NOOSA PLANNING SCHEME POLICY 6 - ENGINEERING DESIGN STANDARDS WATER & SEWERAGE

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1 INTRODUCTION

1.1 PURPOSE OF POLICY

The purpose of the policy is to communicate Council's position with respect to Water and Sewerage Reticulation works by:

a. Stating the specifications and standards for design of reticulation works, including those associated with material change of use or reconfiguring a lot applications, which meet the overall outcomes set out in the *Water and Sewerage Reticulation Code.*

b. Stating the standards for construction of water and sewer assets throughout the former Noosa Shire.

c. Stating the information required for 'as constructed' details.

d. Stating the standard conditions that apply to the design, construction and maintenance of assets.

e. Providing standard drawings for the design of assets.

1.2 APPLICATION OF THE POLICY

The policy functions as part of the Integrated Development Assessment system (IDAS) under the *Integrated Planning Act* 1997 (IPA).

The policy provides probable solutions for codes within The Noosa Plan (the Planning Scheme for the northern sub-region of the Sunshine Coast) and is to be read in conjunction with The Noosa Plan.

This policy is also a reference for Consultants engaged in the design and construction of water and sewerage works for Council, and Council's general civil engineering works.

Where reference is made to other design manuals etc, this document takes precedence over the design requirements specified in such manuals.

1.3 WATER SERVICES ASSOCIATION OF AUSTRALIA NATIONAL CODES

Council supports the Water Services Association of Australia (WSAA) National Codes initiative to develop national codes for water supply and sewerage. Benefits of the national codes include the development of best practices, the encouragement of innovation and minimisation of capital costs through standardisation of components used in water supply and sewage collection systems.

The supplementary information to the WSAA codes, contained within Sections 2 and 3 of this policy, has been developed to define the particular requirements

of Council in relation to the WSAA National Codes. Only details that differ from that of the WSAA national codes are provided.

1.4 INTERPRETATION

Where reference is made to the consultant, the consultant shall be a registered professional Civil Engineer (RPEQ) experienced in the design, construction and supervision of civil works and services related to reconfiguring a lot and other development works.

Where reference is made to the surveyor, the surveyor shall be a licensed Surveyor endorsed in the Register of Surveying Associates, Surveying Graduates, Surveyors - Body Corporate and Surveyors - Individual.

Council's 'Level of Service Impact Assessment Specification' means the framework by which the Water Agency may require information to assess development applications, due diligence requests or other information that may impact upon the Water Agency's ability to achieve the desired standard of service (DSS) for customers as defined in the Water Agency's current water supply and sewerage growth management strategies. The specification sets out information requirements essential to assess the existing and future effects on the performance and capacity of water assets including the identification of infrastructure needs, costs, and timings associated with deviation from population assumptions/sequencing underpinning the Water Agency's current long term infrastructure planning.

"Water Agency" – the owner and administrator of water and sewerage assets.

2 WATER SUPPLY

2.1 RELEVANT CODE REQUIREMENTS

This section relates to probable solutions in Part 14, Division 21 of The Noosa Plan (Water Supply and Sewerage Reticulation Code). It sets out standards and potential information requirements for the provision of a reticulated water supply system.

In applying the following standards, applicants should also have regard to requirements set out in Part 14, Division 20 of The Noosa Plan (Water Sensitive Design Code).

2.2 STANDARDS

This policy shall be read in conjunction with, and take precedence over, the WSAA Water Supply Code of Australia – WSA 03-2002 to define the technical requirements of Council and the Water Agency in relation to the planning, design and construction of water supply systems.

All new unit type developments whether single or multi-storey shall be provided with individual water meters. The cost of the installation of the water meters shall be borne by the developer and the water meters will be supplied by Council. Primary water meters should be located within the immediate title boundary.

Council may request that in multi-storey strata title unit developments of three (3) storeys or more, individual meters shall be connected with remote reading counters located at the ground floor level or for two storey unit developments, all individual meters shall be located at the ground level above ground.

2.3 PLANNING AND DESIGN

2.3.1 Pt 1 –1.5.2 Water Agency

Add to WSAA requirement:
For development proposals the Water Agency may request that a water supply network analysis be undertaken to determine (a), (b) and (c).

2.3.2 Pt 1 – 2.1 System Planning Process

Add to WSAA requirement:
The designer shall liaise with the Water Agency prior to commencement of the design.

2.3.3 Pt 1 – 2.2 Demands

Replace WSAA requirement with:
Water demands shall be determined in accordance with the Councils Level of Service Impact Assessment Specification.

2.3.4 Pt 1 – 2.2.3 Peak Demands

Replace WSAA requirement with:
The designer shall liaise with the Water Agency to obtain the peak demand factors.

2.3.5 Pt 1 – 2.3 System Configuration (a) & (b)

Add to WSAA requirement:
Where deemed necessary by the Water Agency, existing asbestos cement water mains shall be replaced along the full frontage of any proposed development site or where affected by any development works.

Replacement of existing water mains will be required in commercial and industrial and high density residential precincts where existing mains fronting any proposed development are less than 150mm diameter. Mains shall be replaced along the full frontage of the proposed development site prior to the placement of any site sheds or construction materials over or adjacent to the water main.

2.3.6 Pt 1 – 2.4.2 Network Analysis

Add to WSAA requirement:
The Water Agency will undertake, at the designer's expense an assessment, and establish any adverse impacts, of the proposed developments on the existing system using the Water Agency's hydraulic model. The designer shall provide details of the proposed system development and demands to allow completion of this assessment. Alternatively, the Water Agency may require the designer to carry out this assessment. Network analyses are to include all pipes in the network model and comply with Councils Level of Service Impact Assessment Specification.

2.3.7 Pt 1 – 2.4.3 Operating Pressures

Add to WSAA requirement:
The minimum desirable service pressure shall be 220kPa at the water meter. The maximum service pressure shall be 800kPA.

2.3.8 Pt 1 – 3.2.2 Minimum Pipe Sizes

Add to WSAA requirement:

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Pipe sizes shall not be less than DN150mm diameter for high density residential, commercial and industrial and rural residential precincts.

2.3.9 Pt 1 – 3.2.4 Fire Flows

Replace WSAA requirement with:
Fire flows shall comply with the requirements specified in 'Guidelines for Planning and Design of Urban Water Supply Schemes' Chapter 21A, 1997, Dept of Natural Resources and Mines.

The water supply scheme shall be capable of supplying the following fire flow demands above maximum hour demand: Commercial and Industrial Precincts – 30 litres per second at 12 metres residual pressure. Residential Precincts – 15 litres per second at 12 metres residual pressure.

2.3.10 Pt 1 – 3.7.2 Minimum Pressure Class

Replace WSAA requirement with:
The minimum pipe and fitting pressure class for reticulation mains shall be Class16.

2.3.11 Pt 1 – 4.1.1 Design Tolerances

Add to WSAA requirement:
Horizontal alignment shall be referenced to GDA mapping co-ordinates.

2.3.12 Pt 1 – 4.3 Location of Water Mains

Add to WSAA requirement:
Reticulation water mains shall generally be located within the road reserve on a 1.5 metre alignment from the property boundary.

In general, water mains are not to be constructed on private property, however, in instances where this is unavoidable it will be necessary to provide an easement of minimum 3.0 metres width registered for the benefit of the Council on the title of the land. The main is to be constructed centrally within the easement. A wider easement may be necessary in some instances, as determined by the Water Agency, to ensure adequate access for maintenance purposes.

2.3.13 Pt 1 – 4.3.2 Water Mains in Road Reserves

Add to WSAA requirement:
Mains shall be located to provide a minimum 0.5 metres horizontal clearance from existing or proposed footpaths.

Landscape planting within 1.0 metre of Council water infrastructure or within a water easement shall be low growing when mature and be suitable approved varieties.

Consideration shall be given at land reconfiguration stage to ensure road reserves are of adequate width to provide required clearances between all services and improvements.

2.3.14 Pt 1 – 4.4 Shared Trenching

Replace WSAA requirement:
Water mains shall not be co-located with other services.

2.3.15 Pt 1 – 4.5 Duplicate Mains

Add to WSAA requirement:
Water mains are to be provided on both sides of the road in the case of divided carriage ways, commercial, industrial and high density residential precincts.

2.3.16 Pt 1 – 4.7 Connection of New Mains to Existing Mains

Add to WSAA requirement:
All works on the existing reticulation system shall be considered 'live works' and will be constructed by the Water Agency at the contractors cost. These works shall be clearly delineated on the drawings and shown in sufficient detail such that the works can be readily constructed. The connection point to the existing system shall be located to minimise disruption of supply to customers and be subject to Water Agency approval.

2.3.17 Pt 1 – 4.8.3 Temporary Ends of Water Mains

Add to WSAA requirement:
Water mains shall be constructed across the full frontage of any property being developed.

2.3.18 Pt 1 – 4.9 Property Services

Add to WSAA requirement:
Replace WSAA Standard Drawings WAT – 1106, WAT – 1107 and WAT – 1109 with Council Standard Drawings SCW 350, SCW 355 and SCW 360.

Add to WSAA requirement:
Ductile iron pre-tapped fittings and service pipework shall be installed by the developer at the time of lot reconfiguration in accordance with Council Standard Drawing SCW 360. Conventional tapping bands may

be utilized for pipe diameters where pre-tapped fittings are not available. Property service connections shall only be installed on reticulation mains with a diameter less than or equal to 300 mm. Property connections shall be installed in accordance with Council standard drawings. Water service pipework shall be provided for the length of access strips and access easements serving Lots (25mm NB minimum).

Conduits shall be provided under all roads to carry water services to properties on the opposite side to the main. Conduits shall be installed in accordance with Council standard drawings and at an alternate position to power and/or telecommunication services. Kerb markers shall be placed in accordance with Council standard drawings.

If, as may occur at corner properties, electrical pillar boxes are located on both side boundaries, the property service connection shall be placed at the RP boundary truncation point. Community title schemes shall be provided with a single service to the boundary of the property.
All internal works will be privately owned and the responsibility of the body corporate.

Water meters shall be installed by the developer prior to survey plan release. The water agency will advise the type and supplier of the approved water meters. Meters shall be installed in accordance with Council standard drawings SCW-350, SCW-355, SCW-360.

2.3.19 Pt 1 – 4.10.4 Clearance from Structures

Replace WSAA requirement with:
Other structures deemed satisfactory to be constructed over or adjacent to Council's water supply shall be designed and constructed to protect the infrastructure from physical damage and to allow Council access when necessary.

2.3.20 Pt 1 – 5.4.2 Pipe Cover

Add to WSAA requirement:
Where site works either reduce the depth of cover below the minimum, or increase the depth of cover to invert above 1.5 metres, the water main shall be re-laid to maintain the required depth.

2.3.21 Pt 1 - 5.5.1 Geotechnical Considerations– General

Add to WSAA requirement:
Considerations to include the existence of acid sulphate soils (ASS) and possible acid sulphate soils (PASS). Refer to the planning study "Acid Sulphate Soils in the Noosa River Catchment" within The Noosa Plan.

2.3.22 Pt 1 – 6.1.4 Installation

Replace WSAA Standard Drawings WAT– 1301, WAT – 1304 and WAT – 1309 with Council Standard Drawings SCW 320, SCW 365 and SCW 330.

2.3.23 Pt 1 – 6.2.1.1 Stop Valves – General

Replace first paragraph of WSAA requirement:
When extending an existing water main, a stop valve may only be installed at the junction of the existing and new water mains if approved by the Water Agency.

2.3.24 Pt 1 – 6.2.3 Stop Valves for Reticulation Mains

Add to WSAA requirement:
Stop valves are required on each side of all mains crossing railway reserves, major roads and on mains traversing easements.

Valves shall be resilient seated, coated, o-ring stem sealed, anticlockwise closing class 16 conforming to AS2638. The wedge shall be totally encapsulated in an approved synthetic rubber conforming to AS1646. The body shall be internally and externally coated with fusion bonded epoxy (FBE) or a thermoplastic polyamide such as Rilson Nylon 11. Valves to be installed in accordance with SWC 320 and WAT 1207.

2.3.25 Pt 1 – 6.2.5 1 Stop Valves – Location and Arrangements – General

Add to WSAA requirement:
Stop valve locations shall be in accordance with Arrangement 1.
Zone valves shall be in accordance with Arrangement 3(b).

2.3.26 Pt 1 – 6.3.2 Pressure Reducing Valves (PRVs)

Add to WSAA requirement:
PRVs shall be designed in accordance with Standard Drawing SCW 330.

2.3.27 Pt 1 - 6.4.1 Air Valves – Installation Design Criteria

Replace WSAA Standard Drawing WAT– 1302 with Council's Standard Drawings SCW 320 and SCW 325.

2.3.28 Pt 1 – 6.7 Swabbing Points

Add to WSAA requirement:
Swabbing points will generally only be required on large diameter or lengthy transfer mains. The Water Agency will advise any requirements on a case by case basis.

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2.3.29 Pt 1 – 6.8 Hydrants

Add to WSAA requirement:
Hydrants shall be installed as follows:

- Location – opposite common boundaries, generally installed at crests or sags and end of mains.
- Spacing – maximum 80 metres.
- Orientation – spring hydrants shall be oriented with bolts parallel to the water main.

Hydrants must comply with AS3952-1991 for DN80 spring hydrants and shall be fusion bonded epoxy (FBE) or thermoplastic polyamide (Rilsan Nylon 11) coated. All fasteners are to be 316 stainless steel.

2.3.30 Pt 1 - 6.8.8 Hydrant Locations:

- Replace WSAA Standard Drawings WAT –1300 with Council Standard Drawing SCW 365;
- Replace WSAA Standard Drawing WAT 1301 with Council Standard Drawing SCW 320;
- Replace WSAA Standard Drawing WAT 1302 with Council Standard Drawings SCW 320, SCW 325.

2.3.31 Pt 1 - 7.2.2 (d) Composition of Design Drawings

Longitudinal sections are to be prepared for water mains 250mm diameter or larger.

Add to WSAA: (e) Ensure that all revision amendments are clouded.

2.4 PRODUCTS AND MATERIALS

2.4.1 Pt 2 – 8.4 Product Standards and Specification

Add to WSAA requirement:
The following materials are approved for use in the construction of water reticulation and trunk main systems.

Diameter		**Function**	**Material**				
Material Description		Copper	PVC-O	PE	DICL	MSCL	**PVC-M**
WSAA Purchase Specification		AS3500	PS-210	PS-207	PS-234	PS-203	**PS-209**
DN-20 – DN50	Water Service	Approved	N/A	PE100B PN16	N/A	N/A	**N/A**
DN50 – DN100	Water Service	Approved	N/A	N/A	N/A	N/A	**N/A**
DN63	Water Main- Cul de sac only	N/A	N/A	PE100B PN16	N/A	N/A	**N/A**
DN100 – DN150	Water Main	N/A	PN16 SN 10	N/A	PN35	N/A	**PN16 SN10**
DN150 – DN300	Water Main	N/A	N/A	N/A	PN35	N/A	N/A
DN375 – DN750	Water Main	N/A	N/A	N/A	PN35	Note 1	N/A

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2.5 CONSTRUCTION

2.5.1 Pt 3 – 10.2 Personnel Qualifications

Add to WSAA:
Pipe layers shall be accredited by the pipe manufacturer.

2.5.2 Pt 3 – 11.5.4.2 Traffic Management

Replace WSAA requirement with:
A traffic management plan shall be prepared for all projects. Details to be presented in accordance with Council Policy.

2.5.3 Pt 3 – 15.1.4 Laying

Replace WSAA Standard Drawing WAT –1101 with Council Standard Drawing SCW380.

2.5.4 Pt 3 – 15.2.3 Bending Pipe

Replace WSAA requirement with: Cold bending of PE pipe to manufacturers specifications is permitted. Cold bending of all other pipes is not permissible.

2.5.5 Pt 3 – 15.5 Thrust and Anchor Blocks and Restrained Joints

Delete WSAA Standard Drawing WAT– 1206.
Add to WSAA: Hydrant tees are to be restrained in accordance with socketed valve standard. Refer WAT 1207.

2.5.6 Pt3 – 15.6 Property Services and Water Meters

Replace WSAA Standard Drawings WAT–1106 to WAT – 1109 inclusive with Council Standard Drawings SCW 350, SCW 355 and SCW 360.

2.5.7 Pt3 – 15.11.1 Installation

Replace WSAA Standard Drawings WAT- 1301 to WAT – 1306 with Council Standard Drawings SCW 320 and SCW 325.

2.5.8 Pt3 – 15.11.2 Valve Chambers for Large Diameter Mains

Replace WSAA Standard Drawings WAT – 1308 and WAT – 1309 with Council Standard Drawing SCW 330.

2.5.9 Pt3 – 15.16 Location Markers

Replace WSAA Standard Drawing WAT – 1300 with Council Standard Drawing SCW 365.

2.5.10 Pt 3 – 22 Connections to Existing Water Mains

Replace WSAA requirement with:
All works that may involve connection to or modifications of the existing water supply system shall be undertaken by the Water Agency at the applicant's expense. Water mains are considered to be live once accepted 'on maintenance' by the Water Agency.

No person, other than authorised Water Agency employees, shall operate any existing valve or draw water from any existing main without the authority of the Water Agency.

2.6 SPECIFICATIONS

All relevant details are applied under Water Services Association of Australia (WSAA) National Code.

2.7 STANDARD DRAWINGS

WSAA Drawing Numbers		Remarks
All		**The Water supply Code of Australia WSA 03 drawings detail a number of infrastructure options and arrangements. A number of these options are not compatible with current Council practice. The acceptance, modification or deletion of the WSAA drawings is set out below.**
WAT-1100	**Not adopted**	**Use SCW 385 – drawing under development**
WAT-1101	**Not adopted**	**Use SCW 380 – drawing under development**
WAT-1102	**Adopted**	**Valve to be directly off tee**
WAT-1103	**Adopted**	**Valve to be directly off tee**
WAT-1104	**Adopted**	**1.) 63 OD PE water mains in cul de sac heads only. 2.) 63 OD PE water mains to be looped using entire head of Cul de sac.**
WAT-1105	**Adopted**	
WAT-1106	**Not adopted**	**Use SCW 350, SCW 355 and SCW 360.**
WAT-1107	**Not adopted**	**Use SCW 355**
WAT-1108 **WAT 1109**	**Not adopted** **Not Adopted**	**Use SCW 360** **Use SCW 350**

WAT-1200	**Adopted**	
WAT 1201	**Adopted**	
WAT-1202	**Adopted**	
WAT-1203	**Adopted**	
WAT-1204	**Adopted**	
WAT-1205	**Adopted**	
WAT-1206	**Not Adopted**	
WAT-1207	**Adopted**	**Hydrant tees are to be restrained in accordance with socketed valve restraints**
WAT-1208	**Adopted**	
WAT-1209	**Adopted**	
WSAA Drawing Numbers		**Remarks**
WAT-1210	**Adopted**	
WAT-1211	**Adopted**	
WAT-1212	**Adopted**	
WAT-1213	**Adopted**	
WAT-1214	**Adopted**	
WAT-1300	**Not adopted**	**Use SCW 365**
WAT-1301	**Not adopted**	**Use SCW 320**
WAT-1302	**Not adopted**	**Use SCW 320 & SCW 325**
WAT-1303	**Not adopted**	**Use SCW 320 & SCW 325**
AT-1304	**Not adopted**	**Use SCW 320 & SCW 325**
WAT-1305	**Not adopted**	**Use SCW 320 & SCW 325**
WAT-1306	**Not adopted**	**Use SCW 320 & SCW 325**
WAT-1307	**Adopted**	
WAT-1308	**Not adopted**	
WAT-1309	**Not adopted**	**Use SCW 330**
WAT-1310	**Adopted**	
WAT-1311	**Adopted**	
WAT-1312	**Adopted**	

WAT-1313	**Adopted**	
WAT-1400	**Adopted**	
WAT-1401	**Adopted**	
WAT-1402	**Adopted**	
WAT-1403	**Adopted**	
WAT-1404	**Adopted**	
WAT-1405	**Adopted**	
WAT-1406	**Adopted**	
WAT-1407	**Adopted**	
WAT-1408	**Adopted**	
WAT-1409	**Not adopted**	
Public Utilities		**Remarks**
SEQ R-100		**Public Utilities – Typical Service Corridors and Alignments**
SEQ R101		**Public Utilities – Typical Service Conduit Sections**

3 SEWERAGE

3.1 RELEVANT CODE REQUIREMENTS

This section relates to probable solutions in Part 14, Division 21 of The Noosa Plan (Water Supply and Sewerage Reticulation Code). It sets out standards and potential information requirements for the provision of a reticulated sewerage system.

In applying the following standards, applicants should also have regard to requirements set out in Part, 14 Division 20 of The Noosa Plan (Water Sensitive Design Code).

All on-site sewerage systems require relevant approval from Council. All applications are to comply with the Plumbing and Drainage Act (2002), Standard Plumbing and Drainage Regulation (2003), Australian New Zealand Standard-on-site domestic-wastewater management (AS/NZS 1547:2000), and Queensland Plumbing and Wastewater Code (Department of Infrastructure and Planning).

3.2 STANDARDS

The key standards applied to water supply and sewer reticulation is the Water Services Association of Australia (WSAA) National Codes. This

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policy shall be read in conjunction with, and take precedence over, the WSAA Sewerage Code of Australia – WSA 02-2002 to define the technical requirements of Council and the 'Water Agency' in relation to the planning, design and construction of reticulated sewerage systems.

3.3 PLANNING AND DESIGN

3.3.1 Pt 1 – 1.4.2 Objectives of the Sewerage System

Add to WSAA requirement:
Sewerage system provisions to include:

- Extension of sewers to upstream property boundaries of development sites.
- Sewage pumping stations will not be approved where a reticulated gravity system could be provided.

3.3.2 Pt 1 – 2.3 Planning Parameters

Replace WSAA loading rates with:
Average daily loading shall be in accordance with Council's Level of Service Impact Assessment Specification.

3.3.3 Pt 1 – 3.2.2 Traditional design Flow

Estimation Method.

Replace WSAA requirement with:
Design flows shall be in accordance with Council's Level of Service Impact Assessment Specification.

3.3.4 Pt 1 – 4 Detail Design

Add to WSAA requirement:
The minimum pipe size for sewer reticulation shall be 150mm diameter.

3.3.5 Pt 1 – 4.2.3 Sewer Layout

Add to the WSAA requirement:
Where practicable all sewers are to be located as shown in the following table:

Table - Preferred Sewer Alignments

Location	Alignment
Roadway	**On application**
Footpath	**On application**
Private Properties (side boundaries)	**1.0 metre**
Private Properties (rear and front boundaries)	**1.5 metres**

- Sewers in lots with zero lot boundaries shall be located at the front of Lots where possible;
- Sewers in industrial precincts are to be located at the front of lots where possible. Sewers in commercial precincts should be located within the road reserve, where possible;
- Sewers are to be constructed to serve the entire area of each lot within the development site and are to be extended to the boundaries of the site to serve existing lots and potential development sites upstream at the developer's full cost;
- Wherever possible, sewerage manholes shall be located on the high side of allotments;
- In flat areas, sewers are to be designed to serve properties on both sides of the sewer;
- Where sewers are located in road reserves, they shall be located on the opposite side to watermains, electricity and communications cables;
- Sewers shall be constructed to serve the entire area of the allotment using a fall of 1:60 for the internal allotment drains allowing 300mm cover to top of pipe at head of drain;
- Sewers shall be designed to follow the natural grade of the land.

3.3.6 Pt 1 – 4.2.5 Easements

Add to WSAA requirement:
All sewers located within private property shall be contained within a minimum 3.0 metre wide easement. Sewers in excess of 3.0 metres deep shall be contained within a minimum 4.0 metre wide easement. Unless otherwise agreed with the Water Agency, sewers shall be located centrally in the easement.

3.3.7 Pt 1 – 4.3.4 Public and Private Property

Add to WSAA requirement:
Maintenance structures on private property shall generally be 1.0 metre from side boundaries and 1.5 meters from front and rear boundaries and shall be a minimum of 0.5 metres clear of the property boundary.

Landscape planting within 1.5 metres of Council sewerage infrastructure or within a sewer easement shall be low growing when mature and be suitable approved varieties.

3.3.8 Pt 1 – 4.3.5 Changes in Direction Using a Maintenance Hole

Replace WSAA requirement with:
The maximum change in direction at a maintenance hole shall be 90 degrees unless otherwise approved by the Water Agency.

3.3.9 Pt 1 – 4.3.7 Horizontal Curves in Sewers

Replace WSAA requirement with:
Horizontal curves in sewers are not permitted.

