

The test panel shall be used in evaluation of the final work.

2.4 Structural Design and Documentation

Refer to Section 4 of AS 3610.

All formwork documentation required in accordance with AS 3610, shall be supplied by the Contractor to the Superintendent prior to construction for direction on whether the documentation is suitable.

2.5 Construction

2.5.1 General

Refer to Section 5 of AS 3610.

2.5.2 Multistorey Formwork

Backpropping of multistorey formwork systems shall be in accordance with the requirements of AS 3600 and AS 3610 provided that the following criteria are complied with:

- the minimum number of levels of undisturbed supports to be in place during the time of each pour on a floor shall be in accordance with the Table below;
- if backpropping is to be done, the number of levels of the supports in the Table shall be increased by one;
- backpropping may be done only on the lowest set of formwork and it shall not be commenced until 2 days after the pour;
- the service load divided by the slab self weight shall be greater than 1.8;
- there shall be NO stacked materials on any of the floors;
- the time between pours of successive floors shall be not less than 5 days;
- the average ambient temperature shall be not less than 5oC;
- reshoring shall not be carried out;
- the proposed method of backpropping has been notified to the Superintendent.
### TABLE FOR MULTISTOREY FORMWORK - MINIMUM NUMBER OF LEVELS OF UNDISTURBED PROPS

<table>
<thead>
<tr>
<th>Time Between Pours of Successive Floors, Days</th>
<th>Minimum Number of Levels of Supports in Use, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5, 10, 15, 20, 25</td>
</tr>
<tr>
<td>7</td>
<td>4, 4, 3, 3, 3</td>
</tr>
<tr>
<td>11</td>
<td>3, 3, 2, 2</td>
</tr>
<tr>
<td>14 or more</td>
<td>3, 2, 2</td>
</tr>
</tbody>
</table>

2.5.3 **Maintenance of Forms**

All formwork shall be cleaned before use or re-use.

Temporary openings shall be provided at the base of column and wall forms where necessary to facilitate cleaning and inspection. All forms shall be clean and free from foreign matter immediately before concrete is placed.

The interior surfaces of forms shall be treated with a release agent to prevent adhesion of mortar. Release agents shall be of non-staining type and shall be applied in a thin film before the reinforcement is placed. The reinforcement shall not be allowed to come in contact with the release agent.

Any reinforcement in contact with the release agent shall be thoroughly cleaned to remove all traces of the release agent or shall be removed and replaced by new reinforcement. Any surplus moisture shall be removed from the forms before concrete is placed.

Any formwork bolts that are to be removed from the concrete shall be coated with a concrete retarder and shall be arranged so that they can be extracted without excessive jarring or hammering and without injury to the concrete surface.

2.5.4 **Formwork Stripping**

The Contractor shall give the Superintendent not less than one working day’s notice before stripping formwork and assemblies.

Refer to Section 5.4 of AS 3610.

Notwithstanding anything to the contrary in Section 5.4 of AS 3610, the minimum formwork stripping times shall be:
MINIMUM STRIPPING TIMES

<table>
<thead>
<tr>
<th>Member Type</th>
<th>Member Type</th>
<th>Member Span mm</th>
<th>*Effective Span mm</th>
<th>Minimum Stripping Time (Days) For Average Air Temperature During Period Prior to Stripping</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20°C and over</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10°C to 20°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4°C to 10°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Under 4°C</td>
</tr>
<tr>
<td>Vertical, unloaded</td>
<td>Wall, column, beam side</td>
<td>0</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>and slab side</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Vertical, loadbearing</td>
<td>Wall, column or loadbearing structure</td>
<td>0</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Horizontal</td>
<td>Slab</td>
<td>Under 3000</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3000-6000</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Over 6000</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28</td>
</tr>
</tbody>
</table>

* Effective span is the maximum distance between supports (either temporary or permanent).

2.5.5 Slip Formwork

Where moving formwork is used, it shall be constructed and operated by personnel experienced in the system.