3.3.10 Pt 1 – 4.3.8 End of Lines (NEW)

Replace WSAA requirement with:
Sewers are to be designed to terminate at a MH or TMH, except for branch lines less than 15 metres in length that serve no more than one lot.

3.3.11 Pt 1 – 4.4.4 Clearance from Structures

Replace WSAA requirement with:
Buildings shall provide at least 1.5 metres horizontal clearance from the outermost projection of the structure to the nearest edge of any existing or proposed infrastructure.

Other structures deemed satisfactory to be constructed over or adjacent to Council's sewerage infrastructure shall be designed and installed to protect the infrastructure from physical damage and to allow Council access when necessary.

Proposals to construct within 1.5 metres of infrastructure – 150mm diameter or less:

The Water Agency's consent is required to construct within 1.5 metres of water supply or sewerage infrastructure and will only be considered where it is demonstrated that clauses 1 or 2 below cannot be achieved:

1. The building or other structure is redesigned, or relocated to provide a minimum 1.5 metres horizontal clearance from the existing infrastructure to the outermost projection of the proposed structure.

Or;

2. Existing infrastructure is relocated, with the approval of the Water Agency, to provide a minimum 1.5 metres horizontal clearance from the outermost projection of the proposed building or other structure.

Where it is demonstrated that clauses 1 and 2 cannot be achieved, the Water Agency may consider giving consent to construct within 1.5 metres of the infrastructure subject to any or all of the following requirements:

- Submission of a structural footing design prepared and certified by a registered professional engineer, demonstrating that the building or other structure does not impose any load on the infrastructure;
- Any footings of the building or structure which are within the zone of influence of the infrastructure are to extend below Line B (refer Figure 1) either with piers or a continuous footing located a minimum horizontal distance of 1.0 metre clear of the pipe;
- Replacement of the existing pipe work with DICL or an approved PVC-U pipe material to ensure a future life in excess of 50 years;
- Design of the building or structure to permit its easy removal for access to the Water Agency's infrastructure if required;
- A pre and post construction video inspection of the affected sewerage infrastructure;
- Lodgement of a security bond, as determined by Council under bonding requirements, to cover potential damage to the infrastructure as a result of the proposed building works;
- Construction of a maintenance hole immediately upstream and/or downstream of the structure;
- Completion of a Deed of Indemnity, by the property owner/s, legally indemnifying Council against any future structural failure, repair or reinstatement works;
- Payment of the prescribed application fee.

Proposals to construct within 1.5 metres of infrastructure larger than 150mm diameter.

For infrastructure larger than 150mm diameter, building within 1.5 metres of infrastructure is not permitted. The infrastructure is to be relocated or the building designed to provide a minimum 1.5 metres horizontal clearance from the outermost projection of the structure to the nearest edge of the pipe.

Proposals to construct 1.5 metres or greater from infrastructure.

The foundations of any structure, located 1.5 metres or a greater horizontal distance from water supply or sewerage infrastructure, but within Zone B (refer Figure 1) are to extend below Line B either with piers or a continuous footing.

There are no requirements for structures outside the zone of influence.

The following structures do not require consent from the Water Agency, however the design considerations of this code still apply:

- Any structure located 1.5 metres, or greater horizontal distance from water supply or sewerage infrastructure;
- Any demountable fence;
- Masonry fences up to 1.8 metres high, located on boundaries and constructed parallel to the sewer with a minimum horizontal distance; from the fence foundation of 1.0 metre clear of the pipe;
- Retaining walls less than 1.0m high;
- A single demountable lightweight garden shed with wall lengths of less than 3.0 metres, lightweight roof and concrete floor no greater than 100mm thick. The shed shall be easily removable from the concrete pad.

Other Considerations:

Where masonry fences greater than 1.0 metre high cross a sewer the fence shall be self supporting for a minimum of 1.0 metre either side of the sewer main.

No excavation or filling shall be undertaken over or adjacent to water supply or sewerage infrastructure without the consent of the Water Agency. Where consent is obtained, any affected maintenance holes or fittings shall be adjusted as required.

Council generally does not support the construction of buildings over sewers.

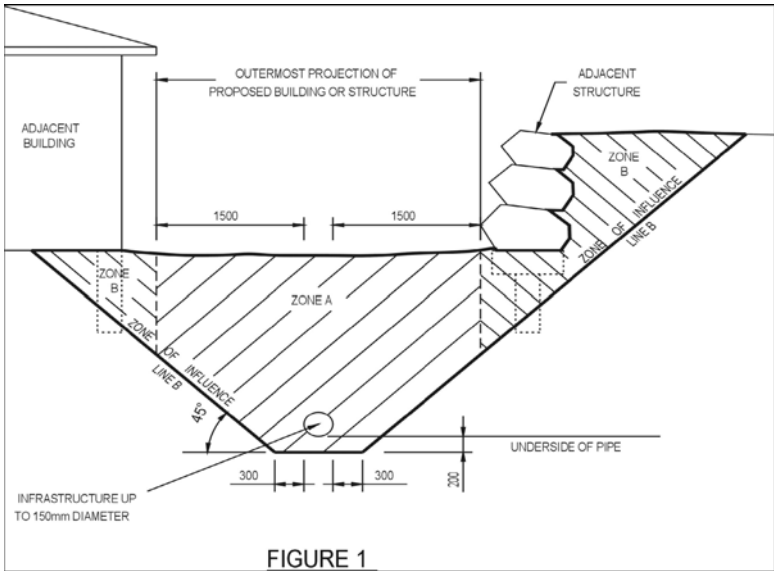


FIGURE 1

Ground surface levels shall not be altered in a way causing ponding of water over any maintenance hole.

A sewer connection point shall have:

- A clear area of at least 2.0m x 2.0m maintained around the sewer connection;
- A minimum horizontal clearance of 1.0m from any building;
- A minimum unobstructed vertical clearance of 2.4m.

Unrestricted access shall be maintained to water supply and sewerage infrastructure at all times.

3.3.12 Pt 1 – 4.4.5 Underground Structures and Services

Add to WSAA requirement:
Sewerage mains crossing stormwater culverts or pipes in excess of 225mm diameter are to be laid or replaced with PVC-U class 12 pipe for the full extent of the crossing plus 1.5 metres either side.
Spigot ends of the class 12 pipe are to be chamfered to provide a smooth transition of flows.

A minimum horizontal clearance of 1.0 metre shall be maintained between stormwater pipes greater than 225mm diameter and any sewerage and water supply reticulation.

Stormwater infiltration and filtration devices, and soakage trenches shall be located to provide a minimum 1.5 metres horizontal clearance to any sewerage infrastructure.

3.3.13 Pt 1 – 4.5.3 Minimum Air Space for Ventilation

Replace WSAA requirement with:

Minimum air space in sewer mains shall be in accordance with Council's Level of Service Impact Assessment Specification.

3.3.14 Pt 1 – 4.5.7 Minimum Grades for Self Cleansing

Replace WSAA table 4.6 with:
Minimum grades for reticulation sewers shall be as shown in the following table:

Diameter Minimum Grade

Diameter	Minimum Grade
150mm (up to 2 lots)	1 in 80
150mm (3 – 5 lots)	1 in 100
150mm general (6 or more lots)	1 in 150
225mm	See WSA02 Table 4.6
300mm	See WSA02 Table 4.6

Sewers shall not be upsized to take advantage of flatter grades.

3.3.15 Pt 1 – 4.5.8 Minimum Grades for Slime Control

Add to WSAA requirement:
Unless otherwise agreed with the Water Agency, the minimum grade of sewerage mains of 300mm diameter and greater shall ensure that a slime stripping velocity is achieved.

3.3.16 Pt 1 – 4.6.1 Vertical Alignment of Sewers - General

Add to WSAA requirement:
Sewers shall not be in excess of 5.0 metres deep.
Junctions in excess of 3.0 metres in depth shall be "Sugden" type.

3.3.17 Pt 1 – 4.6.2 Long Section Design Plan

Replace first paragraph of WSAA requirement with:
Vertical alignments of sewers shall be shown on the longitudinal section of the design drawings.

3.3.18 Pt 1 – 4.6.3 Minimum Cover Over Sewers

Add to WSAA requirement:

Additional sewer depth may be required in lots and footpaths where future access driveways could be constructed. In exceptional circumstances, a minimum 0.6 metres pipe cover may be approved in road reserves subject to construction in DICL or PVC-U Class 18 pipe from maintenance hole to maintenance hole.

3.3.19 Pt 1 – 4.6.4 Lot Servicing Requirements

Add to WSAA requirement:
Where development is proposed on allotments currently serviced by combined house drainage systems, the applicant will be responsible to upgrade the system to current sewerage standards. This responsibility may extend to any affected adjacent properties.

The use of private sewage pump stations is not acceptable for any proposed development within Council's sewerage headworks planning areas.

3.3.20 Pt 1 – 4.6.5.4 –Depth of Connection Point

Replace part (b) and (d) of WSAA requirement with:
Sewer connections shall not be in excess of 1.5 metres deep. Replace WSAA Standard Drawing SEW– 1109 with Council Standard Drawings SCW 125 and SCW 130.

3.3.21 Pt 1 – 4.6.7 Vertical Curves

Replace WSAA requirement with:
Vertical curves are not permitted.

3.3.22 Pt 1 – 4.6.8 Compound Curves

Replace WSAA requirement with:
Compound curves are not permitted.

3.3.23 PT 1 – 5.2 Limitations of Connection to Sewers

WSAA Standard Drawings SEW – 1409 to SEW – 1411 inclusive are not adopted by Council.

3.3.24 Pt 1 – 5.3.1 Methods of Property Connection – General

Replace WSAA requirement with:
House drainage connections shall comply with Council standard drawings and approved WSAA Standard Drawing.

Replace WSAA Standard Drawing SEW– 1107 with:
Council Standard Drawings SCW 125 and SCW 130.

3.3.25 Pt 1 – 5.6 Location of Connection Points

Add to WSAA requirement:
Connection points shall be located clear of driveways and a minimum of 1.0 metre inside the property boundary and otherwise in compliance with WSA02 Section 5.6.

For battleaxe allotments, where the sewer house connection lies within the access strip, sanitary house drainage is to be extended from the provided Inspection.Opening, along the access strip, at a minimum grade of 1 in 60, to a point 1.0 metre inside the main body of the lot, prior to construction of the driveway.

3.3.26 Pt 1 – 5.7 Y – Property Connections

Replace WSAA with:
Property connections to be in accordance with Council's Standard Drawing SCW 125.

3.3.27 Pt 1 – 5.8 Length of Property Connection Sewers

Replace WSAA requirement with:
The maximum length of a house connection, measured from the reticulation sewer to the boundary of the property to be served, shall be 5.0 metres.

3.3.28 Pt 1 – 6.1 Types of Maintenance Structures

WSAA Standard Drawings SEW – 1307 and SEW – 1315 are not adopted by Council.

3.3.29 Pt 1 – 6.3.2

Replace WSAA requirement with:
For reticulation sewers, the maximum distance between any two consecutive maintenance structures shall be 90 metres, subject to the provisions of Clause 6.3.1. Plastic maintenance structures shall not be used at junctions of mains.

3.3.30 Pt 1 – 6.5 Special Considerations for Connection of New Sewers to Existing Sewers

WSAA standard Drawing SEW – 1502 are not adopted by Council.

Where pressure sewers discharge to a gravity system, the receiving structure shall be a plastic maintenance hole or approved alternative. Connection to the Council sewer system shall be by gravity only to a

maintenance hole with an approved H2S gas inhibiting product. The two maintenance holes immediately downstream and one immediately upstream shall also be treated with an approved H2S gas inhibiting product.

3.3.31 Pt 1 – 6.6.2 Types of MH Construction

WSAA Standard Drawing SEW – 1307 are not adopted by Council.

3.3.32 Pt 1 – 6.6.8 Ladders, Step Irons and Landings

Replace WSAA requirement with:
Fixed internal access arrangements are not permitted in maintenance holes servicing sewers. Stainless steel safety bars and landings shall be provided in maintenance holes servicing sewers of 400mm diameter and greater.

3.3.33 Pt 1 – 6.6.9 MH Covers

Add to WSAA requirement:
Bolt down metal access covers (water tight type) shall be specified on MH's located:

- On all MH covers below the 1: 100 ARI flood level;
- On all MH covers on sewers of 450mm diameter or greater;
- On all MH covers within roadways;
- On all MH covers designated by the Water Agency.

3.3.34 Pt 1 – 7.2 Boundary Traps

Replace WSAA requirement with:
Boundary traps are not required.

3.3.35 Pt 1 – 7.3 Gas Check Manholes

Replace WSAA requirement with:
Gas check manholes are not required.

3.3.36 Pt 1 – 7.9.2 Design Parameters for Emergency Relief Structures (ERS).

Replace WSAA Standard Drawing SEW –1412 with Council Standard Drawing SCW 135.

3.3.37 Pt 1 – 8 Structural Design

Add to WSAA requirement:
Concrete encasement of sewerage mains is not permitted.

3.3.38 (Part 1, Section 9.2.1) General

Add to WSAA. Design Drawings are to include:
Signed checking certification from a RPEQ.

3.3.39 (Part 1, Section 9.2.3) Sewers (Plans)

Add to WSAA. Design Drawings are to include:

- Ensure that all revision amendments are clouded;
- Stage boundaries clearly defined;
- Kerb and channel location;
- Proposed sewerage easements drawn;
- Where removal of trees is contemplated these must be shown on plans;
- Size and location of other services located within 1.5 metres of sewerage infrastructure. Dimensioned clearances of services to the sewer main to be included;
- Finished surface level contours at intervals not greater than 0.5 metres;
- Existing surface spot levels at corners of proposed allotments;
- Finished surface spot levels at corners of proposed allotments;
- Sewer line and maintenance hole numbers;
- Details of allotments with zero or reduced building setback alignments.

3.3.40 (Part 1, Section 9.2.4) Structures

Add to WSAA: Design Drawings are to include:
Structures are to be referenced to GDA mapping co-ordinates.

3.3.41 (Part 1, Section 9.2.5) Longitudinal Sections

Add to WSAA:

- Revision amendments are to be shown clouded;
- Cut and fill notated;
- Natural surface and proposed finished surface levels;
- Bedding and sewer foundation details;
- Pipe size, class and material;
- Existing and proposed services crossing the sewer main. Size, material and levels of these services shall be included;
- Levels and references to AHD;
- Chainages and invert levels of all proposed house connections;
- Sewer line and maintenance hole numbers;
- Pipe bedding type;

- Depths to pipe invert;
- Depth and location of other services including stormwater.

3.3.42 (Part 1, Section 9.2.6) Title Block Notation and Standard Notes

Add to WSAA:

- Estate name (if known);
- Council Development Application number (if available);
- Drawing number and revision number.

3.3.43 (Part 1, Section 9.3) Drafting Standards

Add to WSAA:
Drawings are to be prepared in accordance with this Policy.

3.4 PRODUCTS AND MATERIALS

3.4.1 Pt 2 – 10.4.1 Product Standards

Add to WSAA requirement:
The following materials are approved for use in the construction of sewerage systems.

Diameter	Function	Material								
Material Description		PVC-U	VC	GRP	CONCRETE PVC lined	ABS	PP	PE	PVC-0 (Note 6)	DICL (Note 6, 8)
WSAA Purchase Specification (note 9)		PS-230	PS-231	PS-232	-	PS-238	-	PS-207	PS-210	PS-234
Applicable Notes		1, 2,3,4	1,4	1,4,5	1,4	1,4,5	1,4	1,5	1,4,6,7	1, 4,6,7
DN 100	House connection	SN6	CS 34	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DN 150	House connection	SN8	CS 34	N/A	N/A	SN 8	N/A	SN 8	PN 16	PN 35
DN 150	Sewer	SN8	CS 34	N/A	N/A	SN 8	N/A	SN 8	PN 16	PN 35
DN 225	Sewer	SN8	MCN 160	N/A	N/A	SN 8	N/A	SN 8	PN 16	PN 35
DN 300	Sewer	Min Class 12	MCN 120	SN 10	N/A	SN 8	SN 10	SN 8	PN 16	PN 35
DN 375 – DN450	Sewer	N/A	MCN 95	SN 10	N/A	SN 8	SN 10	SN 8	N/A	PN 35
DN 525	Sewer	N/A	MCN 95	SN 10	N/A	SN 8	SN 10	SN 8	N/A	PN 35
DN 600	Sewer	N/A	MCN 95	SN 10	CLASS 3	SN 8	SN 10	SN 8	N/A	PN 35

Notes:

Planning Scheme Policy
commenced 3 February 2006

NOOSA PLANNING SCHEME POLICY
ENGINEERING DESIGN STANDARDS
WATER & SEWERAGE

1. **Pipe classes specified are minima only. The designer shall confirm pipe class suitability by structural analysis.**
2. **Class SN 8 is acceptable for sewers up to maximum 3.0m depth. Sewers in excess of 3.0m deep to be constructed from PVC-U class12 series 1 pipework.**
3. **Pipe to be solid wall type, maximum 3.0m lengths.**
4. **Rubber ring seal only.**
5. **Suitable for specific uses only, as approved by the Water Agency.**
6. **Allowable in sewerage pressure pipeline systems.**
7. **Sewerage pressure pipeline fittings shall be fusion bonded polymer encapsulated ductile iron cement lined.**
8. **DICL pipes shall be protected against chemical attack by an approved method such as Calcium aluminate cement mortar lining**
9. **WSSA Product Purchase Specifications are available to down load at www.wsaa.asn.au**

3.5 CONSTRUCTION

3.5.1 Pt 3 – 12.2 Personnel Qualifications

Add to WSAA:
Pipe layers shall be accredited by the pipe manufacturer.

3.5.2 Pt 3 – 13.5.4.2 Traffic Management

Replace WSAA requirement with:
A traffic management plan shall be prepared for all projects.

3.5.3 Pt 3 – 17.1.4 Laying

WSAA reference to SEW – 1103 is not adopted by Council.

3.5.4 Pt 3 – 17.7 Property Connection Sewers

Replace WSAA Standard Drawing SEW 1109 with Council Standard Drawings SCW 125 and SCW 130.

3.5.5 Pt 3 – 17.8 – Dead Ends

Replace WSAA Standard Drawing SEW – 1109 with Council Standard Drawings SCW 125 and SCW 130.

3.5.6 Pt 3 – 17.9 – Marking of Property Connection Sewers and Dead Ends

Replace WSAA Standard Drawings with Council Standard Drawings SCW 125 and SCW 130.

3.5.7 Pt 3 –17.12 – Bored Pipes Under Roads, Driveways and Elsewhere

3.5.8 Pt 3 -18.1 – Maintenance Holes (MHs) - General

WSAA Standard Drawing SEW -1307 are not adopted by Council.
WSAA Standard Drawing SEW – 1400 are not adopted by Council.

3.5.9 Pt 3 - 19.1 – Maintenance Shafts (MS and TMS) and Inspection Openings (IO) – General

Replace WSAA referenced standard drawings with Council Standard Drawings SCW 160, SCW 125, SCW 130, SEW - 1314, SEW - 1316 and SEW – 1317.

3.5.10 Pt 3 - 19.2 – Sealing Caps

Replace WSAA Standard Drawing SEW – 1106 with Council Standard Drawing SCW 125 and SCW 130.

3.5.11 Pt 3 – 19.3 - Covers

Replace WSAA Standard Drawings SEW – 1106 and SEW – 1109 with Council Standard Drawings SCW 125 and SCW 130.

3.5.12 Pt 3 – 20.6 – Concrete Embedment and Encasement

WSAA to the Standard Drawing SEW – 1400 is not adopted by Council.

3.5.13 Pt 3 – 22.4 – Air Pressure and Vacuum Testing of Sewers

Add to WSAA requirement:
Vacuum testing shall be undertaken on all sewers and maintenance holes.

3.5.14 Pt 3 – 22.6 – Deflection (Ovality) Testing of Flexible Sewers

Add to WSAA requirement:
Deflection testing shall be undertaken on all flexible sewers.

3.5.15 Pt 3 – 22.6.3 – Flexible Sewers

Replace with 22.6.4

3.5.16 Pt 3 – 22.7 – CCTV Inspection

Add to WSAA requirement:
CCTV inspection shall be undertaken on all sewers prior to ‘on’ and ‘off’ maintenance inspections.

3.5.17 Pt 3 – 24 – Connection to Existing Sewers

Replace WSAA requirement with: All works that may involve connection to or modification of the existing sewerage system are known as ‘live sewer works’.

Typical works include:
- new connections to existing maintenance holes and sewers;
- connection of a new maintenance hole over an existing sewer or dead end;
- extension or re-laying existing sewers;
- replacement of sewers;
- raising or lowering of existing maintenance holes;
- other works on existing sewers and maintenance holes.

‘Live sewer works’ shall be clearly identified on the drawings. All ‘live sewer works’ shall be undertaken by the Water Agency at the applicant’s expense. Sewer mains are considered to be live once accepted ‘on maintenance’ by the Water Agency.

3.5.18 Pt 3 – 27 – Excavation or Filling over Existing Sewers

Where Water Agency approval is granted to alter the existing ground surface level over an existing sewer:

- House connections on the sewer are to be altered to the minimum depth capable of draining the entire property;
- Maintenance holes affected by the works are to be altered as required.

3.6 SPECIFICATIONS

All relevant details are applied under Water Services Association of Australia (WSAA) National Code.

3.7 SEWERS IN LAND TO BE FILLED

Where the site requires excavation or fill operations to enable the site to properly drain or keep the site above flood levels, the work must be completed prior to the construction of roads and other services

Where sewers are laid on land that is to be filled, the fill is to be placed and compacted prior to the sewers being laid. Compaction test results from a recognised Geotechnical Engineer shall be submitted for approval prior to commencement of sewer works.

The Consultant shall incorporate suitable foundation requirements in his designs so that structures or pipelines will not be affected by long term settlement in filled ground or differential settlement in varying ground conditions.

The following specific investigation shall be undertaken to determine suitable foundation requirements in areas of landfill, marine clays, acid sulphate soils, low lying areas, or any areas near natural swamp, creeks, lakes, or river. This includes, but is not limited to, developments such as Noosa Waters, Noosa Springs, Noosa Banks, and future development west and south of Lake Doonella.

A preliminary geotechnical survey of the site shall be undertaken, including sufficient borehole logs to establish potential areas where ground conditions may compromise or threaten long term integrity of pipelines or structures. Where survey reveals potential problem areas in locations where sewerage mains are intended to be constructed, a further detailed investigation shall be undertaken along the proposed route of the sewer.

Borelogs identifying underlying strata shall be produced at 45m maximum intervals and these reports submitted to Council with the recommended foundation and bedding details for the pipeline and structures

Pumping stations shall be installed in accordance with Noosa Standard Drawings Nos. 9823B, 9824B, 9825, 9826K, 9827, 9828B, 9829B, 9830, 9831L, 9832H, 9833H, 9834D, 9835E, 9836B, 9837C, 9838B, 9839D, 9840E and 9841E.

Manhole Identification
All new sewer manholes and end points shall be numbered to allow for integration into Council's Asset Management System and to allow for easy identification of sewerage pump station catchments.

All manholes and end points are to be designated a pump station catchment number and a unique line number within each catchment. For developments within an existing catchment, Council's Water & Sewerage Assets Manager should be contacted to obtain the range of unused line numbers available for the new development.

Manholes and end points shall be labelled in the following manner:

Pump Stat	Line No.Number	Manhole/Endpoint
NH37	4	1

Thus the manhole would be identified as NH37/4/1.

3.8 STANDARD DRAWINGS

3.8.1 Standard Drawings

WSAA Drawing numbers		Remarks The Sewerage Code of Australia WSA Standard Drawings detail various infrastructure options and arrangements. A number of these options are not compatible with current Council practice. The acceptance, modification or deletion of the WSA drawings is set out below.
SEW-1100	Not Adopted	Drawing under development
SEW-1101	Adopted	
SEW-1102	Not Adopted	
SEW-1103	Not Adopted	
SEW-1104	Not Adopted	Use SCW 125
SEW-1105	Not Adopted	Use SCW 160 - Drawing under development
SEW-1106	Not Adopted	Use SCW 125, SCW 130
SEW-1107	Not Adopted	Use SCW 125, SCW 130
SEW-1108	Not Adopted	Use SCW 125
SEW-1109	Not Adopted	Use SCW 125 and SCW 130
SEW-1200	Adopted	
SEW-1201	Adopted	
SEW-1202	Adopted	
SEW-1203	Adopted	
SEW-1204	Adopted	

SEW-1205	**Adopted**	
SEW-1206	**Adopted**	
SEW-1207	**Adopted**	
SEW-1208	**Adopted**	
SEW-1300	**Adopted**	
SEW-1301	**Adopted**	
SEW-1302	**Adopted**	
SEW-1303	**Adopted**	
SEW-1304	**Adopted**	
SEW-1305	**Adopted**	
SEW-1306	**Adopted**	
SEW-1307	**Not Adopted**	
SEW-1308	**Adopted**	
SEW-1309	**Adopted**	
SEW-1310	**Adopted**	
SEW-1311	**Adopted**	
SEW-1312	**Adopted**	
SEW-1313	**Adopted**	
SEW-1314	**Adopted**	
SEW-1315	**Not Adopted**	
SEW-1316	**Adopted**	
SEW-1317	**Adopted**	
SEW-1400	**Not Adopted**	
SEW-1401	**Adopted**	
SEW-1402	**Adopted**	
SEW-1403	**Adopted**	
SEW-1404	**Adopted**	
SEW-1405	**Adopted**	
SEW-1406	**Adopted with Modificatio**	**Excluding Option 2**
SEW-1407	**Adopted**	
SEW-1408	**Adopted**	
SEW-1409	**Not Adopted**	
SEW-1410	**Not Adopted**	
SEW-1411	**Not Adopted**	
SEW-1412	**Not Adopted**	**Use SCW 135**
SEW-1500	**Adopted**	
SEW-150	**Adopted**	
SEW-1502	**Not Adopted**	

3.8.2 MAXIMUM POSSIBLE FLOWS (IN EQUIVALENT TENEMENTS)

GRADE	150DIA	225DIA	300DIA	375DIA	450DIA	525DIA	600DIA
1000							3852
950							3965
900						2727	4089
850						2817	4224
800						2916	4372
750						3025	4535
730					1922		
700					1969	3146	4716
650					2054	3281	4918
600					2150	3434	5147
570				1271			
550				1297	2259	3608	5407
500				1369	2385	3808	5707

450				1454	2532	4043	6059
420			766				
400			787	1555	2708	4323	6477
350			850	1678	2921	4663	6986
300			928	1832	3189	5089	7623
290		458					
250		493	1030	2033	3537	5643	
200		551	1170	2308	4015	6404	
150	215	636	1379	2719			
125	236	697	1530	3016			
100	264	779	1738	3424			
75	305	900	2047	4032			
50	373	1102	2579	5075			

3.8.3 MINIMUM ALLOWABLE FLOWS (IN EQUIVALENT TENEMENTS)

PIPE DIA (mm)	MINIMUM GRADE	MINIMUM DEPTH OF FLOW (mm)	MINIMUM No OF TENEMENTS	MINIMUM PUMPED FLOW – L/S
150	1 in 150	25	4	2
225	1 in 290	40	170	5
300	1 in 420	50	270	8
375	1 in 570	70	530	15
450	1 in 730	80	690	19
525	1 in 900	95	970	27
600	1 in 1000	110	1360	36

3.8.4 MAXIMUM POSSIBLE FLOWS (IN LITRES PER SECOND)

GRADE	150DIA	225DIA	300DIA	375DIA	450DIA	525DIA	600DIA
1000							176
950							181
900						130	186
850						134	191
800						138	197
750						142	203
730					96		
700					98	147	210
650					101	153	218
600					105	159	227
570				66			
550				68	110	166	237
500				71	116	174	249
450				75	122	184	262
420			43				
400			44	79	129	195	278
350			47	85	138	208	298
300			51	92	149	225	321
290		24					
250		26	55	100	163	247	
200		29	62	112	183	276	
150	11	33	71	130			
125	12	36	78	142			
100	14	41	87	159			
75	16	47	101	183			
50	19	57	124	224			

4 SUBMERSIBLE SEWAGE PUMPING STATIONS

4.1 RELEVANT COUNCIL STANDARD DRAWINGS

9823B	Submersible Sewage Pump Station - General Arrangement
9824B	Submersible Sewage Pump Station - Fabricated Metalwork
9825	Reinforcement, pressure gauge arrangement and air release pipework
9826K	Telemetry and backflow prevention device cubicle and pump well sprinkler system
9827	Disconnection box and base
9828B	Construction and fabrication of 7.2 metre ventpole
9829B	Construction and fabrication of 12.0 metre ventpole
9830	Aluminium ladders
9831L	Pump Station Telemetry RTU Interface
9832H	Radio telemetry cubicle arrangement
9833H	Schematic circuitry for telemetry hardware
9834D	Pump Station Cubicle Layout 0 - 6 kW
9835E	Pump Station Cubicle layout 7.5 - 22 kW
9836B	Standard Power Schematic 0-6 kW D.O.L
9837C	Standard Control Schematic 0-6 kW D.O.L.
9838B	Telemetry Connections & Equip. List 0-6 kW D.O.L
9839D	Standard Power Schematic 7.5 and above Soft Starter
9840E	Standard Control Schematic 7.5 and above Soft Starter
9841E	Telemetry Connections & Equip. List 7.5kW and above Soft Starter
9842b	Marker Posts and Valve Installation for Pressure Mains and Vacuum Systems - General arrangements

4.2 MINIMUM REQUIREMENTS

4.2.1 The Consulting Engineers shall prepare detailed drawings and specifications for the pumping station. The documentation shall reflect the requirements of these guidelines and of those set out in Volume 1 of the Water Resources Commission's "Guidelines for Planning and Design of Sewerage Schemes". The documentation shall make provision for the following: -

i A reinforced concrete pumping station structure with attached valve pit (refer Section 4.3);

ii. Dual submersible sewage pump units of adequate capacity to handle the proposed loading (refer Section 4.4);

iii. A pressure main discharging to a suitable location in Council's existing system or to a new gravity main (refer Section 4.5);

iv. Electrical switchgear for the automatic operation of the pumping station including telemetry interfacing wiring (refer Section 4.6);

v. Radio Telemetry Unit (RTU), and store and forward repeater if required (refer Section 4.7);

vi. Ventilation, odour control, automatic cleaning and backflow prevention for the pumping station (refer Section 4.8);

vii. A means of odour control for the pressure main, if required by the Manager Sewerage (refer Section 4.8);

viii. The pumping station shall incorporate emergency storage to the satisfaction of the Manager Sewerage (refer Section 4.3.10);
ix. Vehicular access (refer Section 4.10);
x. PSM on top of pump well (refer Section 4.3.5)
xi. Asset manual for the pumping station and all other equipment (refer Appendix 4C (refer Clause 4.16);

4.2.2 The asset manual shall be prepared and submitted in draft format with initial engineering design and drawing submission.

4.3 PUMPING STATIONS

4.3.1 Location

4.3.1.1 Pumping stations shall be located as far as possible from existing or proposed dwellings but in no case closer than 30m from the nearest residential, commercial or industrial land use property boundary. A distance of 100m would be desirable.

4.3.2 Numbering

4.3.2.1 The Consulting Engineer shall contact Council to have the proposed pumping station designated by a former Noosa Council's sewage pumping station number (eg T5, SB29, NV30). This number shall be used on all documentation and drawings including those prepared by the mechanical and electrical contractor.

4.3.2.2 An R-W-R plastic sign with this number shall be fixed to the switchboard door with four number Grade 316 stainless steel round head metal threads. The letters shall be 100mm high.

4.3.3 General Arrangement

4.3.3.1 Pump stations shall be minimum 2.0m diameter unless loading is less than 30 ET whereby consideration may be given by Sewerage Manager for a Council approved 1.5m dia precast pipe well station to be utilised. Approved design details for these stations are available upon request.

4.3.3.2 For pumping stations with a well diameter of 2.0m the general arrangement of the pump well, reinforcement, fabricated metalwork, general details and vent poles shall be in accordance with Council's standard drawings.

4.3.3.3 Digitised copies of these drawings are available in AutoCAD files from Council. The drawings shall be edited to reflect the detail design levels, inlet pipe and pump configuration and access hatch configuration and hinge location for the particular pumping station and shall be submitted with the pumping station number in the title block.

4.3.3.4 Where the duty (or lead) pump unit's duty point at 3.5 x ADWF is in excess of 30 L/s or where the loading exceeds 800 Equivalent Tenements (ET), a single pump well with a minimum diameter of 3.2m shall be provided. The pump well shall be divided by an internal diaphragm wall, which effectively isolates the two wells and allows pump isolation.

4.3.3.5 Consultants will be required to prepare a design brief for discussion with Council for stations of this type. The specifications in the design brief are to be accepted by the Manager Sewerage prior to commencement of design.

4.3.4 Pumpwells

4.3.4.1 The pumping wells shall be constructed from Class S40 concrete and in accordance with the drawings. The Consulting Engineer's specification for the concrete shall contain the requirements listed in Appendix 4A (Clause 4.12). In particular the contractor will be required to submit to Council test certificates from a NATA registered laboratory certifying that the seven (7) day target compressive strength has been attained. The thickness of the plug (caisson) or the floor shall be increased to ensure that the pumping station shall be free from the risk of flotation with a factor of safety of 1.25 ignoring external skin friction on the pump well cylinder.

4.3.4.2 The roof of the pumping station shall be finished at least 150mm above the finished ground level and the surrounding ground shall be shaped to fall away from the pumping station. Unless flood levels or access arrangements impose restriction, the roof of the pumping station shall be finished no greater than 250mm above surrounding finished ground level.

4.3.5 Permanent Survey Marks

4.3.5.1 A standard permanent survey mark is to be installed in the roof of the pumping station in a position not more than 600mm from either pump access hatch opening on the unhinged side. The survey mark is to be registered with the Dept of Natural Resources and details of the permanent survey mark are to be forwarded to Council. The survey mark is to be a brass plug or stainless steel mushroom spike either cast insitu or set in epoxy mortar, flush with the roofslab and surrounded with a painted red triangle of nom 100mm sides.

4.3.6 Concrete Coating

4.3.6.1 Various surfaces of the pump well shall be coated with Peerless "Epigen 1311", Wattyl "Sigmaguard CSF75" or Resene “Altrashield 2000”. The extent of

the coating shall be the benching, pump well walls, valve pit walls and pump well and valve pit roof soffit.

4.3.6.2 All air holes shall be filled and other defects rectified by bagging with a sand and cement mortar and grinding as appropriate to ensure a smooth surface for coating. The epoxy resin coating shall not be applied until at least 28 days have elapsed from the time of placing the concrete. The receiving surfaces shall then be well cleaned of all loose material by lightly sandblasting or acid etching and coated in strict compliance with the manufacturer's recommendations.

4.3.6.3 The resultant coating shall be white in colour and shall have a smooth surface free from any pinholing irregularities or undulations. A sample of the finished coating on a piece of fibre cement sheet, or similar, shall be supplied to the Council's Officers together with details of the method of application for approval prior to any surfaces being coated. Two coats shall be applied. The epoxy resin coating shall be applied by specialist contractors approved by the supplier. The coating shall show no noticeable deterioration at the end of the maintenance period. Should deterioration be evident the coating shall be made good in accordance with the recommended procedures of the paint manufacturer.

4.3.6.4 The valve pit floor shall be coated with a 5mm thick layer of Monier Relpatch Acrylic Modified Mortar or an equivalent approved product. The material shall be mixed and applied in accordance with the manufacturer's recommendations.

4.3.7 Access

4.3.7.1 Hinged access covers shall be provided in the roof to give access to the valve pit and to the pump units. The access covers shall be fabricated from marine grade aluminium by Halco Engineering or be an equivalent design. The covers shall be finished with aluminium chequer plate and provided with aluminium or stainless steel handles. Hatches shall be fitted with aluminium or stainless steel support stays such that they may be securely locked in an open near vertical position whilst carrying out routine maintenance or inspection. The covers shall be capable of being locked with padlocks, which will be supplied by the former Noosa Council. Hinge pins and all fasteners shall be Grade 316 stainless steel. All stainless steel shall be separated from aluminium with high molecular weight (HMW) polyethylene sleeves or washers etc as appropriate. Aluminium surfaces in contact with concrete shall be painted with two heavy coats of approved alkali-resistant bituminous paint.

4.3.7.2 The access cover above the pump units shall be fabricated in two equal parts, positioned and sized to facilitate pump unit removal. The upper end of the pump unit's guide rail shall be bolted to the concrete opening immediately below the frame of the cover. Approved safety nets shall be provided beneath aluminium pump access hatches on all stations where the wetwell depth exceeds 2.4m. Current suppliers of approved safety nets are Emmetts Ropes, phone 07 3399 9305, and SafeTnett, phone 07 5592 2107.

4.3.7.3 Aluminium ladders shall be provided for access to the valve pit and to the pump well. An aluminium safety handrail shall be provided between the valve pit and pump well, with a 6mm diameter thick link, Grade 316 stainless steel safety chain across the access to the pump well ladder.

4.3.8 Fasteners

4.3.8.1 ALL bolts, nuts, screws, washers and threaded items used in the pumping station and ancillary installations shall be Grade 316 stainless steel. All valve body bolts and nuts shall be Grade 316 stainless steel. Washers shall be provided under all nuts as well as under bolt heads where rotation can occur causing damage to protective coatings. Insulating washers are to be provided for any areas where stainless steel is in contact with aluminium.

4.3.8.2 Loctite 222, Loctite 567 or Rocol shall be used on all threads and between stainless steel mating surfaces as an anti-galling lubricant.

4.3.9 Inlet Sewer

4.3.9.1 A control manhole shall be provided on the inlet sewers so that there is only one pipe entry to the pumping station. The manhole shall be located between 2m and 5m from the pumping station.

4.3.9.2 An isolating valve shall be provided on the gravity inlet sewer inside the pumping station. The valve shall be a fully Grade 316 stainless steel lugged knife gate valve including stainless steel superstructure and non-rising spindle adaptor with stainless steel metal to metal seat such as a Dezurik KGS or similar complete with a Grade 316 stainless steel non-rising extended spindle and brackets. The brackets shall be spaced at a maximum of 1.5m and shall be provided with HMW polyethylene bearings.

4.3.10 Emergency Storage

4.3.10.1 The matter of unplanned overflows of raw sewage from the pumping station, in the event of a power outage or equipment failure, shall be addressed. Queensland's "Water Resources Guidelines for Planning and Design of Sewerage Schemes", Volume 1, require that the provision of emergency storage shall be related to the anticipated response time by Council or to the duration of power outages. Council does not favour the provision of surface storage for sewage. Council's Officers will advise of the duration of the shut-down that shall be provided for each specific pumping station based on its potential for impact on the environment or the community and its operational priority in the sewerage transport system. The Consulting Engineer shall investigate the most cost effective manner to provide such storage. Notwithstanding the above, the minimum shut-down time that shall be provided will be 6 hours between **alarm level** and **overflow level** at average dry weather flow (ADWF).

4.3.11 Overflow

4.3.11.1 An overflow shall be provided from the pumping station, control manhole or other suitable position in the system as approved by Council and the Environment Protection Agency. The overflow shall not operate until the

emergency storage has filled. The overflow shall be screened to prevent the discharge of gross solids.

4.3.11.2 The overflow pipe line shall be graded to an overflow manhole where a "Hardiking" fibreglass flapvalve, mounted near to horizontal to ensure positive closure, shall be provided to prevent stormwater entering the sewerage system. The outlet from the manhole shall be connected to an approved open drain or stormwater pipe.

4.4 MECHANICAL EQUIPMENT

4.4.1 Pumps

Two submersible centrifugal sewage pump units shall be installed capable of passing 75mm diameter spheres. The pump duty and pressure main size shall be selected on the basis of the greatest flow from the following criteria based on scour velocity or ADWF:-

i. minimum scour velocity of 0.75m/s in the pressure main at maximum head (single pump) and maximum scour velocity of 1.8m/s (double pump) at minimum head ie. well full.
ii. single pump capacity of 3.5 x ADWF at maximum head; and
iii. parallel pump capacity before overflow of 5 x ADWF; and
iv. an additional 30 per cent loading on the design flowrate to be applicable on all stations where the total design head for single pump duty exceeds 20m; and
v. pump motor speed shall not exceed 1500 rpm and shall be limited to 960 rpm where possible; and
vi. the Consulting Engineer shall ascertain from Council's Officers if the proposed pump selection falls within the standard pump ranges adopted by Council. If so, the adopted pump duty shall suit a pump unit at the top of the specific standard range.

The ADWF shall be taken as 600 L/ET/D or 180 L/EP/D for the Detached Housing Zone.

4.4.2 Pump Guide Rails

4.4.2.1 Pump guide rails shall be hot-dipped galvanised after cutting to length in accordance with AS 1650. Minimum average coating thickness shall be 450gm/m^2. Water pipe or similar shall not be permitted.

4.4.3 Lifting Chains

4.4.3.1 A heavy duty Grade 316 stainless steel lifting chain shall be provided for each pump unit. Grade 316 stainless steel 'D' shackles shall be provided at 1500 mm centres and on the chain end for connection to the pump unit. The chain shall be supplied with a proof load certificate and shall be sized generally as follows:-

Minimum link diameter (mm)	Maximum pump unit weight (kg)
8	200
13	700
16	1,100

A Grade 316 stainless steel hook arrangement shall be provided to fix the chain to a point near the access cover.

4.4.4 Pipework

4.4.4.1 Valve pit pipework shall be supported by concrete plinths and vertical pipework by Grade 316 stainless steel brackets. Pipes and fittings shall be Class K12 flanged ductile iron with heavy cement lining. Ductile iron pipes and fittings shall be coated with System Reference LP1-A as detailed in AS 2312 consisting of an inorganic zinc silicate primer followed by two coats of a high build catalysed epoxy paint with a total dry film thickness of not less than 400 microns. If aftermarket coating required, colour of DICL pipework and valves shall be T45 Cootamundra to AS2700 - Colour Standards for General Purposes

4.4.4.2 An approved thrust transmitting dismantling joint shall be provided in the discharge pipework between the isolating valve and the valve pit wall (refer to standard drawings – Clause 7.14).

4.4.4.3 A 20mm air release cock shall be provided upstream of each pump unit's isolating valve.

4.4.5 Valves

4.4.5.1 Isolating and reflux valves shall be provided on the pressure main and shall be located in the valve pit. Isolating valves shall be sluice type valves.

4.4.5.2 Isolating valves shall be OBE 'Elypso' or Tubemakers Tubeline 'Series 500' Class 16 or prior approved equivalent and shall conform to AS 2638. The valves shall be resilient seated. The valves shall be flanged and coated internally and externally with Rilsan Nylon 11. The wedge shall be totally encapsulated in an approved synthetic rubber. Twist-locking insertion boxes with 100mm diameter cored holes shall be provided in the roof immediately above the pressure main isolating valves to enable use of extension spindles if necessary. Handwheels, fusion bonded epoxy (FBE) or epoxy paint coated, shall be provided on each of these valves. Extension spindles need not be supplied on discharge pipework isolating valves.

4.4.5.3 Reflux valves shall be coated internally and externally with FBE. Reflux valves shall be flanged. Those using springs to effect closure will not be accepted. HDL 5087 Ball Type reflux valves are recommended for high head applications, however velocity through the valve should approach 2m/sec for effective operation.

4.5 RISING MAINS

4.5.1 Size

4.5.1.1 Rising mains shall have a minimum diameter of 100mm except for approved, 1500 dia stations with very small macerating pump units where minimum diameter 63mm OD (Nom 50mm ID) MDPE PE80B PN10 polyethylene pipe may be approved.

4.5.1.2 The mains shall be sized such that minimum scour velocity is 0.75m/s in the pressure main at maximum head (single pump) and maximum scour velocity is 1.8m/s (double pump) at minimum head, ie. well full.

4.5.2 Design Standard

4.5.2.1 The rising main is to be capable of withstanding pressures twice the pump station maximum pump pressures. In any case, minimum pressure class will be as specified in Clause 4.5.4. Where requested by the Manager Sewerage, a water hammer analysis shall be required to be submitted prior to approval of design.

4.5.2.2 Total head shall be calculated for two cases, minimum and maximum conditions, as set out below.

	Static Head	uPVC Pressure Main Friction Head	Cement Lined Pressure Main Friction Head
Maximum head case	Pump unit stop level	C = 120	C = 100
Minimum head case	Pump well flooded to overflow	C = 160	C = 150

"C" is Hazen Williams coefficient

4.5.3 Odour Control Requirements

4.5.3.1 The design of the sewer rising main pump size is to be such that the detention time of sewage in the rising main is kept to a minimum. Where the detention times are in excess of 1.0 hour at ADWF (based on the approved number of allotments in the stage being serviced), a Council approved activated carbon odour control unit shall be installed by the

contractor/contractor at the next immediate downstream pump station site in the system and a method to reduce sulphide generation in the main shall be provided.

4.5.4 Pipe Materials

4.5.4.1 Rising mains are to be constructed using the following materials:

Pipe Dia	Material	Class
100mm	uPVC AS1477 Series 2 -1999 RRJ PVC-O AS4765 Series 2 - 2000 RRJ DICL AS2280 RRJ	12 16 K9
150mm	uPVC AS1477 Series 2 -1999 RRJ PVC-O AS4765 Series 2 - 2000 RRJ DICL AS2280 RRJ	12 16 K9
Note:	***PVC pipe to be Ductile Iron OD compatible***	
200mm and above	DICL AS2280 RRJ Sintacoted MSCL (or other as approved by Manager Sewerage)	K9

4.5.5 Discharge Manholes

4.5.5.1 Rising main discharge manholes are to be reinforced concrete fully lined with profile 7 HDPE Polyethylene liners (Hardi Iplex 'Black Brute' or equivalent). PE manholes shall be fabricated complete with 20mm thick top, 600 dia lid section, 15mm thick benching, channelling, step irons and inlets, outlet and any drop structures integrally, fusion welded. Manhole liners are to be encased in Class N32 concrete with a minimum thickness of 150mm.

4.5.5.2 Manhole inlets and channelling should be designed to cause minimal turbulence to incoming sewage.

4.5.5.3 Inlets to discharge manholes shall be at the side of the manhole; bottom entry shall not be permitted.

4.5.5.4 The discharge manhole must not be located on private property and must be a minimum of 20m from the nearest house connection branch.

4.5.6 Indicator Markers on Rising Mains

4.5.6.1 All bends and valves on the sewage pressure main external to the valve chamber shall have indicator posts clearly designated 'RM' and 'V' placed adjacent to the bend or valve in accordance with Std Dwg 9842b. The marker on the bends shall also display the offset distance and depth of the main. The marker on the valves shall display the offset distance of the valve. Lettering on the indicator posts is to be red on a white background. The top 300mm of the indication post is to be painted bright red. The valve box top surface fittings shall be bright red to differentiate between sewage valves and water supply valves.

4.5.7 Inspection and Testing of Rising Mains

4.5.7.1 CCTV inspection and pressure tests are to be undertaken on all new rising mains after installation in accordance with the methods specified in Clause 5.12 of this Manual.

4.6 ELECTRICAL AND INSTRUMENTATION EQUIPMENT

4.6.1 General

4.6.1.1 All electrical work shall be in accordance with Energex's requirements. The electrical circuitry design shall be strictly in accordance with Council's Standard Drawings 9836B, 9837C and 9838B for DOL installations (generally up to 6kW) and 9839D, 9840E and 9841E for all other installations from 7.5kW and above. Wiring is to be labelled in accordance with numbering adopted on these Standard Drawings. Circuit drawings for installations above 22kW shall be submitted to Council for approval.

4.6.1.2 The Consulting Engineer's specification for the mechanical and electrical equipment shall contain the requirements listed in Appendix 4B/2 (refer Clause 4.14) which includes the Standard Electrical Component list of electrical equipment.

4.6.2 Switchboard

4.6.2.1 Unless otherwise required by Council's Officers, the switchboard shall be plinth mounted and the incoming electrical mains shall be underground.

4.6.2.2 The Consultant shall contact Council prior to design of electrical cubicle to seek highest recorded flood levels at the proposed site. Cubicle and plinth design shall be such that all compartments housing non-waterproof componentry shall be a minimum 150mm above this flood level. Council's highest recorded flood RL shall be detailed on the submitted pump station layout drawings.

4.6.2.3 All joints in the cubicle and doors shall be continuously TIG welded and ground smooth, they shall be free from crevices. Cubicles shall be coated externally with an approved polyester based powder coating. Each equipment panel shall also be coated with the approved polyester based powder coating. The powder coating shall be applied strictly in accordance with the manufacturer's instructions.

4.6.2.4 The switchboard doors shall be fitted with a 92268 lock keyed to Council's master key system and door stays to retain the door in the 120 degree open position.