During concreting the moving forms shall proceed at an average rate of 350 mm per hour. If the Contractor wishes to use a different rate the Contractor shall demonstrate that such a rate can produce a finished structure of the quality and appearance specified. The height of the forms shall not exceed 1200 mm.

The facing of the forms shall be correctly tapered and shall be free from defects that might cause scoring of the fresh concrete at the slip surfaces. The decking system shall be capable of supporting, without excessive deflection, a superimposed load of 5 kPa. Allowance shall be made for impact loading on the deck.

The method of lifting the forms during construction shall be submitted to the Superintendent with the Formwork Drawings.

The Contractor shall take precautions to prevent the formwork’s jamming against the concrete when the formwork is left stationary overnight.

A hanging scaffolding shall be provided below the moving form on all faces, from which surface treatment and inspection can be carried out.

The Contractor shall use a system that will permit continuous checks to be made on wall verticality and formwork levels.

All equipment associated with the moving form process shall be supplied and used as per the manufacturer’s specifications and their approval of the correct use of the equipment shall be obtained throughout the operation.

2.6 Tolerances of Formed Surfaces

Refer to Section 19.5 of AS 3600 and to Section 5 of AS 3610.

Where the requirements of AS 3600 and AS 3610 are in conflict, the more stringent requirements shall apply.
3.0 Reinforcement

3.1 General
Refer to Clause 19.2 of AS 3600.

3.2 Storage
Reinforcement when delivered to the Site shall be stored in a suitable steel rack. The rack shall be constructed so that the steel shall be amply protected from the weather and shall not come into contact with the ground.

3.3 Fabrication and Placement
Immediately before concrete is placed, reinforcement shall be free from loose rust, loose mill scale, grease, tar, paint, oil, mud, mortar and foreign matter.

The reinforcement shall be secured against displacement by tying at intersections with annealed wire ties not smaller than 1.25 mm diameter or by purpose made clips.

The ends of wire ties shall be bent away from nearby faces of forms and shall not project into the concrete cover.

In reinforcement in the form of a mat, each bar shall be secured at alternate intersections and at other points as required so that the specified fixing tolerances shall be maintained as concrete is placed.

Each beam ligature shall be secured to a bar in each corner of the ligature and all longitudinal column reinforcement shall be secured to all ligatures at every intersection.

Reinforcement shall not be displaced from the positions shown on the Drawings for the purpose of accommodating pipes of any description except as may be directed by the Superintendent.

3.4 Cover
Refer to the Drawings.

3.5 Supports
Reinforcement shall be supported by bar chairs, spacers and ties made from sound concrete, steel (plastic tipped) or plastic but pieces of wood, aggregate, brick etc shall not be used. Unprotected ferrous metal shall not be used in such supports where they extend to the surface of the concrete, or where they are used in conjunction with galvanised or zinc coated reinforcement.

Top and bottom slab reinforcement shall be supported at intervals sufficiently close to ensure that there shall be no undue deflection of the bars as concrete is placed. The spacing of supports shall not be greater than 60 diameters for bars and 750 mm for fabric.

Longitudinal beam and column reinforcement shall be secured by spacers or ties at spacings not greater than 1000 mm.

3.6 Splices
Splicing of reinforcement shall only be carried out in the locations shown on the Drawings, or otherwise permitted by the Superintendent. Splices shall be in accordance with AS 3600.

3.7 Welding and Heating
Heating or welding of reinforcement shall be carried out only if approved by the Superintendent.

Welding of reinforcing bars shall satisfy the requirements of AS 1554.3.

3.8 Fixing Tolerances
Refer to Section 19.5 of AS 3600.
Notwithstanding anything to the contrary in Section 19.5 of AS 3600, reinforcement shall be placed within the following tolerances.

- Bar positions controlled by cover
  - Beams, slabs, columns and walls - 0, +10 mm
  - Slabs on ground - 10, +20 mm
  - Footings cast on the ground - 20, +40 mm
A positive value indicates the amount by which the cover may be increased and a negative value the amount by which it may be decreased.