4.6.2.5 Unless specified to the contrary in the Job Specification, the cubicle colour shall be Interpon Heritage Green No. MK 044A or Dulux Deep Brunswick Green 50068 and the equipment panel colour shall be Interpon White No. MA 009A.

4.6.2.6 On stations with pump units up to 22kW only, an approved three-phase plug and socket shall be provided for the motor cable to each motor. A plug connection shall also be provided for the thermistor circuit from each motor. Drives above 22 kW shall be hard wired to the motor starter via terminals in the disconnect box. The conduit to the pump well shall be sealed with a tapered rubber plug to prevent sewer gases entering the switchboard cubicle. The tapered rubber plug shall be 50mm high with a diameter to match the electrical conduit and shall be manufactured from 30 Durometer rubber and shall be split part way across with pre-formed holes for each motor, level probe and any other cable. The sealing arrangement shall be capable of being resealed with a non-setting sealant after pump unit removal or replacement.

4.6.2.7 The compartment for the electrical switchgear shall house the supply authority's meters. The Main switch and meter panel shall be 6mm thick laminated phenolic resin.

4.6.2.8 A concrete or paved hardstand area shall be provided directly at the front of the switchboard and RPZD/RTU cubicle doors at a suitable level to allow easy and safe access and inspection by operations and maintenance staff under all weather conditions. A minimum of 1.0m x 1.0m of concrete hardstand shall be provided in front of any electrical cubicle door.

4.6.2.9 <u>Switchboard Size 0 to 6kW DOL</u>

The switchboard shall be IP53 to AS 1939 and be constructed from 3mm thick marine grade aluminium. The switchboard shall be 800mm wide x 800mm deep x approx 1700mm high and contain four separate sealed compartments, two each side of approx 400mm depth in accordance with Std Dwg 9843. The front two compartments for electrical control equipment and pump well electrical cables, and the rear two for Telemetry equipment and RPZD equipment.

4.6.2.10 Switchboard Size 6 to 22kW Soft Start

The switchboard shall be IP53 to AS 1939 and be constructed from 3mm thick marine grade aluminium. The switchboard shall be 900mm wide x 900mm deep x approx 2000mm high and contain four separate sealed compartments, two each side of approx 500mm depth for the front and 400mm depth for the rear in accordance with Std Dwg 9844c. The front two compartments for electrical control equipment and pump well electrical cables, and the rear two for Telemetry equipment in the upper and RPZD equipment in the lower.

4.6.2.11 Switchboard Size over 22kW

Switchboards larger than 22kW shall be constructed in a similar manner to the smaller switchboards however the size shall be increased to suit the larger equipment. Also additional tiers and compartments may be required for miscellaneous equipment such as chemical dosing controls etc.

4.6.3 Auxiliary Power Provision

4.6.3.1 Unless advised otherwise by the Manager Sewerage the switchboard shall have provision for a mobile generator to power one pump at the station in the event of supply authority power outage. A plug in type three phase Wilco WIBM 532R socket for 0-6kW pump units and a Wilco WIBM 550 R socket for 6-22 kW pump units is to be provided within a separate lockable compartment at the switchboard side of the cubicle. Copper busbar tags drilled to accept lug terminals shall be provided for switchboards over 22kW. A Traffolyte label attached to the inside door of the compartment shall specify in kVa the minimum size generator required to start and drive one (1) pump unit at the station. A suitable interlock system shall be provided to ensure that only one pump may operate whilst powered by the generator.

4.6.4 Electrical Equipment

4.6.4.1 Switchgear assemblies shall be Form 2 to AS 3439.1 unless otherwise specified for pump units up to 22kW and Form 3A to AS 3439.1 with type 2 short circuit coordination to IEC 947.4.1 in all cases for pumps larger than 22 kW and in other cases where Council deems necessary.

4.6.4.2 The electrical equipment mounted on the switchboard shall include the following:

- main switch, minimum 16 kA fault current rating;
- voltmeter (Ph-N) with selector switch;
- multiple earth neutral (MEN) earthing system;
- phase failure relay with 3 single phase circuit breakers;
- surge diverter and surge reduction filter;
- circuit breaker for each motor power and control circuit with auxiliary contact which shall, when CB's trip, initiate a fault condition;
- circuit breaker for each control circuit;

- motor starter for each motor;
- surge protection for externally mounted instruments;
- ammeter/current display and hours run meter for each motor;
- current transformer/transducers to indicate pump motor amps via a 4-20MA signal to SCADA (0-6kW only);
- Manual-Off-Auto rotary selector for each pump unit with inputs to SCADA for Manual and Auto positions;
- Control circuitry including thermistors and thermal overload protection;
- stop-start buttons for each motor;
- front panel mounted A-O-M switch to control solenoid valve for internal wetwell sprinkler system;
- fault light and reset push button for each motor;
- Double GPO's with earth leakage circuit breaker (ELCB) in both switchboard and RTU cabinet;
- cabinet lights for both switchboard and RTU cabinet;
- 24 V power outlet and lead light.

4.6.5 Level Control

4.6.5.1 Pump unit operation shall be controlled in 'Auto' mode by the PLC/telemetry system supplied by Serck Controls Pty Ltd based on a Koyo DL205/240 PLC. PLC units must have E.E.P.R.O.M. (Electronically Erasable Programmable Read Only Memory). The PLC shall alternate the pump duty after each run. The level signal shall be an analogue input to the PLC directly from a VEGAWELL 72 -XXAA4X1DHM pressure transducer loop powered from the telemetry 24volt supply. The VEGA pressure transducer shall be calibrated for a standard 0-10 metres. The Vega spanning unit shall be a VEGADIS 12 XBAX with integral display.

4.6.5.2 The VEGA Pressure Transducer shall be restrained in a 100mm dia uPVC stilling pipe mounted with SS316 support brackets to the internal wall as shown on standard drawings. The stilling pipe shall extend to within 200mm of floor and to 200mm below overflow level. Allowance is to be made in Wetwell benching for the pressure transducer to extend to within 100mm of the floor. The instrument cable holding bracket shall be hung from a secure stainless steel hook arrangement to facilitate easy removal.

4.6.5.3 The PLC, as well as controlling the pumps, shall initiate a high wet well level alarm on the SCADA, 600mm above normal TWL. The alarm shall deactivate once the well level falls below Standby pump cut-in level. The PLC shall also initiate an ‘Overflow Alarm’ on the SCADA at 100mm below actual overflow invert level.

4.6.5.4 A High Level float switch shall be installed to start the pumps 150mm below overflow level. The float switch shall be fixed to the well wall with sufficient cable to give a pump stop/start differential above the normal operating range. The float switch shall be hard-wired to a 24 volt AC timer powered by the 24 volt AC transformer. The timer shall have one instantaneous contact, to start Pump 1. The second contact shall have a thirty (30) second delay to start the second pump. In addition an auxiliary relay shall be provided to signal the RTO of the float switch activation. The pump start contacts shall

override the auto-off-manual switch but include the pumps thermal overloads.

4.6.5.5 The 24 volt transformer shall be short circuit proof in accordance with AS3018. There shall be no fuses or circuit breakers in the secondary side of the transformer supplying the float switch circuit. A circuit breaker shall be incorporated in the circuit supplying the Low Voltage outlet only.

4.6.5.6 The automatic pump control system shall have the following positions (descending):

- Station Overflow level
- Hard wired pump start (High Level Float)
- Well Overflow Alarm from RTU
- Hard wired pump stop (High Level Float)
- High Level Alarm
- Standby pump unit start
- Duty pump unit start
- Standby and Duty Pump unit stop.

4.6.5.7 The above levels shall be submitted to Council with draft asset register on the form in Appendix 4C (refer Clause 4.16).

4.6.6 Phase Failure Relay

4.6.6.1 The operation of the phase failure relay is to cause the de-energisation of all control circuits fed from the surge reduction filter. This will require the phase failure relay driving a suitable auxiliary relay having a contact fault rating consistent with the total load of all circuits fed from the surge reduction filter. A timer is to be incorporated with the phase failure relay to prevent the re-energisation of control circuits for an adjustable period of 1-10 seconds. The auxiliary relay and timer are to be powered from the phase failure/voltmeter circuit breakers.

4.6.6.2 A power reset circuit is to be provided that automatically resets any switchboard faults on return of the AC power.

4.6.7 Flowmetering

4.6.7.1 An ABB Kent-Taylor Magmaster electro-magnetic flowmeter shall be provided on pressure mains of pumping stations where directed by Manager Sewerage. The primary element for the flowmeter shall be the same diameter as the pressure main and shall be located in a separate flowmeter pit. The flowmeter pit may be rectangular or a minimum 1500mm dia standard manhole. The primary element and pipework shall be offset within the pit to allow suitable access for maintenance personnel and shall be equipped with an access ladder or stepirons. The pit shall be provided with a sump pump unit driven by a three (3) phase, 415 V, 50 Hz motor. The

pump unit shall be provided with all of the controls nominated for the sewage pump units.

4.6.8 Current Monitoring 0 to 6kW Drives

4.6.8.1 Current monitoring for 0 to 6 kW drives will be in the form of ammeters connected in series with the drive power supply cables. A combined current transducer/transmitter is to be used to provide the 4-20mA signal to the RTU.

4.6.9 Current Monitoring 7.5kW Drives and over

4.6.9.1 All drives of 7.5kW and larger will be either soft starter or VSD. The drive is to be configured to provide a 4-20mA output proportional to current. An escutcheon panel mounted digital LCD display unit is to be wired in series with this signal to provide a current readout in Amps. This 4-20mA signal is also to be looped through the RTU analog inputs to provide the current signal to the RTU for monitoring. Signal isolators will be required between the Soft Starter 4-20 mA output and the RTU input and LCD display unit.

4.7 TELEMETRY AND SCADA

4.7.1 General

4.7.1.1 Detailed requirements of the former Noosa Council's SCADA design are documented in Appendix 4B/3 (refer Clause 4.15). General details of these requirements follow hereunder:-

4.7.1.2 Telemetry shall be provided for each pumping station to allow its inclusion in Council's Sewerage SCADA System. The telemetry and SCADA system shall monitor or control the following:-

i) pump unit/s available
ii) pump unit/s fault
iii) pump unit/s automatic
iv) pump unit/s manual
v) pump unit/s running
vi) pump well/s levels (4-20 mA) using VEGA pressure transducer
vii) high well level
viii) pumping station overflow level
ix) pressure main flow when applicable
x) rainfall when applicable
xi) ventilation fan fault when applicable
xii) odour control unit fault when applicable
xiii) phase failure and/or power failure
xiv) pump motor current

xv) hard-wired pump hi-level float switch status.

xvi) spill management

4.7.1.3 The telemetry cubicle shall be wired as per the most recent update standard drawings 9833, 9838 or 9841.

4.7.2 Cubicle

4.7.2.1 The RTU/RPZD shall be housed in separate compartments, but integral and back to back with the main electrical control cubicle. One side of the cubicle shall have an upper compartment for the remote telemetry unit (RTU) and the lower compartment for the backflow prevention device. The upper compartment, which shall be completely sealed from the lower compartment, and shall be minimum 800mm high by 800mm wide by 400mm deep. The lower compartment shall be minimum 800mm high by 800mm wide by 400mm deep.

4.7.2.2 All 240V terminals shall be shrouded and all 240V cable shall be double insulated in the RTU compartment. This is to allow non-electrical personnel to access the cubicle. The antenna cable shall penetrate the RTU cubicle from the bottom below all electronic components enclosed in a waterproof gland fitting. The telemetry cubicle is to contain a cabinet light and double GPO.

4.7.2.3 Cubicles housing RTU's shall be provided with forced ventilation. The fan(s) shall be controlled by a thermostat mounted inside the cubicle in a location typical of the average temperature in the cubicle. Manual fan control shall also be provided.

4.7.3 Telemetry and SCADA Equipment

4.7.3.1 The RTU, PLC, power supply and ancillary telemetry equipment shall be supplied by Serck Controls Pty Ltd, phone 02 4941 1211 at the contractor's full cost.

4.7.3.2 The works involved in undertaking a radio survey for the site will be arranged by Council and carried out by Council's radio consultant. Inclusion of the pumping station in the telemetry, reconfiguration of the SCADA system's CMF & RMF, spill management, report amendment and commissioning will be undertaken by Serck Controls Pty Ltd and shall be arranged by Council.

4.7.3.3 Where the new pump station is required as a result of new land development, the Developer shall bear all costs of adding telemetry to the pump station including any costs of works arranged directly by Council as detailed above.

4.7.3.4 For works carried out under Council's Backlog Sewerage Programs, the contractor shall be liable for costs of supply, installation and precommission testing of telemetry site equipment only as well as defects liability of such equipment for twelve months.

4.7.4 Telemetry Procurement and Installation Procedure

1. The Consultant shall prepare detail designs for the pump station and submit to Council for approval.

2. Upon approval of design Council shall:-

   i. arrange radio path testing to determine most appropriate repeater and necessity for store and forward repeater;

   ii. advise Serck Controls Pty Ltd of requirement for new SCADA site and arrange development of PLC/PDS programs;

   iii. arrange Serck Conrols Pty Ltd to alter configuration on both CMF and RMF, SCADA graphics, RTU's , database;

   iv. arrange Serck Conrols Pty Ltd to Incorporate new station data into Reports;

   v. arrange Serck Conrols Pty Ltd to develop spill management for this site.

3. The approved Contractor shall place an order with Serck Controls Pty Ltd, Cardiff, NSW and purchase the following equipment:

   i. a fully programmed PLC
   ii. an RTU unit pre-programmed to suit spill management and the sites applicable repeater
   iii. a power supply unit
   iv. a battery
   v. a radio
   vi. an antenna.
   vii a store and forward repeater (if applicable)

4. The contractor's electrical contractor shall install and wire all equipment into the telemetry cubicle as per Council's Standard Drawings 9833H, 9838B or 9841E. The electrical contractor shall arrange precommission testing of the station's SCADA system following installation.

   Council's nominated radio path specialist (currently Radiocomm) shall be engaged by the contractor to undertake precommission testing of the radio signal path back to the CMF/RMF and to provide Council with a printed test sheet certifying radio signal path acceptability.

5. Council will carry out commission testing of the stations SCADA system including, reconfiguration of CMF/RMF screens, reports and spill management. Practical Completion shall not be considered until all elements of the SCADA system have been commissioned and are fully operational.

6. The Contractor's electrical contractor shall be responsible for any site faults, which occur in the station's telemetry system for the duration of the defects liability period.

4.8 VENTILATION, ODOUR CONTROL, AUTOMATIC CLEANING AND BACKFLOW PREVENTION

4.8.1 Ventilation

4.8.1.1 The pumping station shall be provided with an appropriately designed ventilation system incorporating a fresh air inlet, a vent pole of appropriate height depending on the topography and air-tight access openings. The vent pole shall be fitted with a uPVC inner pipe and a rotating vent cowl to provide a degree of forced ventilation.

4.8.1.2 The vent pole shall be coated externally with an approved polyester based powder coating system Colour Interpon Heritage Green No. MKO44A or Dulux Deep Brunswick Green 50068 or two coats of approved high build two pack epoxy paint to match these powdercoat colours.

4.8.1.3 If vent pole is required to carry overhead services the pole is to be designed to carry the load.

4.8.2 Odour Control

4.8.2.1 In regard to odour control, the following policy shall apply:-

i. ***Collector Pumping Station*** (ie Head of Systems only)

- The pumping station shall be smoke-tested at times specified by Council's Officers before it is commissioned, to determine the likely path of exhausted gases. If, in the opinion of Council's Officers, the direction of travel of the gases is likely to cause a nuisance to existing or proposed buildings, or the station is sited less than 30m from any future building, an approved activated carbon filter odour control unit shall be installed.

- Measures to limit sulphide production in the pressure main shall be required if the detention time of sewage in the pressure main at ADWF is in excess of 1.0 hr. The injection of air or magnesium hydroxide shall be necessary and this shall be discussed with and approved by Council's Officers before action is taken.

- In any pumping station where detention time is sufficiently long to require the injection of air or magnesium hydroxide into the pressure main, a suitable approved activated carbon filter odour control unit shall be installed at the next downstream pumping station, at the developer's cost.

ii. ***Minor Transport Pumping Station***
(ie. any station which receives flows from another station)

- An approved activated carbon odour control unit shall be installed unless the pumping station is located in excess of 100m from any proposed residential or commercial building whereby policy i. above for a collector pumping station shall apply.

- Measures to limit sulphide production in the pressure main shall be provided as specified by Council's Officers.

iii. ***Major Transport Pumping Station***

- Any pumping station considered by Council's Officers to be a major transport pumping station within Council's sewerage system shall require the installation of an approved activated carbon filter odour control unit regardless of setback distances from any building.

- The appropriate measures to limit sulphide production in the pressure main shall be taken as specified by Council's Officer.

4.8.2.2 Where it is determined that chemical or air injection is required for odour control Council officers shall specify all details of method to be used, equipment, installation, and operating regime.

4.8.3 Automatic Cleaning

4.8.3.1 An internal wet well sprinkler system shall be installed to provide automatic pumping station cleaning and to assist in odour suppression.

4.8.3.2 The sprinkler system shall have a Water Resources, Queensland Department of Primary Industries approved backflow prevention device such as 'Watts 909, $^{3}/_{4}$" Backflow Preventer' or prior approved equivalent, fitted between the pumping station and the town water supply. The system shall comprise a 20mm diameter 'Reduced Pressure Zone Valve" including two reflux valves, a bypass and an air breaker. A Goyan solenoid valve and NHP - Crouzet timer shall provide a variable 2 to 5 minutes sprinkling per 15 minute time period.

4.8.3.3 On 2.0m dia Wetwell stations the sprinkler head shall be a Senninger 'Super Spray' with No 26 nozzle (10.32mm orifice) and shall be fitted to the underside of the roof slab above the pump well. A No. 20 nozzle (7.94mm orifice) may be required on stations with lower water pressure. Internal pumping station pipework from the external wall of the wet well shall be 20mm diameter ABS fixed with Grade 316 stainless steel brackets and -

fasteners. The ABS sprinkler elbow shall be 20mm Faucet x 20mm ABS. Pipework external to the wet well shall be 20mm diameter copper.

4.8.3.4 On 3.2m dia Wetwell stations a customised approved sprinkler system utilizing all stainless steel components shall be installed. The consultant should discuss the proposed system with Council Sewerage Operations Manager at design stage.

4.8.4 Back Flow Prevention

4.8.4.1 The backflow prevention device shall be housed in the RPZD compartment of the electrical control cubicle referred to in Section 4.6.2. The backflow prevention device shall be located upstream of any pumping station water supply service. All discharge water from the RPZD shall be directed by 25mm copper pipe to the outside of the cubicle.

4.8.4.2 Installation of the backflow prevention device shall be by a licensed accredited plumber and prior to acceptance 'on maintenance', the device shall be inspected and tested by an accredited licensed plumber. The results of the test detailing the device type, model and serial number shall be submitted to Council for its asset register, together with a copy of the Plumber's Certificate of Endorsement to install and test such devices.

4.8.4.3 A ¾" (20mm) 'Dorf' brand hosecock including flat-sided anti-vandal handle and top assembly fixed to a post above ground shall be provided beside the pumping station. The water service shall be a minimum of 25mm Type B Copper from Council mains. The above ground pipework to the hosecock shall be 20mm diameter copper. Any copper pipe penetrating concrete shall be encapsulated within a PVC conduit.

4.9 LANDSCAPING

The pumping station shall be suitably landscaped to minimise visual impact and in this regard a landscaping plan shall be submitted and approved prior to the pumping station design being finally approved. The trees, shrubs and grass will have to be well established prior to the work being accepted 'off maintenance'. An approved drip watering system shall be provided if required by Council.

4.10 VEHICULAR ACCESS

4.10.1 A 3.5m wide access road shall be constructed to the pumping station from a roadway over a standard crossover. The road shall be either reinforced concrete driveway, interlocking pavers, BG blocks or compacted gravel and AC sealed as determined by Council to suit the specific site. Paver, BG block or AC surfaced roads shall have a minimum pavement depth of a 200mm subject to subgrade investigation.

4.10.2 A turnaround area shall be provided for service vehicles. The pumping station's layout shall be arranged for convenient access by Council's truck mounted cranes for pump unit removal. A sealed standing area min 7m x 4.5m wide shall be constructed adjacent to the pump well access covers, with the access road leading to this standing area and continuing a minimum of 6m past the centre of the pump well. The sealed access in the vicinity of the pump station shall be widened to min 4.5m to allow manoeuvring of maintenance vehicles. Access bays shall be designed to suit a 4m turning radius.

4.10.3 The position of switchboard, vent and access cover opening shall suit the standing area's position for pump unit removal. The pumping station site plan shall detail the access facilities and finished ground levels as well as location of the vent pole and switchboard, incoming sewer and pressure main. The access covers shall open away from the direction of the standing area, i.e. open covers shall not occur between the access opening and the vehicle standing area.

4.11 AS CONSTRUCTED INFORMATION

4.11.1 As - Constructed Survey and Equipment Manuals

4.11.1.1 The Contractor shall be responsible for arranging as constructed survey progressively as necessary throughout the course of construction. At the end of construction, survey information in an acceptable format shall be passed to the Engineering Consultant for preparation of formal as - constructed drawings and asset register. Survey information shall be certified as accurate by a registered surveyor or civil engineer.

4.11.1.2 Details of pipes including size, class, dia and details of equipment including supplier, model, part no's of expendables, test certificates, operation curves, operation manuals etc shall be provided by the Contractor to the Engineering Consultant for preparation of, or inclusion in the stations asset register.

4.11.1.3 Practical Completion shall not be considered on pump stations under backlog sewerage works until such time as all the above information has been provided in an acceptable format to the Engineering Consultant.

4.11.1.4 For pump stations constructed as part of new development works, As-Constructed drawings and asset registers shall be submitted to Council by the Developer's Engineering Consultant and approved prior to Practical Completion being granted for the works.

4.11.2 Drawing formats

4.11.2.1 'As-Constructed' details and a copy of all drawing files in AutoCAD format on diskette CD-Rom or e-mail shall be provided by the Engineering Consultant for the following:-

i. ***General Arrangement***

Plans and sections showing 'As-Constructed' dimensions and AHD levels of the concrete structures including the location, registered number and level of the PSM installed in the top of the station;

ii. ***Pumping Station Pipework***
Including pipe diameter and type of pipe material and class;

iii. ***Pressure Main***
Plan and long section, diameter, material, class and external corrosion protection system;

iv. ***Overflow pipeline and structures*** detailing actual overflow levels, invert levels, surface levels, chainages, pipe diameter, material, class.

v. ***Electrical Installation***
Electrical power and control schematics and cubicle drawings with dimensioned equipment layouts.

4.11.3 Pumping Station Asset Manual (*Refer also Appendix 5C- Clause 4.16*)

4.11.3.1 5.11.3.1 Details necessary for the proper maintenance of the installed equipment and the necessary data for Council's Asset Register shall be provided in a Pumping Station Asset Manual which is to be produced by the Engineering Consultant following construction. Manuals shall be A4 sized, bound and clear plastic covered. Three (3) copies of the manual shall be supplied.

4.11.3.2 The manual contents shall be as set out in Appendix 5C (Clause 4.16 and shall contain at least the following:

i. A3 print of general arrangement plans and sections showing 'As Constructed' dimensions and AHD levels of the concrete structures

ii. A3 print of the pumping station pipework

iii. A3 print of the pressure main plan and long section, diameter, class and external corrosion protection system

iv. A3 print of overflow pipeline and structures.

v. electrical power and control circuit diagrams and cubicle drawings

vi characteristic pump curves and system resistance curves

vii an average operating flow rate calculated from an on-site test of flow rate (pump well operating volume divided by time to empty) with the pumping station isolating valve closed and using town water.

viii Asset Valuations, Electromagnetic Radiation Certificate, RPZD Installation/Test Certificate, Ancillary Equipment details.

4.11.3.3 The characteristic curve for single and parallel operation shall be based on actual works testing data NOT manufacturers' commercial curves.

4.11.3.4 The system resistance curve of the 'As-Constructed' pressure main shall be based on the criteria detailed in Clauses 4.5.1 and 4.5.2.

4.11.3.5 Additionally, specific hydraulic design details including the following shall be included in the manual:

i. loading calculations
ii. design ultimate flows
iii. design ultimate ET from internal catchment and external catchments i.e. other pumping stations
iv. volume of design emergency storage in the reticulation system and pumping station above the alarm level before overflow occurs
v. minimum calculated time to overflow under ADWF conditions at the ultimate design loading after the alarm level is reached
vi. in respect to odour, pressure main detention time calculations shall be presented.
vii. A brief overall design philosophy in regard to overflows shall be provided to assist Council's staff in operation of the system. Incidents such as pump unit failure and power outages can be addressed by overflow storage, overflow to other systems, overflow to storm water drains and the use of generators. In larger, multi-stationed developments (e.g. Noosa Waters), emergency overflow prevention procedures shall be recommended. These procedures may involve action on other adjacent pumping stations and shall be prioritised and listed in the order to be undertaken to best achieve minimisation of surcharge, pollution and environmental damage. Any point of discharge to State waters, including storm water drainage systems, gullies, creeks etc is to be clearly identified in this section.

4.12 APPENDIX 4A – SPECIFICATION FOR PLAIN AND REINFORCED CONCRETE PUMP STATIONS

TABLE OF CONTENTS

SPECIFICATION FOR PLAIN AND REINFORCED CONCRETE FOR SEWERAGE PUMP STATIONS

1 PURPOSE

The purpose of this Specification is to ensure that the quality of concrete and associated items, supplied and placed in a structure will result in satisfactory durability, strength and appearance of the completed structure.

2 SCOPE

This Specification applies to plain, reinforced concrete cast in-situ structures designated below. It covers the supply and placing of concrete as well as the supply and placing of reinforcements and other items required to be cast into the concrete.

The Pumping Station shall be constructed using Class S40 concrete in accordance with AS 1379.

Structures:-
(1) Sewerage Pumping Stations

3 REFERENCES

AS 1012	-	Methods of Testing Concrete
AS 1141	-	Methods for Sampling and Testing Aggregates
AS 1302	-	Steel Reinforcing Bars for Concrete
AS 1303	-	Steel Reinforcing Wire for Concrete
AS 1304	-	Welded Wire Reinforcing Fabric for Concrete
AS 1379	-	The Specification and Manufacture of Concrete
AS 1478	-	Chemical Admixtures for Use in Concrete
AS 1650	-	Hot Dipped Galvanised Coatings on Ferrous Articles
AS 2124	-	General Conditions of Contract
AS 2758.1	-	Concrete Aggregates
AS 3582	-	Supplementary Cementitious Materials for Use with Portland Cement
AS 3582.1	-	Fly Ash
AS 3582.2	-	Slag - Ground Granulated Iron Blast Furnace
AS 3600	-	Concrete Structures
AS 3610	-	Formwork for Concrete
AS 3735	-	Concrete Structures for Retaining Liquids
AS 3972	-	Portland and Blended Cements

4 DEFINITIONS

Refer to definitions contained in the references.
Superintendent – as defined in AS 2124.

5 SPECIFICATION

5.1 Materials

5.1.1 General

Unless otherwise stated, all concrete shall be Portland Cement Concrete and shall be composed of Portland Cement, fine aggregate, coarse aggregate, additives if approved and water proportioned and mixed as specified herein. All materials for use in concrete shall conform to the requirements of this Specification and shall be approved by the Superintendent. Any materials which do not conform shall be immediately removed from the site at the Contractor's expense.

5.1.2 Portland Cement

All cement used shall be Portland Cement of approved brand and Australian manufacture and shall comply with Australian Standard 3972. The type of cement used shall be Type GP - "General Purpose Portland Cement" unless otherwise designated.

Unblended Portland cement shall comprise at least 60% of the total weight of cementitious material in a mix.

5.1.3 Water

Mixing water shall comply with the requirements of AS 1379.

5.1.4 Fine Aggregate

Fine aggregate shall consist of natural sand, a combination of natural sands, or a combination of natural and manufactured sands. Particles shall be clean, hard and durable. It shall conform with the Australian Standard 2758.1 "Concrete Aggregates". Light weight aggregate shall not be used.

5.1.5 Coarse Aggregate

Coarse aggregate shall consist of uncrushed gravel, crushed gravel, crushed stone, or combinations thereof. Particles shall be clean, hard and durable. It shall conform with the Australian Standard 2758.1 "Concrete Aggregates".

Unless noted otherwise on the drawings the nominal size of aggregate which may be used in all classes of concrete shall be 20mm. Light weight aggregate shall not be used.

5.1.6 Testing of Aggregate

Aggregates shall be tested to the requirements of AS 2758.1 in accordance with the methods of AS 1141 for severe exposure conditions.

The water absorption of the aggregates shall be determined and shall not exceed 2.5%.

Durability of fine and coarse aggregates shall be determined and shall satisfy the requirements of AS 2758.1 for the severe exposure classification. For coarse aggregates, durability shall be assessed using the method set out in Clause 10.2.1 of AS 2758.1.

The aggregates shall be tested for weak particles, light particles and impurities and reactive materials in accordance with Clauses 11, 12 and 14 respectively of AS 2758.1. It is a requirement of this Specification that all aggregates be tested for alkali-reactive materials in accordance with Clause 14.3.1 of AS 2758.1.

The Contractor shall provide a certificate of compliance for the aggregate. The certificate shall be provided in accordance with Clause A4.1 of AS 2758.1.

No concrete shall be delivered to the site until the test certificate has been provided, and the material has been approved in writing by the Superintendent.

The total reactive alkali content as determined in accordance with AS 2758.1 shall not exceed 3.0 kg Na_2O (equivalent) per cubic metre.

5.1.7 Storage of Material

Materials shall be stored in accordance with the requirements of AS 1379 and the additional requirements of this section.

If the Contractor proposes to use cement which has been stored for two months or more on works, the Superintendent may require a re-test of the cement at the Contractor's expense before it is used in the work. Cement showing lumps which cannot be broken to the original fineness by finger pressure will be rejected irrespective of age, and replaced at the Contractor's expense.

Aggregates shall be stored on site in such a manner that they will not segregate, become contaminated by foreign matter, or intermixed nor shall water be permitted to drain into them. Aggregates shall not be stored in direct contact with the ground. Generally storage areas shall be surfaced with concrete slabs.

5.1.8 Admixtures

Admixtures shall not be used in concrete without the written approval of the Superintendent. Admixtures shall only be approved when the proof that

such admixtures, agents or agencies will not have deleterious effect on the essential qualities of concrete is supported by substantial evidence. Should the Contractor desire to use an admixture he shall give the Superintendent notice in writing of:-

(a) Type and brand of admixture to be used;
(b) Rate of application;
(c) Type and location of metering device;
(d) Part of the structure where admixture is proposed to be used;
(e) Reasons for use; and
(f) Manufacturer's data sheet giving chemical constituents of the admixture, recommended dose rates and method of dosing.

If more than one admixture is proposed, the Contractor shall provide test evidence as to the compatibility of the admixtures.

Generally admixtures approved will be restricted to air entraining admixtures, and for certain approved applications, water reducing set-retarding admixtures, Type WRRe.

Despite the use of admixtures, the quantity of cement shall in no case be reduced below the value specified in Clause 5.2.1.2 for the particular class of concrete.

Calcium Chloride shall not be used as an admixture in reinforced concrete.

Any admixtures if approved shall comply with the requirements of AS 1478 "Chemical Admixtures for use in Concrete". A test report in accordance with Clause 5.7 of AS 1478 shall be provided for each admixture prior to its use.

Admixtures shall not be used in concrete containing fly ash, slag or blended cement unless test results are available to show that the concrete properties will not be affected by use of the admixture.

Where air entrainment is allowed the air content shall be within the range 3-5 per cent except where otherwise specified.

The Contractor shall have a suitable air content gauging device on the job so that the air content of the freshly mixed concrete may be accurately determined in accordance with AS 1012, Part 4.

Admixture metering shall be by an approved and well maintained dispenser.

5.1.9 Other Cementitious Material

Fly ash, ground granulated iron blast furnace slag and silica fume may be used separately or in combination, in concrete. The cementitious material may be supplied separately or as a blended cement. The Contractor shall state the proportions of each cementitious material in the mix design and provide a test certificate in accordance with the relevant part of AS 3582.

The Contractor shall only obtain cementitious material from a source approved by the Superintendent.

Fly ash shall conform to and be used in accordance with AS 3582.1. Fly ash shall not be used together with an air-entraining agent in a concrete mix, unless tests to the satisfaction of the Superintendent, prove that the amount of air entrained can be controlled and that the compressive strength is satisfactory. The proportion of fly ash by weight shall not exceed 30% of the cementitious content and the water cement ratio shall not exceed 0.45.

Slag shall conform to and be used in accordance with AS 3582.2. The proportion of slag by weight shall not exceed 40% of the cementitious content.

Silica fume shall conform to and be used in accordance with AS 3582.3.

5.2 Design and Approval of Concrete Mixes

5.2.1 Class of Concrete

Unless otherwise nominated in the job documents all concrete shall be Class S40 performance grade. Any other nominated special class concrete shall be performance grade.

The compressive strength shall be determined in accordance with Australian Standard 1012 Part 9. Target slump values, maximum water cement ratios, minimum and maximum cement contents shall be within the following values.

Class of Concrete	Characteristic 28 day compressive strength	Target	Cement Content (kg/m³)		Maximum Water/Cement Ratio by weight
			Min.	Max.	
S40	40 MPa	40-80	350	420	0.45
Blinding	---	---	170	---	---

The drying shrinkage at 56 days, for concrete used in water retaining structures, shall not exceed 600 microstrain as determined in accordance with AS 1012.13.

5.2.2 Concrete Mix Design and Acceptance

Approved concrete suppliers must provide the appropriate Test Certificates to demonstrate that the product meets the requirements of the Specification.

No concrete shall be placed until Preliminary Mixes have been made, tested and/or the mixes approved in writing by the Superintendent. Upon request of the Contractor, the Superintendent may give provisional approval of a Class S40 mix if the average of the 7-day strengths is not less than 36 MPa. Notwithstanding any approval given, the concrete shall meet the specified preliminary mix strength at 28 days and the specified maximum shrinkage at 56 days.

5.3 Control of Concrete Quality

1. Concrete quality shall be assessed by determining the compressive strength of the concrete. The method of testing and assessment of the concrete compressive strength shall be in accordance with Appendix B of AS 1379. Project assessment of strength grade in accordance with Clause B7 of AS 1379 is required.

2. The Superintendent shall be provided with the monthly production assessment reports for the plant supplying the concrete to site. The reports shall be provided for the full duration of the Contract period.

3. For concrete manufacturing plants which produce no controlled strength grades, the production assessment shall be supervised by an independent person who shall be a Registered Professional Engineer, Queensland or equivalent. Such person shall be approved by the Superintendent.

4. Unless otherwise directed by the Superintendent, all test cylinders produced as a result of the project assessment provisions of Clause 5.3(1) shall be manufactured, handled and cured by the Contractor in accordance with AS 1012.1, 1012.3 and 1012.8. The cost of manufacture, handling, curing and testing the cylinders shall be borne by the Contractor.

5. In addition to strength testing, the quality of S40 concrete shall also be assessed by measuring drying shrinkage. Sampling and testing shall be in accordance with Clause 5.6.2 of AS 1379. Concrete shall be sampled and tested prior to placement or whenever there is a change in the source of supply or nature of any mix ingredient.

6. All sampling and testing shall be performed by a NATA registered technician.

5.4 Batching and Mixing

5.4.1 Plant and Equipment

All plant and equipment used for the manufacture of concrete shall comply with the requirements of Section 3 of AS 1379.

5.4.2 Production and Delivery of Concrete

The production and delivery of concrete shall comply with the requirements of Section 4 of AS 1379. Concrete shall be manufactured by the batch production process unless otherwise specified in the job documents.

Handmixing shall be permitted only in the case of emergency and only then with the approval of the Superintendent. Where permitted the quantity of hand mixed concrete shall be limited to that required to complete a member or reach a construction joint.

Hand mixing shall be carried out on a water-tight platform and the batch shall be turned a minimum of three times dry and three times wet.

Notwithstanding the provisions of Clause 4.2.3 of AS 1379, water shall not be added to the mixed batch on site unless the concrete manufacturer provides a certificate stating how much additional water may be added. The certificate shall state the total amount of water which has already been added to the mix, including the water content of the aggregate. Water shall be added to the mixer using a graduated container approved by the Superintendent.

No water shall be added to a truck mixer on site once it has commenced discharging its load or if the certificate described in Clause 5.4.2.4 is not provided to the Superintendent. A sample of concrete shall be taken from every truck load of concrete to which water is added on site. This sample shall be subject to project assessment testing in accordance with Clause B7 of AS 1379. Notwithstanding the provision of a certificate, the concrete may be rejected if slump testing is not satisfactory, following the addition of extra water.

The following requirements shall apply when concreting in hot weather:

(a) Precautions shall be taken to avoid premature stiffening of the fresh mix and to reduce water absorption and evaporation losses.

Ready mixed concrete shall be placed and compacted within the time limits specified in the following table.

The temperatures in the table shall be the temperatures at the time of discharge from the mixer.

Concrete Temperature	Maximum Elapsed Time from Time of Charging the Mixer
Less than 24^{o}C	90 minutes
24^{o}C - 32^{o}C	60 minutes
32^{o}C - 35^{o}C	45 minutes

For site-mixed concrete deduct 15 minutes from each of the above times.

(b) No concrete pours shall occur if the air temperature exceeds 30° C.

No concrete shall be placed when the shade temperature is less than 5^{o}C.

5.4.3 Slump Testing

a) After completion of mixing, but prior to site handling, all concrete shall have its slump determined in accordance with AS 1012.3. The concrete may be rejected by the Superintendent if the measured slump value is outside the tolerance of the target slump value of the approved mix design. For target slump <60mm, tolerance is ± 10mm, for target slump 60 - 180, tolerance is ± 15mm.

The Contractor shall supply the necessary apparatus to conduct the slump testing and shall arrange to perform the testing in the presence of the Superintendent or his representative. Testing shall be performed by a NATA registered technician.

b) Plastic concrete may be rejected by the Superintendent if it is significantly different in appearance or cohesiveness from previously supplied concrete of the same class.

5.5 Formwork

5.5.1 General

Formwork shall be designed and constructed in accordance with AS 3610.

Formwork documentation, as detailed in Clause 4.7 of AS 3610, shall be submitted by the Contractor to the Superintendent at least two weeks before such formwork is erected. The submission of this documentation shall not relieve the Contractor of his responsibilities under the Contract.

The permanent structure shall not be used for the restraint of formwork without the prior approval of the Superintendent. The Contractor shall demonstrate that the permanent structure is adequate to support the applied loads and shall strengthen the structure, if required, at no cost to the Principal.

Penetrations and inserts in formed concrete surfaces shall be located as shown on the drawings. Any alterations or additions to what is shown on the drawings shall not be permitted unless approved by the Superintendent.

The exposed edges of all columns, beams, floor slabs, landings, steps, kerbs, footpath slabs, plinths and top edges at walls shall be chamfered. The chamfer shall be 20mm by 20mm unless shown otherwise on the drawings. All joints between formwork parts and between formwork and the permanent structure shall be sealed watertight.

Unless otherwise stated in the Job Specification "slip form" or other similar construction techniques shall not be used.

5.5.2 Surface Finish and Colour

All surfaces of concrete which are exposed to view shall have a surface finish of Class 2C in accordance with Section 3 of AS 3610. All other surfaces shall have a Class 3 surface finish. Unless otherwise specified the internal surfaces of water retaining structures shall have a Class 3 surface finish.

Colour control shall be within the range specified in Table 3.6.1 of AS 3610, using the tonal scale contained in Appendix B of AS 3610.

5.6 Placing and Compacting

5.6.1 Program

The Contractor shall submit his proposed programme for placing concrete for the works 14 days prior to commencement. The Contractor shall give the Superintendent 24 hours notice in writing of any change to the programme. Placing of concrete shall be performed only in the presence of the Superintendent.

5.6.2 Preparation

All concrete shall be placed in the dry and no concrete shall be placed until the forms, reinforcing, and foundations as applicable have been inspected and approved in writing by the Superintendent. The formwork shall be inspected in accordance with Clause 5.4.1.7 of AS 3610.

Water and soft foundation material shall be removed from excavation before concrete is deposited, unless otherwise directed by the Superintendent. Any flow of water into the excavation shall be diverted through proper side drains to a sump, or be removed by other approved methods, which will avoid washing the freshly deposited concrete.

Water vent pipes and drains shall be filled by grouting or otherwise, after the concrete has thoroughly hardened. Springs encountered in the foundation shall be plugged, piped or otherwise satisfactorily disposed of.

Before any concrete is placed, forms shall be inspected to see if they are thoroughly clean, and all sawdust, shavings, nails, dirt and rubbish of any description shall be removed from within the forms.

For narrow walls where the bottom of the form is inaccessible, the low form panels shall be left loose so that they may be removed for cleaning out

extraneous material immediately before placing the concrete, and for purposes of compaction.

Where concrete is to be placed on other concrete which has taken its final set prior to the commencement of placing, all laitance, porous concrete or other objectionable substance shall be removed from the surface of concrete. When such area is cleansed and wetted but free from surplus water and approved by the Superintendent or his representative, a layer of mortar 10mm thick, having the same proportions of water, cement and fine aggregate as the concrete to be placed, shall be thoroughly worked into all crevices and depressions, after which the concrete may be put in position and shall be well compacted so as to make a thoroughly bonded and watertight joint.

5.6.3 Handling

Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable, by methods which prevent the separation or loss of ingredients. Mixing and transporting equipment shall be free from hardened concrete and foreign materials on the inner surface. The concrete shall be deposited in the forms as near as practicable in its final position, to avoid rehandling. Unless otherwise required by the Job Specification or otherwise directed by the Superintendent, concrete shall be so deposited as to maintain until the completion of the unit, a plastic surface approximately horizontal.

Forms for walls shall be provided with openings, or other devices, that will permit the concrete to be placed in a manner that will avoid accumulation of hardened concrete on the forms or metal reinforcement. Under no circumstances shall concrete which has partly hardened be deposited in the work.

When concrete is conveyed by chutes, the plant shall be of such size and design as to ensure a practically continuous flow in the chute. The angle the chute shall be such as to allow the concrete to flow without separation of the ingredients. The delivery end of the chute shall be as close as possible to the point of deposit. The chute shall be thoroughly flushed with water before and after each run; the water used for this purpose shall be discharged outside the forms.

Pneumatic placers and concrete pumps shall be used only if authorised by the Superintendent. Such equipment shall be arranged so that no vibrations may damage freshly placed concrete. The delivery end of the pipe shall terminate in a fitting of approved design which shall prevent segregation of the concrete. After the completion of any concreting operations the equipment shall be thoroughly cleaned.

Concrete shall be placed in an essentially continuous manner between approved construction joints so as to avoid being placed against partially set concrete.

5.6.4 Placing

Concrete shall be gently placed into position, and shall not be poured from a greater height than 1.5m into the forms unless suitable chutes or downpipes are specially provided. It shall be placed in layers not thicker than 300mm except as otherwise provided herein, and the section of the works undertaken shall be such that the next layer of concrete will be placed on top of the first within 20 minutes of placing the first layer, or such time as to preclude any danger of disturbing the first layer once it has taken its initial set.

It shall be well worked and consolidated around the reinforcement and embedded fixtures and into corners of forms, by means of suitable tools, in such a manner as to prevent the formation of any void spaces, and to ensure the most thorough compacting to obtain density and watertightness.

5.6.5 Placing Concrete Under Water

Concrete shall not be placed under water.

5.6.6 Compaction of Concrete in the Forms

Concrete during and immediately after depositing shall be thoroughly compacted. Concrete other than no fines concrete shall be compacted with high frequency internal vibrators in the manner described below. Hand compaction in lieu of mechanical vibration will be allowed only as an emergency measure when approved by the Superintendent.

(a) The vibration shall be internal except as provided in (h) (form vibrators).

(b) Vibrators shall be of an approved type, capable of transmitting vibration to the concrete at frequencies of not less than 8000 impulses per minute at such an intensity to visibly affect a 25mm slump concrete at a radius of 300mm.
Vibrators for Class S40 concrete shall be capable of transmitting vibration to the concrete at frequencies of not less than 12,000 Impulses per minute at an intensity to visibly affect a zero slump concrete at a radius of 300mm.

(c) The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms. The minimum number of vibrators to be provided will depend on the rate of placing concrete but in no case shall be less than 1

vibrator for each 5 cubic metres of concrete or part thereof placed per hour with a minimum of 2 vibrators. At least one vibrator in working order shall be held in reserve at all times.

(d) A vibrator shall be inserted into the concrete at successive positions not more than 500mm apart and vibration shall continue at each position until air bubbles cease to emerge. It shall then be withdrawn slowly.

(e) Vibrators shall be inserted so as to thoroughly compact the concrete around the reinforcement and embedded fixtures and into the corners and angles of the forms.
Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete.
Where more than one layer is being placed in a continuous operation the vibration shall be inserted through the layer into the layer below.

(f) The vibrators shall be inserted into and withdrawn from the concrete slowly. The vibration shall be of sufficient duration to thoroughly compact the concrete, but shall not be continued so as to cause segregation.

(g) Vibration shall not be applied directly or through the reinforcement, to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms.

(h) The provisions of this section shall also apply to precast members except that if approved by the Superintendent, the manufacturer's method of vibration may be used. For precast slab units internal vibration shall be used in conjunction with external mould vibration.
Special care shall be taken to ensure complete compaction behind prestressing anchorages.

5.6.7 Embedment of Metal Work

Where metal work is to be built into concrete it shall be truly placed in the position shown on the plans or as directed by the Superintendent and so secured that this position shall be maintained after the concrete has set. Where such built-in work is out of position, it shall be brought back to position or otherwise adjusted as directed by the Superintendent and at the Contractor's expense.

5.6.8 Construction Joints

The surface of set concrete to which fresh concrete is to be bonded shall be termed a construction joint. The location of the construction joints has not been strictly set. All concrete shall be placed in as large sections as possible without a break to ensure a minimum of joints. Joints shall be

located so at least to impair the strength and appearance of the structure. The Contractor shall complete by continuous depositing of concrete, sections of the work between such joints.

Vertical construction joints will not be allowed in the walls of sewerage pumping stations and the placing of these structures shall be in full circle lifts. When placing of concrete is interrupted by some contingency long enough for the concrete to take a set, concreting operations shall cease and the surface shall be treated as a construction joint.

Joint surfaces shall be prepared by air-water jetting or by brushing with stiff wire brushes. This shall be done approximately three to 6 hours after placing the concrete, when the concrete is stiffened but before it becomes too hard for effective cutting. Should the concrete become set, it shall be treated as directed by the Superintendent to ensure satisfactory bonding of the new concrete.

Great care shall be taken fitting the forms at joints. Should unevenness in the surface occur at a joint, the Contractor must immediately treat the surface by chipping and/or grinding so that a smooth even surface results. In addition, the Contractor must alter, where necessary, his method of fixing forms at joints or reshape his formwork or both so that the next joint is smooth and even.

The Contractor shall not permit walking over or upon finished surfaces of concrete until these are sufficiently hardened. While setting, the concrete shall not be disturbed or subjected to vibration or interference of any kind. Should concreting be stopped for any reason, the work shall be left protected until operations are resumed.

5.7 Removal of Formwork

5.7.1. Except where otherwise provided in this clause, the forms shall be removed as soon as the concrete has hardened sufficiently to prevent damage by careful form removal in order to facilitate satisfactory progress with the specified curing and to enable the earliest practicable repair of the surface imperfections.

5.7.2. The removal of formwork including minimum stripping times, shall be in accordance with the requirements of Clauses 5.4.3 and 5.4.4 of AS 3610 and Clause 19.6.2 of AS 3600. The requirements of AS 3610 shall apply where these are more stringent than the relevant requirements of AS 3600.

5.8 Concrete Surfaces

5.8.1 Exposed Surfaces

Exposed Surfaces such as tops of wells and floors shall be properly screeded off to correct levels shown on the plans and given a suitable finish by the use of steel trowel or float.

5.8.2 Repair of Concrete

Repairs to concrete surfaces shall be performed by skilled workmen. All concrete repairs shall be carried out in the presence of the Superintendent or his representative. Repairs of imperfections shall be completed within 24 hours after removal of forms or in the case of unformed concrete, within 24 hours after the placing of the concrete. All fins and encrustations shall be neatly removed from surfaces.

Concrete that is damaged through any cause or concrete that is honeycombed, fractured or otherwise defective, must be excavated and replaced with stiff 3 to 1 mortar containing just sufficient water for compaction by ramming or with concrete as hereinafter specified.

Holes resulting from the removal of ends of form ties shall be filled with stiff 3 to 1 mortar. Where bulges or abrupt irregularities protrude on formed surfaces, the protrusions shall be reduced by grinding so that the surfaces are reasonably fair and smooth. Stiff 3 to 1 mortar shall be used for filling holes of small depth, for narrow slots cut for the repair of cracks and tie rod fastener holes.