- Bar positions not controlled by cover:
  - Ends of reinforcement - 0, +50 mm
  - Spacing of bars in walls and slabs and of fitments in beams and columns - 10% of specified spacing or 15 mm, whichever is greater.

3.9 Testing
The Superintendent may direct the Contractor to supply a test certificate for each grade of steel.
If certificates are not available and they are required by the Superintendent, the Contractor shall have tests carried out by a NATA registered laboratory and shall supply reports of the results to the Superintendent.

4.0 Concrete Supply and Placement

4.1 General
The Contractor shall select materials and design concrete mixes.
The Contractor shall be entirely responsible for the design and production of finished concrete and concrete work that is in accordance with this Specification.

4.2 Materials

4.2.1 Cement
Cement shall be Type GP - General Purpose Portland Cement complying with AS 3972.
Cement delivered to the Site shall be contained in multi-walled bags and kept dry and undamaged in weatherproof shed/sheds.
Cement on Site shall be used in the order which it is received and storage shall be arranged to achieve this requirement. The Contractor shall keep records of the dates and quantities of the deliveries received. Cement that has been stored for more than three months shall be retested at the Contractor's expense and shall not be used if it does not then comply with AS 3972. Cement showing lumps that cannot be broken to the original fineness by finger pressure shall not be used irrespective of its age.

4.2.2 Fly Ash
Fly ash shall be used as an additive to cement, unless it can be established to the satisfaction of the Superintendent that aggregates for the concrete mix are unlikely to have the potential to create an environment for an aggregate/alkali reaction.
The proportion of fly ash shall be 25% by weight of the total combined weight of fly ash and cement.
Fly ash shall satisfy the requirements of AS 3582.1 and AS 3583.
Where the Contractor wishes to use both fly ash and an air entraining agent in a concrete mix, the Contractor shall provide to the Superintendent proof (from tests on trial mixes or previous production) that the amount of air entraining can be controlled within specified limits and that the compressive strength is satisfactory.

4.2.3 Fine and Coarse Aggregates

Fine and coarse aggregates shall satisfy the requirements of AS 1141 and AS 2758.1.

The maximum coarse aggregate size shall be 20 mm.

Aggregates shall have a well graded combined grading, free of gaps.

Batch weights and material gradings shall be supplied to the Superintendent.

The Superintendent may direct the Contractor to supply fine and coarse aggregates for testing 14 days before delivery commences to the job. The quantity of fine aggregate shall be 20 kg and the coarse aggregate 45 kg in weight. The cost of all materials supplied shall be borne by the Contractor and the cost of testing shall be borne by the Principal.

4.2.4 Water

The water used in mixing concrete shall be clean and free from injurious amounts of oils, acid, alkali, organic matter or other deleterious substances and shall be of potable quality.

4.2.5 Admixtures

Chemical admixtures in concrete shall be used only with the written approval of the Superintendent. Admixtures shall satisfy the requirements of AS 1478.

Calcium chloride shall not be used as an admixture in concrete.

Fly ash is not considered an admixture under the terms of this Clause 4.2.5.

4.3 Concrete Mix Design

The concrete mix design including details of the materials shall be submitted to the Superintendent prior to pouring of any concrete.

4.4 Ready Mixed Concrete and Pumped Concrete

Ready mixed concrete and pumped concrete may be used, provided that it satisfies the requirements of this Specification and of AS 1379.

4.5 Site Mixed Concrete

Site mixed concrete shall be batched, mixed and placed under procedures approved by the Superintendent. The procedure shall provide following details including materials storage facilities, weighing scales usage, liquid admixture volume dosing facility, batching equipments, batching sequences for various materials, mixing method, discharging methods, transport methods and placing methods. The aggregate materials shall be stored in the manner that no segregation will occur during the storing or batching processes.

All concrete shall be batched and mixed in equipment conforming to the relevant requirements of AS 1379.

A quality assurance (QA) plan shall be prepared provided to demonstrate that the specified mix proportion can be consistently achieved throughout the project period. Moisture content of all aggregates in storage facilities shall be tested before batching and the results shall be used in batching process to control the water content in concrete. All batching weight of all materials for each batch shall be recorded accurately for later QA auditing purpose.