Mortar shall not be used for filling behind reinforcement or filling holes that extend completely through a concrete section. Concrete fillings shall be used for holes extending entirely through concrete sections, for holes which are greater in area than 0.1 square metres and deeper than 100mm and for holes in reinforced concrete which are greater in area than 0.05 square metres and which extend beyond reinforcement.

All fillings shall be bonded tightly to the surfaces of the holes and shall be sound, free from shrinkage cracks and drummy areas after curing.

Cracks which appear in concrete in sewerage pumping stations shall be repaired by injecting an approved chemical grout. The repaired crack shall show no sign of water leakage when the structure is subsequently filled with water.

5.9 Curing of Concrete

5.9.1 Water and Membrane Curing

All concrete shall be cured either by water curing or by membrane curing. Water curing is the preferred method of curing and no membrane curing shall be used, unless authorised in writing by the Superintendent. Membrane curing shall not be used on surfaces with a Class 2C surface finish, surfaces to be coated or painted, or construction joints.

The Contractor shall advise the Superintendent, in writing at least 7 days prior to pouring any concrete of the methods proposed to cure the various concrete surfaces to be constructed during the Contract. If it is proposed to use a membrane sealing compound, a sample of the compound, together with the manufacturer's data sheet, shall be submitted to the Superintendent for testing at least 30 days prior to use.

The unformed top surfaces of walls shall be moistened by covering with water saturated material or by other effective means as soon as the concrete has hardened sufficiently to prevent damage by water. These surfaces and steeply sloping and vertical formed surfaces shall be kept completely and continually moist, prior to and during form removal by water applied at the unformed top surfaces and allowed to pass down between the forms and the formed concrete faces.

Concrete shall be cured until the average compressive strength reaches 80% of the 28 day characteristic value.

Concrete cured with water shall be kept wet for a period of not less than 7 days immediately following the placement of concrete, or until covered by fresh concrete, by covering with water or by using an approved water saturated covering or by sprinkling so that the surface will be kept continuously wet.

Covering for not less than 7 days with an impervious sheet such as polythene shall be acceptable on horizontal surfaces or near horizontal surfaces. The concrete surface under the sheet shall be saturated with water at the beginning and end of each day, during the 7 day curing period.

Membrane curing shall be by the application of an approved type of sealing compound which forms a water retaining membrane on the surfaces of the concrete. Generally, the only curing compound which will be approved is paraffin wax emulsion in water. The compound shall be applied at the rate recommended by the manufacturer. The curing efficiency in accordance with requirements of AS 3735 supplement 1 shall be 75%. Resin and PVA based compounds shall not be used.

If necessary, to provide a continuous membrane over the whole of the surface, a second coat of sealing compound shall be applied by spraying in a direction at right angles to that at which the first coat was applied.

Except on the formed surfaces of the sloping faces of concrete from which the forms may be removed as soon as the concrete has stiffened, the repair of surface imperfections shall not be made until after the application of sealing compound.

Where sealing compound is to be used on unformed concrete surfaces, applications of the compound shall commence immediately after the

finishing operations are completed and any bleed water on the surface has evaporated.

When sealing compound is to be used on formed concrete surfaces, the surfaces shall be moistened with a light spray of water immediately after the forms are removed to a point where they will not readily absorb more moisture. As soon as the surface film of moisture disappears, but while the surface still has a damp appearance, sealing compound shall be applied.
After application of the sealing compound has been completed and the coating is dry to the touch, any required repair of concrete surfaces shall be performed. Each repair shall be moistened and coated with sealing compound in accordance with the foregoing requirements.

Traffic or other operations by the Contractor shall be such as to avoid damage to coatings of sealing compound for a period of not less than 28 days after the application of the compound.

Where it is impossible because of construction operations to avoid traffic over the surfaces coated with sealing compound, the membrane shall be protected by a covering of sand not less than 25mm in thickness or by other effective means. This covering shall not be placed until the membrane is completely dry.

Before final acceptance of the work, the Contractor shall remove all sand covering in a manner acceptable to the Superintendent. Any sealing membrane which is damaged or which peels from concrete surfaces within 28 days after application shall be repaired without delay.

5.10 Dimensional Tolerances

Where tolerances are not stated in the Specifications or drawings for any individual structure or feature thereof, deviations from established lines, grades and dimensions shall not be greater than ± 25mm.

5.11 Steel Reinforcement

5.11.1 Quality of Steel Reinforcement

All reinforcements of concrete shall be in accordance with Australian Standard Specifications:
AS 1302 Steel Reinforcing Bars for Concrete;
AS 1303 Hard-drawn Steel Reinforcing Wire for Concrete;
AS 1304 Welded Wire Reinforcing Fabric for Concrete.

The steel shall be of the quality specified in the Standard Specifications and shall have been tested in the manner prescribed therein, and approved by the Superintendent or his representative. All reinforcement is to be of Grade 410Y deformed bar in accordance with Australian Standard Specification 1302 unless otherwise noted on the drawings.

5.11.2 Testing of Reinforcement

The Contractor, if so requested, must supply samples of the various classes of steel after delivery at site. These samples shall be cut to lengths suitable for testing as specified in AS 1302 to AS 1304.

In the event of any of the steel proving unsatisfactory in the course of being worked, such steel will be rejected, notwithstanding any previous acceptance.

5.11.3 Galvanised Reinforcement

Where specified reinforcing bar shall be hot dip galvanised in accordance with AS 1650. The minimum average coating mass shall be 600 g/m^2.

Damaged areas of galvanising shall be repaired in accordance with Appendix F of AS 1650.

Galvanised reinforcing bar shall not be heated or welded.

Galvanised reinforcement shall be electrically isolated from other metalwork, including non-galvanised reinforcement. Tie wire used on galvanised reinforcement shall also be galvanised.

Prior to use all galvanised reinforcement shall be passivated by dipping in a 0.2% sodium dichromate solution. When handling galvanised reinforcement following dipping, skin contact should be avoided.

5.12 Bending of Reinforcement

5.12.1 Bending

Reinforcement shall be bent in accordance with Clause 19.2.3 of AS 3600.

5.12.2 Tagging of Reinforcement

After cutting and bending, bars shall be bundled or stacked according to their respective "marks" as shown in the bending schedule. All reinforcing shall be labelled with strong wired tags for absolute identification.

5.13 Storage of Steel Reinforcement

5.13.1**.** Reinforcement when delivered on to the works shall be stored on suitable racks. These racks shall be so constructed that the steel does not come into contact with the ground.

5.13.2. On no account shall steel be left lying on the ground, or exposed to the weather prior to being placed in a position in the work.

5.14 Placing of Reinforcement

5.14.1 Cleaning of Reinforcement

At the time concrete is placed reinforcement shall be free from mud, oil, grease and other non-metallic coatings and loose rust which would reduce the bond between the concrete and the reinforcement. In this context rust shall not be deemed to be loose if on rubbing with the thumb it leaves only a stain thereon. Nevertheless, a deformed bar complying with AS 1302, "Steel Reinforcing Bars for Concrete", or a welded wire fabric complying with AS 1304, "Welded Wire Reinforcing Fabric for Concrete", and having millscale or rust or both shall be deemed to comply with this Specification if, for a specimen which has been wire-brushed by hand:

(i) the dimensions of cross-section, including height of deformations; and
(ii) the mass

are not less than the dimensions and mass required by the applicable Australian Standard for reinforcement.

5.14.2 Placing and Fixing of Reinforcement

All steel reinforcement shall be accurately placed in the positions shown in the drawings and firmly held during placing and setting of the concrete.

Unless otherwise specified or directed by the Superintendent reinforcement shall be placed in its specified position, within the tolerances given in Clause 19.5.3 of AS 3600 such that the nominal cover shown on the drawings shall not be encroached upon.

Bars shall be held in position by wiring at all intersections with annealed wire not less than No. 18 gauge except where spacing is less than 300mm in each direction when alternate intersections shall be tied. Distances from forms shall be maintained by precast mortar blocks, metal hangers, plastic chairs or other approved devices. Metal supports and tie wires which extend to the surface of the concrete shall not be permitted. Stirrups and ligatures shall pass around the main bars and be securely wired thereto.

Plastic tipped steel bar chairs shall not be used in the works unless the distance from the metal portion of the chair, including those portions encased in plastic is equal to or greater than the minimum concrete cover to reinforcement shown on the drawings.

Concrete blocks shall be cured by immersion in water for at least 7 days until 24 hours before the blocks are to be used. Layers of bars shall be separated by precast mortar blocks or by other equally suitable devices. The use of pebbles, pieces of broken stone or brick, metal pipe and wooden blocks will not be permitted.

5.14.3 Welding of Reinforcement

Welding of reinforcement shall not be carried out unless shown on the drawings, specified, or otherwise approved by the Superintendent. Such welding shall comply with AS 1554, Part 3 - "Welding of Reinforcing Steel".

The following limitations on welding shall apply:

(a) Except as provided in paragraph (b), welding shall not be carried out within 75mm of a bend having an internal diameter less than 12 bar diameters, or any part of a bar that has been bent and subsequently bent in the reverse direction or straightened.

(b) With the approval of the Superintendent, it shall be permissible to tack-weld bars sufficiently to maintain the reinforcement in its correct positions.

5.14.4 Rolled Fabric

If fabric reinforcement is shipped in rolls, it shall be straightened into flat sheets before being placed.

5.14.5 Inspection of Reinforcements

Reinforcement in any member shall be placed and then inspected and approved by the Superintendent before the placing of concrete begins. Concrete placed in violation of this provision may be rejected and removal required.

5.14.6 Splicing

All reinforcement shall be furnished in the full lengths indicated on the drawings. Splicing of bars, except where shown on the drawings will not be permitted without the written approval of the Superintendent. Splices shall be staggered as far as possible. Where bars are spliced they shall be lapped the distances shown on the drawings. Where unscheduled laps are authorised the bars shall be lapped the distances approved by the Superintendent in writing. In lapped splices, the bars being spliced shall be placed in contact and wired together in such a manner as to maintain a clearance of not less than the minimum clear distance to other bars and the minimum distance to the surface of the concrete specified in the plans.

5.14.7 Lapping of Reinforcing Mesh

Sheets of mesh reinforcement shall overlap each other one square.

5.14.8 Substitutions

Substitution of different size bars will not be permitted unless written application is made for such substitution at least 4 weeks before the reinforcing steel is to be placed. Such permission will only be given if the structure is not adversely affected. No additional payment will be made on account of these alterations.

5.15 Defective Concrete

Concrete which is not placed and completed in accordance with this Specification or which, in the opinion of the Superintendent, is defective shall be removed within the limits assigned by the Superintendent. Such concrete shall be replaced at the Contractor's cost by concrete placed and completed in accordance with this Specification.

4.13 APPENDIX 4B/1 - PUMP STATION ELECTRICAL REQUIREMENTS

TABLE OF CONTENTS

SPECIFICATION FOR THE ELECTRICAL INSTALLATION AT SEWERAGE FACILITIES

1 PURPOSE

1. The purpose of this Specification is to ensure that the quality of the manufactured electrical equipment and the electrical installation supplied and installed in a sewerage installation will result in satisfactory performance, reliability, durability, safety and appearance of the electrical installation.

2 SCOPE

2.1. This Specification applies to the electrical equipment, installation, quality assurance and testing of electrical installations together with switchboards, controls and wiring for sewage pumping stations.

2.2. This Specification shall be used in conjunction with the stated requirements of the relevant statutes, local electricity supply authority or other authority in whose area the works shall be constructed.

3 REFERENCES

3.1 The following shall apply to quality systems:

AS 3905.2 Quality Systems Guidelines
AS 9001 Quality Systems for Design/Development, Production, Installation and Servicing
AS 9002 Quality Systems for Production and Installation
AS 9003 Quality Systems for Final Inspection and Test

3.2 The following shall apply to preparation of drawings:-

AS 1100 Technical Drawings
AS 1102 Graphical Symbols for Electrotechnology
AS 3702 Item Designation in Electrotechnology

3.3 The following shall apply to materials and equipment:-

Electrical Equipment

AS 1023 Low Voltage Switchgear and Control Gear - Protection of Electric Motors
Part 1 - Built-In Thermal Detectors and Associated Control Units
Part 2 - Thermal Overload Protective Devices
AS 1029 Low Voltage Contactors
Part 1 -Electromagnetic (Up to and including 1000 V AC and 1200 V DC)
AS 1042 Direct-acting Indicating Electrical Measuring Instruments and their Accessories
AS 1052 CISPR Specification for Radio Interference Measuring Apparatus and Measurement Methods
AS 1202 AC Motor Starters (up to and including 1000 V)

	Part 1 Direct on Line Starters
AS 1307	Surge Arresters (Diverters) Part 1 Silicon Carbide Type for AC Systems Part 2 Metal Oxide Surge Arresters without gaps for AC Systems
AS 1345	Identification of the Contents of Pipes, Conduits and Ducts.
AS 1359	Rotating Electrical Machines - General Requirements Part 30 - Duty and Rating Part 109 – Noise Limits Part 101 – Rotating Electrical Machines General Requirements Rating and Performance
AS 1768	Lightning Protection
AS 1939	Degrees of Protection Provided by Enclosures for Electrical Equipment
AS 2053	Conduits and Fittings for Electrical Installation
AS/NZS 2064	Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radiofrequency equipment
AS 2184	Low Voltage Switchgear and Controlgear - Moulded-Case Circuit-Breakers for Rated Voltages up to and Including 600 V AC and 250 V DC
AS 2279.2	Disturbance in Mains Supply Networks – Limitation of Harmonics Caused by Industrial Equipment
AS 2768	Electrical Insulating Materials
AS 3111	Approval and Test Specification for Miniature Overcurrent Circuit-Breakers
AS 3133	Approval and Test Specification - Air Break Switches
AS/NZS 5000	Electric Cables – Polymeric Insulated
AS 3439.1	Low Voltage Switchgear and Control Gear Assemblies
AS 3947.1	Low Voltage Switchgear and Control Gear, Multiple Function Equipment, Automatic Transfer Switching Equipment
AS 3947.4.2	Low Voltage Switchgear and Control Gear – Contactors and Motor Starters – AC Semi Conductor Motor Controllers and Starters
CISPR 17	Methods of Measurement of the Suppression Characteristics of Passive Radio Interference Filters and Suppression Components

3.4 The following shall apply to workmanship and design:-

AS 3000	Electrical Installations - Building, Structures and Premises (SAA Wiring Rules)
AS 3008	Electrical Installations - Selection of Cables Part 1 - Cables for Alternating Voltages Up To and Including 0.6/1 kV

3.5 The following shall apply to testing and reporting:-

AS 1055	Acoustics - Description and Measurement of Environment Noise
AS 1081	Acoustics - Measurement of Airborne Noise Emitted by Rotating Electrical Machinery
AS 1217	Acoustics - Determination of Sound Power Levels of Noise Sources
AS 1259	Acoustic Sound Level Meters
AS 1686	Metric Units for Use in Water Supply, Sewerage and Drainage (Including Plumbing)

3.6 Other references include:-

i. The Electricity Act 1994

ii Electricity Regulations 1994

4 DEFINITIONS

Refer to definitions contained in the references.

Contract, Contractor, Principal and Superintendent are as defined in AS 2124 General Conditions of Contract.

5 SPECIFICATION

5.1 Electric Motors

5.1.1 Electric motors shall be suitable for operation from three phase 415 V 50 Hz earthed neutral supply. The motors shall have an S1 duty rating in accordance with AS 1359, Part 30, to develop the maximum power required by the driven equipment when running under any condition of operation which may be encountered in normal use. This shall include zero head or closed valve conditions for centrifugal pumps or blowers and jamming by foreign matter for mechanical handling equipment. For positive displacement pumps or blowers this shall include the maximum capacity of the pump or blower against 110% of the worst condition of head expected or the setting of the pressure relief valve (if fitted) which ever is the greater. This maximum power requirement does not include the requirement of the following clause.

5.1.2 Where a motor is driven by a variable frequency drive (VFD), the maximum power requirement for the motor shall be increased by 20% above the power requirement determined from Clause 5.1.1 unless a certificate is provided from the equipment manufacturer guaranteeing that the motor will not exceed Class B temperature rise under all expected operating conditions.

5.1.3 Electric motors intended for use in doors shall be totally enclosed fan-cooled to IP55 with Class F insulation in accordance with AS 2768 and a Class B temperature rise in accordance with AS 1359 part 101.

5.1.4 Electric motors intended for use out of doors without further protection shall be totally enclosed fan-cooled to IP 56 with Class F insulation in accordance with AS 2768 and a Class B temperature rise as specified by AS 1359 Part 101. Such motors when vertically mounted, shaft down, shall have a conical aluminium rain shield of sufficient diameter to protect the upper shaft seal from driving rain. Clearance between the fan housing and the underside of the shield shall be sufficient to ensure adequate cooling air flow.

5.1.5 Electric motors intended to be fully submerged in water or sewage shall have an enclosure to IP X8 with Class F insulation in accordance with AS2768 and a Class B temperature rise in accordance with AS 1359 part 101.

5.1.6 Motor bearings shall be ball or roller, liberally sized with ready access for lubrication. Non-submersible motors shall provide provision for excess grease relief.

5.1.7 Motors greater than 3.5 kW or as specified in the Job Specification shall be fitted with thermistors of the PTC resistor type connected in series, one per phase, integral with the stator windings and clearly marked in the terminal box. The thermistors, their fittings in the motor, reference temperature and testing of the motor shall be in accordance with AS 1023, Part 1.

5.1.8 Regardless of the permissible sound pressure levels or sound power levels listed in AS 1359.109, the sound pressure level for individual motors shall not exceed the levels indicated in the following table, when measured at rated load in accordance with AS 1359.019.

	Rated Load Sound Pressure Level dB(A) (Ref 2 x 10^{-5} Pa) at 1m		
W Range	**960 rpm**	**1450 rpm**	**2980 rpm**
0.18 – 1.5	54	53	61
2.2	55	54	61
3	59	54	65
4 – 15	60	69	79
18.5 – 22	62	69	79
30	62	69	75
37 – 55	68	70	78
75 – 90	68	72	82
110 – 200	75	75	82

5.1.9 Electric motors 75 kW and larger shall be fitted with a 100 Ω platinum RTD type PT 100 embedded in the end windings and terminated in the motor terminal box.

5.1.10 Insulation resistance shall be guaranteed for both works test and site service conditions. Before and after the motor test at the works, the insulation resistance shall be not less than 200 Mohms.

5.1.11 The insulation resistance of the motor at the end of the defects liability period shall be at least 50 Ohm. A 1.6mm thick WBW Traffolyte label shall be attached beside the plug and socket for the motor or on the motor terminal box giving the value at which the motor should be repaired or replaced.

5.1.12 Electric motors not intended for submerged operation in liquids shall be supplied fitted with anti-condensation heaters. Heat shall be transferred to the windings by convection. The heaters shall operate at all times whenever the motor is not operating. The heaters shall be rated at 240V AC, and be supplied by separate circuits. A red Traffolyte label with white lettering shall be fixed to the heater's terminal box and engraved with:

**" DANGER. 240 VOLT A.C.
This circuit can be live when
motor is not in use.
Isolate Elsewhere "**

5.2 Electrical Cubicles

5.2.1 General Requirements

The Contractor shall provide all motor starter and control circuitry, indicating lights and instruments and such other equipment and wiring as are necessary for the operation of the equipment installed under the Contract. The term "cubicle" shall be taken to encompass each of the following: -

- Switchboard
- Motor Control Centre
- Metering Panel
- Local Control Panel
- Disconnection Box
- Control Desk
- Mimic Panel

supplied and installed under this Contract.

Switchgear assemblies shall be Form 2 to AS 3439.1 up to and including 22kW and Form 3A to AS 3439.1 above 22kW.

The equipment to be supplied and installed under the Contract has been allocated to each particular cubicle as shown on the cubicle layout drawings and the single line diagrams where provided.

Circuit breakers for all equipment controlled from each switchboard shall be installed in a circuit breaker cubicle or compartment where specified or shown on the drawings. The circuit breakers shall be logically ordered and shall be installed on the appropriate chassis. Each circuit breaker shall be fully labelled with a description of its function and shall have an isolation-locking device. Each circuit breaker chassis shall have 20% spare poles.

The Contractor shall arrange the control and power wiring equipment in a logical grouping to mimic the front panel layout as much as possible. All equipment where possible shall be DIN rail mounted.

Separate compartments or cubicles shall be provided for any Variable Frequency Drives (VFD's) and associated contactors, overloads and controls supplied and installed under the Contract as shown on the drawings. This is to ensure no RFI coupling occurs with other cables.

A maximum sound pressure level of 50 dB(A), at a 1m radius, is required for VFD's or their cooling fans, which are contained within a cubicle. Where

a sound pressure level is specified in the job specification, the smaller figure shall be used.

Instrumentation and/or programmable logic controllers (PLC) shall be installed in separate compartments or cubicles from switchgear and control gear. Each compartment or cubicle shall be sized to accommodate the various instrumentation transmitters**,** which do not need to be field mounted. A separate cubicle shall be provided for remote telemetry units (RTU).

The Contractor shall provide an RTU cubicle circuit breaker on the main circuit breaker chassis and an isolator in the RTU cubicle with shrouded line terminals for the power supply to the cubicle and a separate circuit breaker, chassis mounted, for each instrument or controller. The circuit breakers shall protrude through the front panel of the cubicle or compartment.

There shall be no single insulated cables or exposed terminals at 240 volts in the cubicle. This is to allow instrumentation fitters to work safely on the equipment.

Separate compartments shall be provided for the Supply Authority CTs and meters where these are required as part of the Contract.

5.2.2 Starters

5.2.2.1 General

Each electric motor shall be provided with either a direct on-line, variable frequency drive, or soft starter. Where not detailed in the Job Specification, electric motors of 7.5 kW and above, except those specified or shown to have VFD's, shall be provided with soft starters. All remaining motors rated at 6 kW or less shall be provided with direct on-line starters.

5.2.2.2 D.O.L. Starters

Automatic direct on-line starters shall be intermittent Class 0.3 to AS 1202 Part 1 and enclosure type IP11 to AS 1939, rated to suit the motor. The starter shall be provided complete with thermal overloads.

5.2.2.3 Soft Starters

Where specified, motors shall be fitted with solid state starters to AS 3947.4.2 to permit the controlled acceleration of the motors when starting. This shall be achieved by electronically varying the voltage applied to the motor terminals. Controlled deceleration of the motor during stopping shall also be provided. The voltage ramp down shall not be uniform over time but shall vary as a function of motor speed.

The starters shall be set to limit the starting current to three times the full load current of the motors. The Solid State starters shall have 3 wire connections to the motor. The starter shall be rated to AS 3947.4.2. The

starter shall be capable of starting the motor five (5) times per hour for motors greater than 50 kW and ten (10) starts per hour for motors less than or equal to 50 kW, with an on time of 90%. The starter shall be suitable for the type of motor to be controlled and shall be rated without a bypass contactor.

The soft starter control panel display shall be mounted remote from the unit on the front panel of the switchboard.

The Solid State starters shall have in-built protection against phase failure, phase rotation, SCR short circuit and open circuit, motor underspeed, stall, heat sink overtemperature, ground faults, and shall be capable of being reset automatically.

5.2.2.4 Variable Frequency Drives

Where specified, electric motors shall be fitted with AC stepless speed controllers which shall be capable of being controlled by a 4 to 20 mA analogue signal generated by the process or other appropriate automatic control system. The Contractor shall provide the necessary equipment to adjust the speed automatically upon receipt of the signal.

The stepless speed controllers shall be Variable Frequency *Drive*s (VFD's). The devices shall contain solid state circuitry able to vary the frequency and voltage of the electrical power supplied to the motor. The output control of the motor drives shall be by the Sine Coded Pulse Width Modulated method. Each drive shall be capable of automatic or manual reset and shall be protected against: -

i. overtemperature;
ii. over/under voltage;
iii. instantaneous power failure;
iv. phase failure and phase reversal;
v. ground fault;
vi. line voltage transients;
vii. overcurrent (based on a variable time delay); and
viii. under current (based on a variable time delay).

All VFD drives shall be provided with automatic reset to provide multiple restart when the drive trips out on non-critical fault conditions. The automatic reset shall be adjustable on number of restarts; time between trip and attempt to restart; and time in which set number of trips may occur.

The VFD unit control panel display shall be mounted remote from the unit on the front panel of the switchboard. The display shall indicate all faults in plain English (not using abbreviations or numbers to describe the protection trip).

The VFD's shall have an overload capacity of 120% FLC for 60 seconds, suitable semi-conductor and microprocessor protection, and shall be

automatically reset. The VFD shall be rated to the FLC of the driven motor.

The acceleration and deceleration times of each motor drive shall be adjustable between 0 and 600 second's minimum. The motor drive shall limit the speed of the motor to between 25% and 100% of its rated speed unless noted otherwise in the Job Specification. The motor drive shall contain a facility to increase the start-up torque output.

5.2.3 Motor Protection

Motors as specified in Clause 5.1.7 of this Specification shall be provided with control equipment suitable for shutting down the motor should the allowable temperature of its windings be exceeded. The equipment shall comply with AS 1023. The thermistor relay shall de-energise a fault relay, which shall disconnect the motor control circuit and provide for fault indication and fault condition latching. The thermistor relay shall be automatically reset when the temperature of the windings falls to an acceptable value. The fault condition latching relay shall be manually reset using a push button on the front panel.

Backup overload protection shall be provided by thermal overload devices in accordance with AS 1023 Part 2 fitted to DOL motor starters. This device shall be automatically reset and shall be fitted to the contactors on the starter. The thermal overload relay shall de-energise the same fault relay as the thermistor relay. This thermal overload device shall be based on full load current with an adjustment on the current to trip. The device shall also afford protection against out-of-balance currents.

5.2.4 Control Equipment

The switchboard equipment shall be arranged so that the controls and indicators required for the day-to-day operation of the installation are readily accessible to the operations staff. These would normally include isolators and circuit breakers, which would be mounted behind the escutcheon panel but with the operating handles protruding through it. Equipment mounted on the escutcheon panel would include selector switches, general switches, push buttons, indicator lights, ammeters and electronic drive control panel displays. Equipment mounted in the compartment and generally accessible only to electrically qualified personnel would include motor starters, relays, contactors, timers, transformers, neutral link, earth busbar and terminal strips. The mounting height of such equipment shall be between 750mm and 1900mm above the operating surface.

Manual speed controllers with digital speed indicators and analogue potentiometer shall be provided for each variable speed drive to control Manual speed operation where specified.

All relays and mechanisms other than contactors shall be fully enclosed separately in dust-tight containers. Exposed live metal shall be shielded to prevent accidental shock. Relays and timers shall have indication, which

shows the energised state. Plug in relays and timers shall have retaining clips.

Pushbuttons shall be of the industrial protected type with one make and one break contact per element. The start and stop elements shall not be combined into one assembly. Contacts shall be double make-break and the mechanism shall provide pre-button and post-button movement with guidance free from binding or jamming.

Indicator pilot lights shall be industrial type with LED's. Each lens shall be approximately 25mm across, flush or nearly flush with the panel. The colour of the lamps shall be amber for fault, red for stop and green for run if required.

Selector switches shall be a robust rotary type, 10 A rated and complete with an escutcheon plate suitably labelled.

Analog indicating instruments shall have 72mm square faces. They shall be in accordance with AS 1042 and to the accuracy class herein specified and shall be calibrated and marked accordingly, as having complied with this requirement.

Earth leakage circuit breakers shall be provided when power outlets are specified or shown on the drawings. Earth leakage circuit breakers shall take a maximum of 2 pole spaces. The sensitivity of each unit shall be 30 mA.

Circuit breakers shall comply with AS 2184 and AS 3111 and shall be used throughout the installation. Only current limiting fuses shall be accepted.

The Contractor shall supply and install the necessary power and control circuits, with all accessories, for the operation of the equipment to be supplied and installed under the Contract as detailed subsequently.

All control circuits shall be hardwired for manual operation without the RTU. All fault circuits shall also be hardwired. The RTU shall generally only operate circuits in the auto mode. The control circuit for a drive shall be supplied by a surge protected circuit breaker through an auxiliary contact on the circuit breaker for that drive.

Each drive isolator shall have an early break late make contact that is connected in series with the control circuit for the respective drive.

Control voltages shall be 240 V AC or 24 V DC.

5.2.5 PLC Equipment

PLC equipment shall be as specified in the job specification.

5.2.6 Construction

Construction of cubicles for all switchboards and panels shall be from Grade 5083-H321 aluminium with 3.0mm minimum thickness;

Cubicles shall be powder coated unless otherwise stated.

Cubicle details and layouts shall generally be in accordance with the drawings.

Indoor cubicles shall have a minimum enclosure rating to IP52. Outdoor cubicles shall have a minimum enclosure rating to IP66 unless equipment requires ventilation in which case IP53 will be accepted.

Outdoor cubicles shall have an inner hinged escutcheon panel. The electrical wiring in outdoor cubicles shall be mounted behind a hinged escutcheon panel inside the switchboard. The escutcheon panel shall be fitted with a door lock. All control equipment and circuit breakers shall be mounted on the face of this panel or in a position such that access is available without opening this panel.

All joints in the cubicle and doors shall be continuously TIG welded and ground smooth, they shall be free from crevices. Each cubicle shall be coated with an approved polyester based powder coating. Each equipment panel shall also be coated with the approved polyester based powder coating. The powder coating shall be applied strictly in accordance with the manufacturer's instructions. Unless specified to the contrary in the Job Specification, the cubicle external colour shall be Interpon Heritage Green No. MK 044A or Dulux Deep Brunswick Green 50068. The equipment panel colour shall be Interpon White No. MA 009A.

Each cubicle shall have a door with a maximum 850mm wide opening to the control equipment. The cubicle shall be no more than 2000mm high above the operating surface and shall be floor mounted to suit cable entries through the bottom of the cubicle as required. Cubicles may be larger with the approval of the Superintendent.

Switchboards shall be manufactured in sections not exceeding 3 metres in length and shall be provided with twenty percent of useable spare space for future use unless noted otherwise in the Job Specification.

Doors shall have hand-operated heavy duty lockable latch fasteners and the keys for door locks shall be L&F 92268 series. Each door-lock assembly shall be designed to minimise the wear and tear of painted surfaces, that would otherwise be expected to occur, during opening and closing of the door over an extended period of time**.** Resilient door gasket shall make continuous contact around door openings. The gasket shall be fitted to doors only and shall be retained by means of metal framing. The gasket shall not be installed in a stressed condition. Hinges, locks, mechanisms and fasteners shall be Grade 316 stainless steel. Doors

greater than 850mm high shall have a 3 point locking system. Outdoor cubicles shall have stays to hold doors open in the 120° position.

A suitable plan pocket 300mm wide x 250mm high x 25mm deep shall be installed on the inside of the front door for the retention of "as-constructed" wiring diagram. The plan pocket and the receptacle shall be manufactured from the same material as the cubicle.

Switchboards shall have bottom entry gland plates made in two halves. One gland plate half shall remain fixed through which cables and cable glands pass. The second gland plate half shall be removable for the purpose of gaining access to the fixed gland plate half to allow the fitting of additional cable glands, following initial commissioning.

Ventilation openings shall be formed in the cubicles' metalwork to ensure the maximum thermo-siphon effect and shall be covered by stainless steel gauze mesh openings not greater in area than 2.6 mm^2 (approximately) to exclude vermin. The gauze shall be retained by metal framing and secured by round head metal thread screws. The vents shall provide a minimum of 22,500 mm^2 total inlet and 22,500 mm^2 total outlet per cubic metre of internal space, and shall be protected from damage. The ventilation openings shall be filtered with removable pads to prevent the ingress of dust in sufficient quantities to interfere with the satisfactory operation of equipment. The filters shall be retained by approved clips.

Cubicles housing VFD's shall be provided with ventilation to complement the operation of the cooling fan in the VFD. This shall consist of ventilation openings at low level in the fascia @ 0.67m^2 (max. free area) per 1000 L/s of airflow required through the VFD and a cowl protected axial flow fan in the upper panel of the switchboard. The recommended airflow through the VFD and the switchboard shall be a minimum of 4.0 L/s per full load kW of the VFD's in the cubicle but shall not be less than the manufacturer recommended airflow for the stated life of the VFD and for the prevailing ambient temperatures.

The fan shall be controlled by a thermostat mounted inside the switchboard in a location typical of the average temperature in the switchboard. Manual fan control shall also be provided.

All aluminium sections shall be insulated from concrete bearing surfaces by painting the contact areas with a heavy coat of approved alkali-resistant bituminous paint or by other means approved by the Superintendent.

All fixing bolts, screws, washers, nuts, holding brackets and conduit saddles used in the switchboard and for wiring and fixing electrical equipment shall be Grade 316 stainless steel.

Control apparatus, switches, etc., shall be neatly labelled with screw attached nameplates.

The panel and equipment mounted on the switchboard shall be neatly designated by approved engraved nameplates manufactured from 1.6mm thick WBW Traffolyte. Minimum letter height shall be 8mm and 4mm for major and minor labels. Each label shall be held securely in place with 5mm metric screws that shall be tapped into the mounting material.

Where labels are attached to duct covers the covers shall be attached to the duct bases with cable ties or alternatively a numbering system shall be used for the correct location of each duct cover.

Equipment and terminal strips shall not be mounted closer than 50mm from cable ducting so as to allow sufficient space for the connection of conductors to the equipment.

5.2.7 Switchboard Wiring

The Contractor shall supply and install all wiring within the switchboard to serve equipment as detailed in the Job Specification. All work undertaken shall be in accordance with AS 3000 and to the requirements of the Supply Authority.

Equipment mounted on switchboard doors and escutcheon panels shall have degree of protection IP20. Where IP20 cannot be achieved, wiring terminations shall be double insulated to prevent accidental contact with live parts.

Switchboard and starter wiring including that in the components and accessories thereof, shall be carried out in accordance with the wiring diagrams. The circuitry shall be such, in conjunction with the equipment and accessories used, as to prevent recycling and feedback and shall be fail safe, ie. fault relays shall be energised in the healthy state.

All control circuits shall be hardwired for manual operation without the process controller. All fault circuits shall also be hardwired. The process controller shall generally only operate circuits in the Auto mode.

The control and instrumentation wiring shall be of adequate size, a minimum of 1.5 mm^2 (30/0.25) for control and 0.5 mm^2 for instrumentation, multi-stranded flexible copper conductors, PVC V75 Grade. Wiring to PLC digital I/O or RTU componentry may be a minimum of 0.5 mm^2, multi-stranded flexible copper conductors, PVC V75 Grade. The minimum size for power cables shall be 2.5 mm^2. Each control wire shall be tinned and terminated with a pin crimp lug and numbered with plastic ferrules at the ends of each control and power wire. Corresponding numbers shall be shown on the wiring diagrams. Wires shall be colour coded as follows:-

Phase wiring (A, B & C)	red, white and blue
Voltmeter and current transformer connections	red, white, blue and black
240V control active	white
Thermistors and no volt contacts	orange
240V neutral	black

ELV positive	brown
ELV negative	grey
Telemetry	violet
Earth	green-yellow

Connections to external control wiring and auxiliaries shall be through numbered terminal strips. Each terminal shall be large enough to accept at least 6 mm^2 cable. Terminals for connection of thermistor wiring shall be clearly labelled with the name of the item of equipment and the test voltage along with a RWR Traffolyte label "Do Not Megger". Terminals shall be minimum of 300mm above ground level. For power wiring, the terminals of terminal strips or equipment shall not bite or indent the wire end, but shall clamp the wire with a plate or use solderless crimp lugs. Every terminal for control wiring shall be capable of accepting at least two control wires.

The use of vertical terminal strips, which are supported from side panels of cubicles, shall be installed with sufficient clearances to allow access to equipment and ducting for the purposes of maintenance, fault finding, and equipment replacement.

Terminals for analogue signals shall incorporate knife blades and connection points for testing purposes.

All earth wires, screens, and armouring, associated with power cabling that connects to motors controlled by VFD's, shall be connected to the motor earth terminal at each motor end and to the VFD drive earth terminal at the load terminals of each VFD. Control and signal cables, associated with VFD drive, shall have their shields and screens connected according to the manufacture's specifications.

All cable cores shall be of sufficient length at each termination to allow a fresh connection to be made that should the original termination break off.

Filtered cables in the switchboard shall not be loomed with any unfiltered sub-mains or cables that terminate outside the switchboard building.

All equipment panels and door panels shall have a minimum of 20% spare space. The spare space shall be useable portions and not the space between adjacent items. Equipment shall not be mounted on the sides of cubicles.

Cable looms shall be protected from mechanical damage, at hinged points, by the use of a continuous material such as split corrugated conduit or a special U rubber and shall be securely held in place.

Where modifications to existing switchboard are carried out, the Contractor shall remove all superseded equipment (relay, timers, wiring, etc) from the switchboard and shall leave the electrical control circuitry in a neat and tidy condition. All holes in equipment front panels shall be sealed in an approved manner.

5.2.8 Earthing

The earthing system shall comprise the Multiple Earthed Neutral System (MEN). The Contractor shall supply and install an earth electrode for each switchboard. The earthing conductor shall be installed between the earth electrode and the earth bar on each switchboard. The earth electrode shall be as a minimum one copper clad steel stake of minimum 13mm diameter driven to a depth of at least 1,800mm. A piece of 150mm diameter conduit shall be placed around the earth stake to protect and keep clear the termination. Additional earthing shall be provided where required to comply with Clause 5.4.2.

5.3 Site Wiring

5.3.1 General

The Contractor shall supply and install site wiring with all accessories and local control stations necessary for the operation of the equipment installed under the Contract as well as for any existing equipment relocated under the Contract, if applicable.

Where power is to be connected to the site or the supply upgraded, the Contractor shall organise the supply with the Supply Authority. The Principal will sign any necessary application forms.

All works shall be in accordance with AS 3000 and the requirements of the Supply Authority and relevant statutes. The Contractor shall arrange for all necessary inspections by the Supply Authority.

5.3.2 Cables

Power cables and control cables shall be circular PVC insulated 0.6/1.0 kV grade, class V75 heavy stranded copper conductors except cable being for motors driven by VFD's.

Cables to motors that are driven by VFD's shall be screened flexible cables or PVC/SWA/PVC circular cables, unless otherwise specified, and shall be suitably glanded and earthed at the source and at the equipment using appropriate glands. The earth screen shall be continuous from the source to the motor frame.

A 660 volt motor cable (screened for VSD use) suitable for use under water shall be supplied and connected to the motor by means of a watertight joint. The cable shall be solid where it passes through a gland and be encapsulated in an appropriate sealant. The other end of the cable shall terminate in a plug, which shall fit into a socket. The plug and socket shall be Clipsal 56 Series or similar approved for drives up to and including 22 kW. Drives above 22 kW shall be hard wired to the motor starter via terminals in the disconnect box. The plug and socket shall be located in a separate lower compartment in the switchboard or in a disconnector box if required or specified in the Job Specification. This will allow the motor to

be disconnected from the power supply by personnel who are not necessarily electrically qualified. The Contractor shall supply and install a tapered rubber plug to fit the top of the conduit.

Power cables shall be a minimum of 2.5 mm^2. Control cables shall be a minimum of 1.5 $mm^{2.}$

Instrumentation wiring and cables to carry analogue signals to PLC or process instrumentation shall be PVC covered, aluminium screened twisted cables minimum 0.5mm^2. All terminations to outdoor field equipment shall be waterproofed. Each screen of all instrumentation cables shall be earthed at only one point.

Cables shall be OLEX "Dekeron IEC 183" or approved equivalent. Adequate separation shall be provided between instrumentation cables and other cabling to ensure non-interference from AC power and control cables. As a minimum, cable trays shall have adequate partitions, and instrumentation cable not in tray shall be run in separate conduits from power cables.

5.3.3 Cable Installation

All cables shall be installed in conduits, in cable tray or ladder or in ducting. The Contractor shall be responsible for the provision of all conduits, tray, ladder and ducting.

All above ground cables shall be installed in aluminium cable tray or ladder or installed in conduits securely fixed in position using grade 316 stainless steel saddles and fasteners. No galvanised steel shall be used.

Where required by AS 3000 or where directed by the Superintendent, the Contractor shall supply and install 2mm thick folded grade 5083-H321 aluminium shields to protect the PVC cable from damage and exposure to direct sunlight.

All cables shall be provided with material that offers protection, against mechanical damage, UV sunlight, and corrosive gases, for the entire length of the cable run.

Underground conduits that enter or leave large cable pits shall do so towards the centre of the pit walls so as to provide maximum working space for drawing and bending of cables.

5.3.4 Termination of Cables

All cables shall be terminated by approved compression type cable glands. Cable glands shall have a non-corrodible finish. Cables shall be supported by saddles; cleats or other prior approved means so that no weight is taken by the cable glands or core terminations.

All cable cores shall be of sufficient length at each termination to allow a fresh connection to be made should the original termination break off.

Where cables are terminated to equipment, motors etc. at a height of 0.6 metres or more, suitable mechanical support and enclosure shall be provided for the cables. Supports shall be manufactured from either grade 5083-H321 aluminium or grade 316 stainless steel box section. Supports shall be fixed using suitable, existing or new, equipment fixings, tapped into structural metal. The use of fixings shall not require the removal of the fixings in order to remove the equipment. Where cables enter or leave box section, the cables shall pass through cable glands or flexible conduit terminators. The cable glands shall be tapped into the box section so as to prevent moisture entering the cable support.

Steel Wire Armoured cables where exposed for short lengths for the purpose of final termination to equipment do not require any further mechanical protection, provided that provision is made to protect the cable sheath from the effects of ultra violet sunlight. An acceptable means of protection would be UV stable paint.

Cables terminated to equipment such as motors etc. shall be run in non-metallic flexible conduits that shall offer excellent protection from abrasion, sunlight, mild acids, alkalies, and oils. Such flexible conduits shall be UV resistant and coloured grey. Flexible conduits shall be run from the mechanical support to the equipment junction box. Flexible conduits shall be terminated using nylon or stainless steel terminating adaptors. Nickel plated brass flame proof adaptors shall be used where required by wiring rules or where it is felt that they are an advantage in the situation that they would be used.

All conduit runs with multiple cables that pass through concrete floors, before connecting to equipment, shall be terminated in PVC junction boxes or adaptable boxes to IP56. The boxes shall be of suitable size to allow easy access for drawing in new cables and shall have entries, glands or adaptors installed in the bottom side of the boxes. Such boxes shall be installed at a height of less than 1 metre but more than 0.2 metres.

The above conduits require no further support or enclosure where the following conditions are met:-

- The conduit is larger than 40mm;
- the conduit is surrounded by the concrete so as to anchor the conduit at one end, and
- the conduit originates in the immediate vicinity of where the termination is to be made.

5.3.5 Conduits

All conduits shall be in accordance with AS 2053. The Contractor shall ensure that an 8mm diameter nylon drawstring is provided, after the

conductors have been pulled through, for future use. The ends of each spare conduit run shall be fitted with slotted unglued end caps in order to seal the conduit and allow the draw string to pass to the outside of the end caps. Light duty uPVC conduits shall not be installed on exterior surfaces where it may be exposed to mechanical damage.

Unless otherwise stated on the drawings, all conduits provided by the Principal shall terminate 200mm above the finished level.

All uPVC conduits that are not UV stabilised and are exposed to direct sunlight shall be protected by painting on the exterior, using Dimet Armoudor 920 acrylic micaceous iron oxide pigmented finished coating or an equivalent PVA or acrylic based paint. Conduits shall be mechanically abraded with a scourer, cleaned and washed then chemically etched with a suitable etching agent such as Super-etch and allowed to dry prior to painting. Colours shall match the background colours and shall be approved by the Superintendent prior to commencement. Minimum coating thickness shall be 100 microns.

5.3.6 Supporting and Mounting

The Contractor shall supply and install where necessary, all supports, brackets and plates necessary for the mounting and positioning of all electrical equipment such as switches, control stations, isolating switches, conduits, cables, cable tray and the like. All electrical equipment shall be mounted and positioned so that it is readily accessible for operation, inspection, replacement, modification and maintenance. Unless otherwise specified, all clamps, fixings, nuts and bolts, etc. installed outdoors shall be stainless steel, brass or other non-corrodible material as approved by the Superintendent.

All changes in conduit size along the length of a conduit run shall effect the size transition via a junction box or cable pit.

All junction boxes shall be weatherproof with a minimum enclosure rating of IP66 to AS 1939.

5.3.7 Cable Trays

The Contractor shall install new cable trays where specified and shown on the drawings. The Contractor shall supply and install such cable trays and associated accessories, including cable tray supports and clamps.

Cable trays and associated accessories shall be fabricated from grade 5083-H321 aluminium. Where aluminium hardware (ie. connectors, splices, cover straps, supports and clamps, etc) is not available, stainless steel components shall be used.

Cable trays shall have support at not more than 2000 centres and intermediate supports at joints. Supports shall be fastened to walls and or concrete ceilings by means of stainless steel masonry anchors and stainless steel bolts. Unless otherwise indicated, supports shall be manufactured from the same materials as the cable tray.

Cable trays run externally shall have aluminium covers to protect from UV radiation. Covers shall be edge ventilated and shall be secured at intervals of 1500mm by means of aluminium or stainless steel cover strip assemblies.

Where instrumentation type cable is installed on cable trays, the cable shall be segregated from other cables by means of a continuous aluminium barrier strip fastened to the cable tray.

Cables shall leave the cable tray in such a manner that no cable shall be in contact with the rails of the tray. In general, cables shall leave the tray in conduit, which shall be securely fixed to the cable tray by means of manufactured accessories.

Cables installed on exterior cable trays shall be completely enclosed, over their entire length, by the cable tray and cable tray cover; particular care should be taken of this requirement where cables transfer from horizontal to vertical cable trays.

5.3.8 Labels

5.3.8.1 Cable Sheath Identification Tags

All cables shall be labelled using non-metallic cable markers such as Critchley PVC black/Yellow in colour or an equivalent approved product and fixed using cable ties. Each cable, including power, control and signal, shall be labelled at its exit from and entry to switchboards, in every pit it passes through and at each termination. Cable numbers shall be shown on the cable schedule. Tenderers shall allow for a maximum of nine (9) letters or numbers for each cable. Cables for the same device shall be cable tied in each pit at 300mm centres with plastic cable ties.

The cable numbers shall be an Alpha-Numeric-Alpha combination as follows:

XXXX -	00 -	X
/	|	\
Origin of Cable	00 to 99	P - power
		C - control
Main switchboard MSB		S - signal
Sub-board 1 SB1		
Sludge heating switchboard SHSB etc.		

The cable numbers shall be developed in consultation with the Superintendent.

5.3.8.2 Identification of Cable Cores

All control and instrumentation cable cores shall be identified at each and every termination in a permanent manner, using proprietary cable ferrules. Cable ferrules shall be of a flexible plastic sleeve type with indelible alphanumeric lettering. The cable ferrules shall be designed for the cable core diameter. The ferrules shall be arranged such that all letters and numbers are in line and visible from the front of the equipment or termination opening as appropriate. Labelling shall agree with circuit diagrams and equipment terminal markings where appropriate.

5.3.8.3 Equipment Labels

Traffolyte labels shall be provided at each field mounted instrument to identify the instrument and each local isolator or stop/start station to identify the piece of plant, which it services. The traffolyte shall be suitable for outdoor exposure.

5.4 Lightning and Surge Protection

5.4.1 General

All equipment shall be protected from lightning and power surges. The protection system shall consist of surge protection devices, shielding and earthing systems. The protection system shall not affect the normal operation of equipment under normal operating conditions.

All surge protection systems shall be installed in accordance with the manufacturer's recommendations.

Materials and fasteners used in the earthing system whilst complying with the requirements of this Specification shall be adequately protected from galvanic action.

5.4.2 Earthing System

A common earthing system shall be used, ie. for surge protection devices, power, equipment cases, etc. The earthing system shall be installed to the requirements of AS 1768, AS 3000 and this Specification.

The earth system shall be tested by the Contractor and the static resistance to earth value reported to the Superintendent. If it exceeds 10 ohms the Superintendent will instruct the Contractor to install additional earthing. The Contractor shall install a 1.8m long copper earth rod a distance 3.6m from the existing earth stake and install 35 mm^2 stranded copper conductor to the new stake. The conductor shall be installed a minimum of 100mm below ground level. The Contractor shall retest the static resistance to earth and report the value to the Superintendent. If the earthing resistance

is unsatisfactory, the Superintendent will instruct the Contractor to install additional earth stakes, at a spacing of 3.6m from the other earth stakes.

Earthing conductors shall be a minimum cross sectional area of 6 mm^2 and the maximum resistance between protected components and the earthing mat or electrode shall be 0.1 ohms. The Contractor shall install the required earthing electrodes and conductors. Surge protection devices installed remotely from a switchboard shall be connected to a local earth electrode.