The equipment shall be regularly inspected and maintained and the calibration of all weighing equipment shall be verified at intervals not exceeding 2 weeks.

For the proposed concrete mixes at the proposed maximum load to be adopted during the pour, minimum mixing time or minimum number of revolutions shall be determined from mixer manufacturer’s recommendations. If no recommendations are provided, the minimum mixing time or number of revolutions shall be determine by a mixer...
uniformity test as specified in AS1379 using the proposed concrete mix. The required minimum mixing time or number of revolutions to achieve an acceptable uniformity shall be complied during the entire project period.

Concrete shall be batched and mixed only in quantities required for immediate placing in the forms.

4.6 No Fines Concrete

No-fines concrete shall consist of Portland cement and coarse aggregate. The coarse aggregate for 20 mm maximum particle size, shall have the following grading:

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>% Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5</td>
<td>100</td>
</tr>
<tr>
<td>19.0</td>
<td>95-100</td>
</tr>
<tr>
<td>9.5</td>
<td>0-5</td>
</tr>
<tr>
<td>4.75</td>
<td>0</td>
</tr>
</tbody>
</table>

No-fines concrete shall be proportioned as follows:
- aggregate: cement ratio in the range of 6:1 to 8:1 by weight;
- water: cement ratio in the range of 0.35 to 0.45 by weight.

4.7 Grout

Grout shall consist of Portland cement and water or of Portland cement, sand and water.

An additive designed to produce fluidity and for expansion of the grout may be used provided that additives containing aluminium powder, chlorides or nitrates shall not be used.

Sand, if used, shall satisfy the requirements of AS 2758 except that the grading may be modified to obtain increased workability.

The water content shall be the minimum necessary for proper placement.

4.8 Mixing and Placing

4.8.1 Addition of Water

After all ingredients of the concrete have been mixed the further addition of water shall not be permitted.

4.8.2 Temperature Conditions

Concrete shall not be placed when the following conditions occur:
- the temperature of the concrete is less than 10°C or exceeds 35 °C or
- the outdoor shade temperature is likely to be greater than 35 °C during placement or within 2 hours subsequent to placement, unless special precautions, to the approval of the Superintendent, are undertaken. Notwithstanding that such special precautions are taken, concrete shall not be placed when the outdoor shade temperature exceeds 38 °C.

Where the concrete temperature is less than 32°C, unless a special retarding admixture is used to delay concrete setting, concrete shall reach its final position in the forms within 30 minutes after the introduction of water to the cement and aggregate, or the cement to the aggregate, except in the case of concrete which is continuously agitated in a truck mixer, when 1.5 hours may elapse between introduction of water and final placing. In hot weather where the concrete temperature is greater than 32°C the above times shall be reduced to 15 minutes and 45 minutes respectively. Notwithstanding the above, the Superintendent may direct other times.

4.8.3 Slumps

The concrete slumps shall be as follows at the construction site:
- general concrete - 80 ± 15 mm;
- pumped concrete - 80 ± 15 mm;
- tremie concrete - 150 ± 30 mm.

### 4.8.4 Sequence of Pours

The proposed sequence of pours shall be submitted to the Superintendent for direction on whether it is suitable. Slabs or beams shall not be poured integrally with supporting columns and walls.

### 4.8.5 Placing

The Contractor shall not cover up formwork and reinforcement by placing concrete without the prior approval of the Superintendent.

Concrete shall not be placed except in the presence of the Superintendent.

Concrete shall not be placed unless materials for curing unformed surfaces are at the site and ready for use.

Before concrete is placed, the formwork and the space into which the concrete is to be placed shall be free of contaminants and free of water.

Concrete shall be brought to the forms and placed in such a manner that there shall be no segregation of the concrete mix. Internal vibrators shall not be used to move concrete within the forms.

Concrete shall not be exposed to rain during mixing, transport or placing, until it second day.

Concrete shall be placed in daylight or under adequate artificial lighting.

Concrete shall be deposited as near as practicable in its final position without segregation. It shall not be dumped from a height greater than 2 metres nor shall it be dumped away from its final position and worked along the forms. If placing operations necessitate a drop greater than 2 metres, the concrete shall be placed using a flexible tube or chute reaching to the base of the formwork.

Chutes, if used to place concrete, shall be used in a manner that avoids segregation of the concrete. Apart from flushing prior to commencement of concreting, the use of water shall not be used to assist the movement of concrete.

Concrete shall be placed continuously between construction joints. Fresh concrete shall not be placed against concrete that has taken its initial set.

The concrete shall be placed and compacted in layers not more than 300 mm.

### 4.8.6 Compaction

During and immediately after placing, the concrete (other than concrete placed underwater) shall be thoroughly compacted by means of high frequency mechanical vibrators. Care shall be taken to fill every part of the formwork, to work the concrete under and around the reinforcement and embedded fixtures without displacing them to work coarse aggregate back from the formed faces and to remove all air bubbles and voids.

Vibrators and their use shall follow the descriptions and recommendations in Chapter 8 of SAA HB 64.

The number of internal vibrators provided shall be not less than 1 per four cubic metres of concrete placed per hour. In addition, at least 1 vibrator shall be provided as a reserve for emergency use.

Internal vibration shall be applied in a systematic manner in the area of freshly deposited concrete, at uniformly spaced points not further apart than one and a half times the radius of visible vibration effect. Vibration shall not be continued so as to cause segregation or to draw grout from the surround concrete.

Vibrators shall not be held against forms or reinforcing steel, nor shall they be used for spreading concrete or moving it along forms. Vibrators shall not be left stationary in one position such as to cause segregation.

The Contractor shall supply to the Superintendent details of all vibrating screeds for flat slabs and vibration of formwork that the Contractor proposes to use.

### 4.8.7 Joints

In general, concrete shall be placed and compacted against unset previously-placed concrete such that the finished work shall be monolithic and uniform in strength and appearance.

All construction joints shown on the Drawings shall be made.
Otherwise construction joints may be made in such locations and in such manner as may be approved by the Superintendent, who may direct the Contractor to scabble or otherwise remove laitance and provide for bond and to provide keys, steps and other means of load transfer. Any such provision, whether shown on the Drawings or directed by the Superintendent, shall be at the Contractor’s expense.

If construction joints for concrete walls are not shown on the Drawings, or specified elsewhere, they shall be incorporated at a spacing not exceeding 10 metres.

If, due to breakdown or other unforeseen contingency, a construction joint becomes necessary at a point not previously agreed to, concreting shall be continued by emergency means to a point designated by the Superintendent and a construction joint made.

4.8.8 Pumping

Pipelines used in pumping concrete shall be connected to the farthest points of delivery and shortened during pumping as work proceeds. The equipment shall be arranged so that no vibrations that may damage freshly placed concrete shall result. Before concrete is pumped the pipeline shall be primed with a 2:1 sand/cement mortar at the rate of 1 cubic metre of mortar to 300 metres of line. All priming mortar shall be discharged to waste. If pumping is stopped for more than a few minutes the pipeline shall be kept free by running the pump for two or three strokes every few minutes, otherwise the pipeline shall be emptied and cleared.

4.8.9 Sprayed Concrete

Placement of concrete by a spraying technique may be used, if approved by the Superintendent.

Sprayed concrete shall be placed in accordance with Concrete Institute of Australia, “Recommended Practice for Sprayed Concrete”.

The placing equipment shall be of an accepted type and the nozzleman shall be experienced in that type of work.

The air operating pressure at the gun outlet shall not be less than 240 KPa.

The nozzle shall be held at right angles to the receiving surface at a distance of 0.6 to 1.2 metres.

Vertical surfaces shall be worked from the bottom up.

No rebound concrete shall be mixed into any batch.

4.8.10 Placing Underwater

Concrete shall not be placed underwater without the prior knowledge of the Superintendent.

Concrete shall not be placed in running water and forms shall be watertight.

The concrete shall be placed carefully in a compact mass in its final position by means of a tremie or similar device. A tremie shall consist of a steel tube at least 200 mm in diameter and be watertight. The discharge end shall be closed at the start of work so as to prevent water entering the tube and shall be entirely sealed in fresh concrete at all other times. The level of concrete in the tremie shall be kept as close to the top of the tube as possible at all times during concreting.

A concrete pump may be used for placing concrete underwater, provided it has the same characteristics as a tremie.

Vibration or disturbance of the concrete after placing is not permitted.

The quantity of cement in the concrete placed underwater shall be increased by 25% above that normally required for that grade of concrete.

4.9 Sampling and Testing

4.9.1 General

Sampling and testing of concrete for compliance shall be in accordance with AS 1379.

4.9.2 slump

Slump tests shall be undertaken in accordance with AS 1379. Slump shall be tested for each concrete batch to ensure the required slump limit is satisfied before concrete is placed.
4.9.3 Strength
Project assessment of each strength grade shall be undertaken in accordance with AS 1379. In addition to the minimum sampling frequency specified in AS 1379 at least one sample shall be tested for each element of the structure and for each grade of concrete placed in any one day.

4.10 Unformed Surface Finishes
Unformed surfaces shall be constructed to a smooth even surface and finished with a wooden float.

4.11 Curing and Protection
All concrete work shall be cured.

For unformed surfaces curing with plastic membrane or curing compound shall be commenced immediately finishing is complete. Water curing on thin elements (slab or wall) shall be commenced second day to avoid surface damage and thermal shock.

The wet curing period from the time of placing concrete (to be continuous) shall be not less than the following:
- Portland cement concrete - 7 days;
- cements with fly ash pozzolanic materials - 10 days.

The curing method shall include one or a combination of the following methods:
- ponding or continuous sprinkling with water;
- curing compound that is in accordance with the recommendations of AS 3799;
- absorptive cover kept continuously wet;
- impermeable membrane.

The Superintendent may direct that any curing method not be used.

The concrete shall be protected from damage during the curing period.

4.12 Rejection of Concrete
Plastic and hardened concrete that does not meet the requirements of this Specification and of AS 3600, AS 3610 or AS 1379 is not in accordance with the Contract.

4.13 Repairs of Concrete
Where repair of concrete is necessary and permitted, such repairs shall be performed by skilled workmen and shall be completed within 24 hours after removal of formwork or, in the case of unformed concrete, within 24 hours after placing of concrete.

The materials and techniques of repair that the Contractor proposes to use shall be notified to the Superintendent prior to commencement. The repairs shall be at no cost to the Principal.

5.0 Measurement and Payment
Concrete work shall be classified according to the parts of the Works or Temporary Works in which the concrete work is incorporated.

Where in the descriptions of items in the Schedule of Rates other characteristics of concrete or concrete work are identified, those descriptions are classifications for the purposes of this Clause 5.

Separate measurement shall be made and payment calculated for concrete work of each classification.

Concrete work of each classification shall be measured as the volume in cubic metres of concrete work satisfactorily completed, calculated from the dimensions indicated on the Drawings.
The scheduled rates for concrete work of each classification each shall include full compensation for excavation if there is no relevant item in the Schedule of Rates, for the supply of materials and construction of bedding or blinding layers if there is no relevant item in the Schedule of Rates, for the supply, erection and stripping of formwork and falsework, for the supply, fabrication and fixing of reinforcement, for fixing embedded items, for the design of concrete mixes and selection of concrete materials, for the supply, handling, placing, compaction, finishing and curing of concrete and for all other costs incurred in executing and completing the work in accordance with the Contract.

Alternatively, where a structure including concrete work is identified on the Drawings and in the Schedule of Rates and the Schedule of Rates shows that payment for that structure is to be calculated by way of a lump sum, that structure shall not be measured. The scheduled lump sum for that structure shall include full compensation for all costs incurred in executing and completing the work as provided for concrete work whose volume is to be measured.