5.4.3 Incoming Mains

Shunt surge diverters specifically designed for multipulse lightning events on powerlines shall be installed on the main 3-phase bus of the switchboard immediately after the supply changeover switch. They are to be connected between each phase and the Neutral bar by the shortest most direct route using straight copper bar or braid with a minimum cross sectional area of 35 mm^2. Suitable fuses, in accordance with the manufacturers recommendations shall be installed between the mains and the surge diverters where the consumer's mains are protected by fuses rated at 100 amps or more. The diverters shall be rated at 275V RMS, and have be rated in accordance with the requirements of the standard components list. The devices shall be encapsulated in shock absorbent material and have 250 VAC isolated alarm contacts. Peak let through voltage as defined in AS 1768 Cat C 20 kA pulse conditions shall not exceed 900V. The devices shall have a design capability of withstanding and diverting at least 1000 20-kA Cat C pulses.

Where a site consists of a main switchboard and a number of sub-switchboards which are located remote from the main switchboard, the above surge diverters shall be installed on each switchboard.

5.4.4 Power Supply

A surge reduction filter rated at 10A shall be provided in each switchboard. The unit shall incorporate filters on the active and neutral with an earth conductor. This device shall supply power to equipment within the switchboard or the same building only.

Remote equipment shall be supplied from the unfiltered mains and shall have a surge suppression device at its remote termination. These remote devices shall have a 500 V let through voltage.

5.4.5 Signal and Data Lines

Surge protection devices shall be provided at both ends of the 4-20 mA signal cables and digital data lines that clamp the voltage to no more than 45 volts. Each device shall be securely bonded to the earthing system. The case of each transmitter and each receiver shall be connected to the earthing system. Remote transmitters shall use a local earth system. Surge protection devices are not required if the signal loop: -

- does not extend outside of the switchboard or
- does not extend outside the confines of a building

Surge protection devices shall be of the series connected type, comprising three stages of protection, fail safe operation (fail to short circuit), common and differential mode protection.

Coaxial cables shall be protected by coaxial surge protectors suitable for the frequency of operation of the radio and antenna system. They shall be Critec or Polyphasor.

5.4.6 Wiring

Filtered cables in the switchboard shall not be loomed with or run parallel to any unfiltered sub-mains or cables that terminate outside the switchboard building.

5.5 Conduit and Duct Identification

5.5.1 The Contractor shall identify all visible conduits and ladder and cable tray by the methods as detailed in AS 1345.

5.5.2 The preferred method of identification shall be the use of markers not less than 375mm long. The markers shall be located as required by Section 7 of AS 1345.

5.5.3 The pipeline markers shall have a 200mm wide full circumference band on one end consisting of equal width diagonal yellow lines alternating with the basic identification colour for electricity. A contents marker with double

arrows shall describe the contents, eg. High Voltage Power, Power Cables, etc.

5.5.4 The size of the contents marker shall be sufficient to accommodate the lettering size as required by AS 1345.

5.6 RFI (Radio Frequency Interference) Protection-VFD's only

5.6.1 General

Doors and equipment panels of VFD cubicles and VFD heat sinks, if protruding through the cubicle, shall be bonded to the welded cubicle with copper strap as specified below.

A copper earth strap of at least 150mm^2 and 100mm wide shall run in as direct a route as possible to bond the cubicle, motor terminal covers and motor frames to a new earth stake outside of the building. The earth stake shall be bolted at the top with the copper strap. Bends in the copper strap shall be minimised in order to reduce the impedance to RFI voltages.

The resistance of the bonding strap specified in the above paragraph from the furthermost end to the earth stake shall not exceed 0.05 ohms at 1 MHz. The resistance of the earth stake to earth shall be better than 1 ohm.

The Contractor shall supply and install an RFI filter on the line side of each variable speed drive, which shall meet the requirement of the following clauses.

5.6.2 Mains Filters for VFD EMI (Electro-magnetic Interference) Suppression

Differential mode insertion loss, when measured in accordance with CISPR 17, Section 4, with a source impedance of 0.1 ohm and a load impedance of 100 ohms shall not fall in the shaded area as shown on Figure 1.

Common mode insertion loss, when measured in accordance with CISPR 17, Section 4, with a source impedance of 0.1 ohm and a load impedance of 100 ohms shall not fall in the shaded area as shown on Figure 2.

Inductive components shall be constructed so that the ratio of inductance measured at full load to that measured at no load shall not exceed 0.75, measured at an ambient temperature of 40^{o}C.

The filter shall be enclosed in a separate compartment to contain RFI. Such enclosures shall be suitably sized and located to minimise Electromagnetic Coupling between the input and output lines of the filter. The filter enclosure shall be bonded to the installation's RF earthing system by copper strap at least 50mm in width or a conductor that provides an equivalent or lower impedance.

5.6.3 Harmonics

The total harmonic distortion produced by each drive shall be less than 5%. The level of the twenty-first harmonic (1050 Hz) injected into the low voltage supply shall be less than Energex's limit of 0.3% volts and shall comply with the requirements of AS 2279 Part 2 in all other aspects.

5.6.4 Harmonics and RFI Testing

Where specified in the Job Specification, the Contractor shall perform harmonic and RFI testing on the variable speed drive.

A NATA registered authority nominated by the Contractor and approved by the Superintendent shall perform the tests.

A report from the testing organisation shall be provided to the Superintendent indicating compliance with the test requirement. Should the test indicate failure of to comply with these requirements, the Contractor shall modify the installation and retest until conformance is achieved.

5.6.4.1 Harmonics Tests

Tests shall be performed on the variable speed drive to measure the amount of harmonic distortion present under normal operation.

The tests measure the harmonic voltage for each of the odd harmonics from the first (1^{st}) to the thirty-ninth (39^{th}) on each of the three (3) phases for each pump. These tests shall be carried out at five (5) speeds over the range fifty percent (50%) to one hundred percent (100%) speed under normal working conditions.

Figure 1

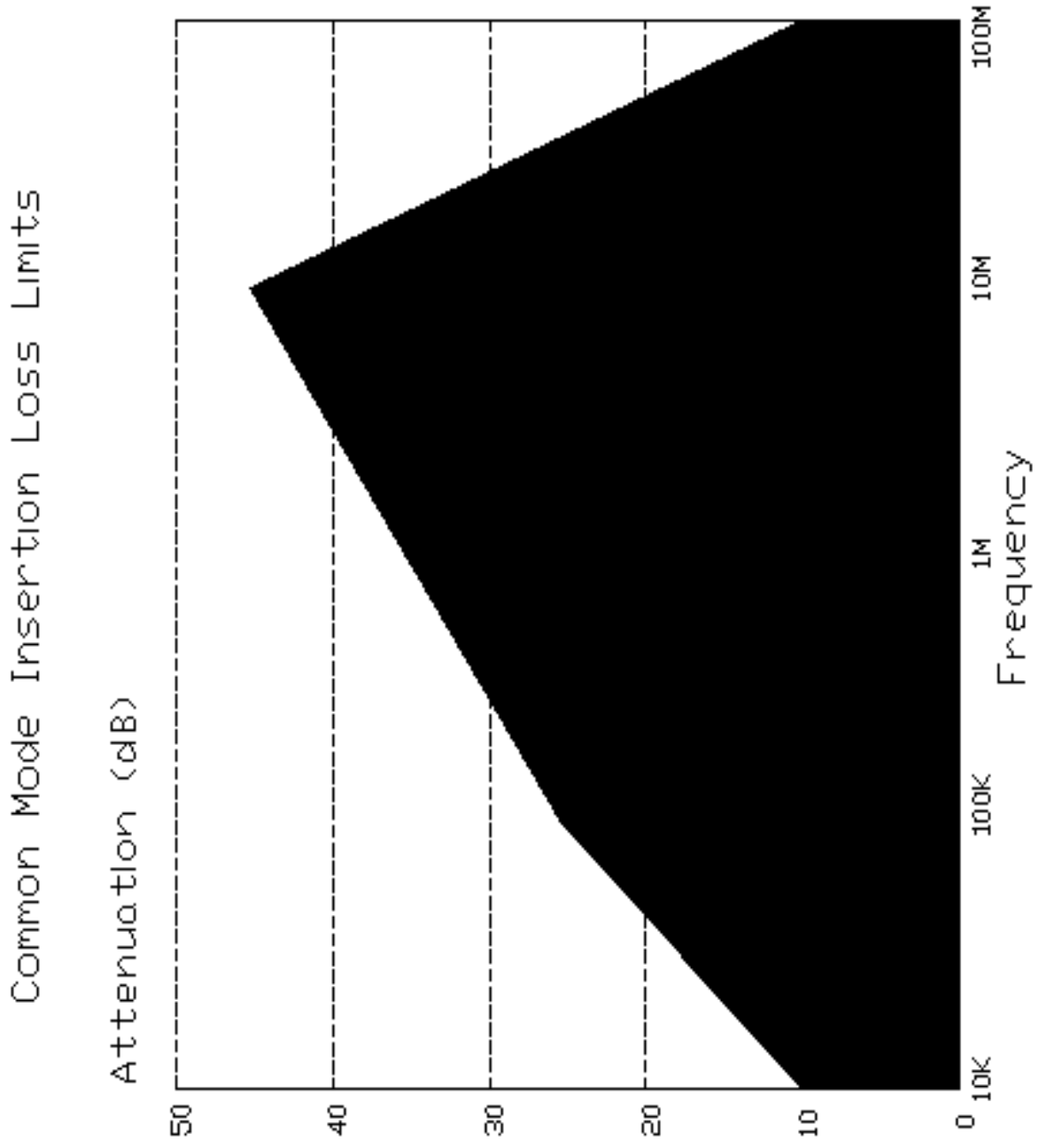
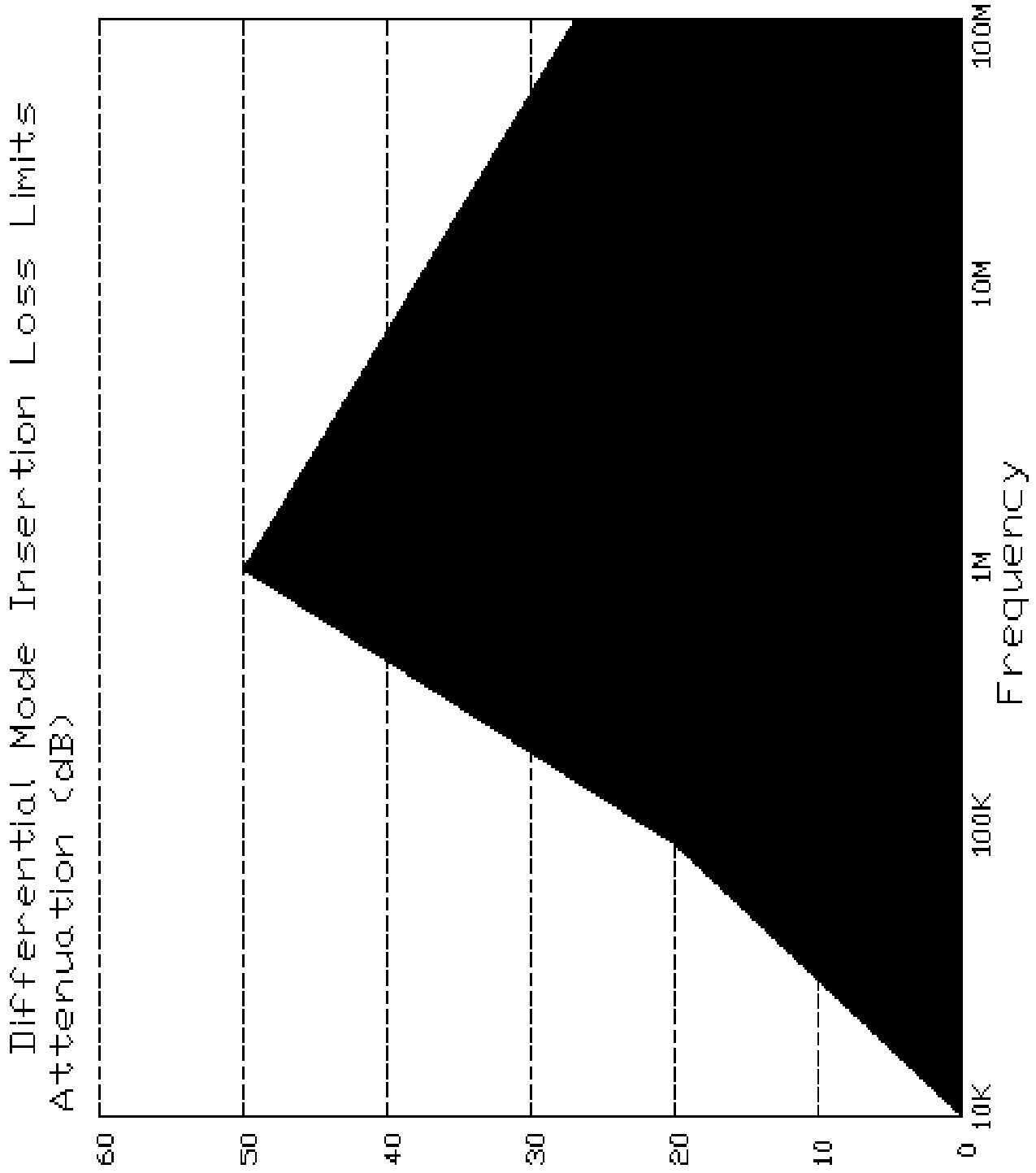

Common Mode Insertion Loss Limits
Attenuation (dB)
50
40
30
20
10
0
10K
100K
1M
10M
100M
Frequency

Figure 2


Differential Mode Insertion Loss Limits
Attenuation (dB)
60
50
40
30
20
10
0
10K
100K
1M
10M
100M
Frequency

The total harmonic distortion produced by the drive shall be less than 5%. The level of the twenty-first harmonic (1050 Hz) injected into the low voltage supply shall be less than Energex's limit of 0.3% volts and shall comply with the requirements of AS 2279 Part 2 in all other aspects.

5.6.4.2 RFI Tests

Test shall be performed on the motor unit, motor cable and switchboard to measure the radiation products and terminal noise voltages present under normal operation.

The tests shall measure the radiation products and terminal noise voltages at five (5) speeds over the range fifty percent (50%) to one hundred percent (100%) speed under normal working conditions.

Radiation products when measured at the terminals of a test aerial as specified in AS 1052 placed at a distance 2 metres from the cubicle or motor and terminated in a 50 ohm load should not exceed 25 uV in the range 150 KHz to 30 MHz and 15 uV in the range 30 MHz to 1000 MHz.

Terminal noise voltages measured at the point of mains entry to the switchboard cubicle using an RF millivoltmeter with a minimum frequency range of 100 KHz to 1 GHz should not exceed 1 mV.

All tests shall be carried out and passed before Practical Completion.

5.7 Wiring Diagrams and Information

5.7.1 The Contractor shall submit the wiring diagrams and switchboard layout drawings to the Superintendent for approval prior to manufacture commencing.

5.7.2 Electrical schematics for the installation shall be drafted on CAD in accordance with AS 1102 and shall include the following:-

i. Ammeter scales and current transformer ratios

ii. Circuit breaker and fuse current ratings

iii. A short name description of each relay, timer or control device to describe its operation

iv. A cross-reference system that indicates where each contact for a relay or timer is located. The system may include sheet and line numbers.

v. Switchboard drawings including layouts and construction details and panel wiring diagrams

vi. Items shall be designated as per AS 3702

vii. All field wiring diagrams.

5.7.3 Electrical wiring diagrams for the installation shall be produced showing all cable terminations including cable numbers, wire numbers and terminal numbers. Electrical drawings shall show fully all power and control schematics. All control and power circuits shall be drawn in full including similar circuits. There shall be no boxes drawn for similar drives with notes or part schematics to detail the minor differences.

5.7.4 A wiring schedule shall be submitted showing all cable sizes and number of cores.

5.7.5 Before the Certificate of Practical Completion is issued, the Contractor shall provide as-constructed drawings to the Superintendent, in both A3 sized hard copy and in AutoCAD DWG or DXF electronic format via CD-Rom or E-mail.

5.7.6 The Contractor shall detail the sizes and numbers of conduits required in all conduit runs. If a conduit schedule exists, the Contractor shall confirm the number and size of conduits in the schedules is suitable.

4.14 APPENDIX 4B/2 – STANDARD ELECTRICAL COMPONENTS LIST

1. Ammeters

Up to 6 kW, 90° Quadrant Scale with 72mm square case
- Crompton Instruments 243-026
- IME RQ96 Series

Above 6 kW LCD display
- Red Lion CUB4LP00 Loop Powered Indicator

2. Current Transducers (0 – 6kW)

- Burkert SC 200-1

3. Circuit Breakers – General Purpose & RCE

DIN RAIL Mount Mini Circuit Breakers (MCB's) c/w Bus Bar Combs/Chassis:
- Clipsal
- Merlin Gerin
- Terasaki
- Sprecher & Shuh

4. Circuit Breakers - Motor Circuits

- Terasaki "X" series
- Merlin Gerin
- Clipsal
- Sprecher & Shuh "KTA" series
- Telemecanique "GV2-P, GV7 series

5. Contactors up to and including 22kW

- Clipsal 6C series
- Sprecher and Schuh
- Telemecanique D Range

6. Contactors Above 22 kW

- Sprecher and Schuh
- Telemecanique D Range

7. Electronic Soft Starters

All sizes
- Telemecanique Altistart 48 series

8. Float Switches

- Flygt ENH-10
- IIT Kelco Q Series

9. Flowmeter

- ABB Mag Master

10. Power Outlets

Single Phase	• Clipsal 2000 Series
Three Phase	• Clipsal 56 Series

11. Hourmeters

- Wattmaster UWZ48E
- IME RQ48.0

12. Indication Lights (LED)

- Telemecanique XB4-BVM series
- Sprecher & Shuh

13. Light (Switchboard)

- ALI Bikini BB113/SW

14. Main Switch for Total Switchboard Load

0 to 6.0 kW	• Clipsal PT80
7.5 kW to 22 kW	• Clipsal T100
25 kW to 75 kW	• Clipsal T200
	• Terasaki
90 kW to 150 kW	• Clipsal T500
	• Terasaki
	• Merlin Gerin

15. Level Controllers for Submersible Sewage Pumping Stations

Level Sensors	• Vega Well 72–XXAA4X1DHM Pressure Monitor with Vegadis 12 Oscillator XBAX to 20-mA loop
Pump Unit Control	• Koyo PLC

16. Phase Failure Relays

- Electromatic SY175-415
- Telemecanique RM4-TA32

17. Programmable Controllers

PID Controller
- Fuji 'Z' Series
- ABB Kent Taylor C355
- RKC

18. Programmable Logic Controller
- KOYO DL 205/240
- Omron
- Modicon
- Allen Bradley

19. Push Buttons
- Telemecanique
- Sprecher and Schuh DT3 Series

20. Pressure Transmitters
- Rosemount
- ABB Kent Taylor
- Vega

21. Pressure Switches
- Square 'D' Industrial Class 9012 Type 'G'
- Telemecanique Type F
- Vega

22. Relays
- NHP Rele Finder
- National HC3L
- Omron LY Series

23. Signal Isolators
- APCS
- MANN Industries
- IIT Transtech TSC-VC

24. Surge Diverters
- Critec 3 x TDS180-4S-277
- IIT Transtech 3 x TLP 240 HP

25. Surge Reduction Filters

10 A, 1 phase
- Critec TDF-10A-240V
- IIT Transtech TLP SF10AI240V

20 A, 1 phase
- Critec TDF-20A-240V
- IIT Transtech TLP SF20AI240V

26. Switches

Auto-Off-Man Selector
- Kraus & Naimer CA10-A210-623 (with 4 screw mounting)
- Electra

Voltmeter Selector (Ph-N) screw mounting)
- Kraus & Naimer CA10-A005-622 with 4
- Electra

27. Thermistor Relays

- Sprecher and Schuh RT3-U
- Telemecanique LT3SM00M

28. Time Delay Relay

- National PMH Series
- Telemecanique RE4-ML11BU

29. Terminals (Minimum Size 6 mm^2)

- Sprecher and Schuh
- Telemecanique
- Legrand

30. Transient Barriers

- Critec UTB-36
- IIT Transtech TLP-30D

31. Voltmeter

90° Quadrant Scale with 72mm square case 0-300Volts
- Crompton Instruments 243-02V
- IME RQ72E-VAC

32. Variable Frequency Drives

- Embsy/Fuji
- ABB
- Telemecanique - Altivar

33. Solenoid Valve
- Goyen 20EW2BWZ-ENBRT-6043 (20 – 1000Kpa)

34. Solenoid Valve Timer
- NHP Crouzet OLR1

4.15 APPENDIX 4B/3 – SCADA REQUIREMENTS FOR SEWERAGE PUMP STATIONS

1 TELEMETRY AND SCADA

1.1 General

Telemetry shall be provided for the pumping station to allow its inclusion in Council's Sewerage SCADA System. The Telemetry RTU, PLC, and ancillary telemetry equipment shall be supplied by Serck Controls Pty Ltd Ph: 02 4941 1211 and purchased and installed by the contractor. Inclusion of the pumping station in the telemetry and SCADA system's CMF & RMF, spill management, amendment of reports and screens and commissioning will be undertaken by Serck Controls Pty Ltd and shall be arranged by Council

The Contractor will be responsible for any defects or failures of the Telemetry system at site for the duration of the defects liability period.

1.2 Telemetry Procurement and Installation Procedure

1. The Consultant shall prepare detail designs for the pump station and submit to Council for approval.

2. Upon approval of design Council shall:-

    - arrange radio path testing to determine most appropriate repeater and necessity for store and forward repeater;
    - advise Serck Controls Pty Ltd of requirement for new SCADA site and arrange development of PLC/PDS programs;
    - arrange Serck Controls Pty Ltd to alter configuration on both CMF and RMF, SCADA graphics, RTU's , database;
    - arrange Serck Controls Pty Ltd to Incorporate new stations data into Reports;
    - arrange Serck Controls Pty Ltd to develop spill management

3. The approved Contractor shall place an order with Serck Controls Pty Ltd, Cardiff, NSW and purchase the following equipment: -
    i a fully programmed PLC
    ii. an RTU unit preprogrammed to suit spill management and the sites applicable repeater
    iii. a power supply unit
    iv. a battery
    v. a radio
    vi. an antenna.
    vii a store and forward repeater (if applicable)

4. The contractor's electrical contractor shall install and wire all equipment into the telemetry cubicle as per Council's Std Dwgs 9833H, 9838B or 9841E. The electrical contractor shall arrange precommission testing of the station's SCADA system following installation.

5. Council's nominated radio path specialist (currently Radiocomm) shall be engaged by the contractor to undertake precommission testing of the radio signal path back to the CMF/RMF and to provide Council with a printed test sheet certifying radio signal path acceptability. In addition Council's nominated radio specialist shall also be engaged by the Contractor to install the antenna, coaxial cable and connectors.

6. Council shall carry out commission testing of the stations SCADA system including, reconfiguration of CMF/RMF screens, reports and spill management. Practical Completion shall not be considered until all elements of the SCADA system have been commissioned and are fully operational.

1.3 Input Output Requirements

The telemetry and SCADA system shall be provided with the following hardwired input/outputs. A terminal strip will be provided by the Electrical Contractor in the RTU cabinet for connection of the telemetry wiring. All telemetry input/outputs shall be wired to the telemetry terminal strip and software configured in the PLC whether a field device exists or not. The following table details these requirements.

I/O Number	Input	Wire No
Digital Inputs		
DI 1-1	Pump 1 Run	41
DI 1-2	Pump 2 Run	42
DI 1-3	Pump 1 Fault	43
DI 1-4	Pump 2 Fault	44
DI 1-5	Pump 1 Auto	45
DI 1-6	Pump 2 Auto	46
DI 1-7	Pump 1 Seal Fail	47
DI 1-8	Pump 2 Seal Fail	48
DI 2-1	Vent Fan Fault	51
DI 2-2	Compressor Fault	52
DI 2-3	Sump Pump Fault	53
DI 2-4	Odour Control Fault	54
DI 2-5	Pump 1 Manual	56
DI 2-6	Rain Gauge	57
DI 2-7	Compressor Run	58
DI 2-8	Pump 2 Manual	59
PDS DI –1	Power Fail	55
PDS DI –2	Overflow Float Switch	80,81
Digital Outputs		
DO 1-1	Pump 1 Run	103,104
DO 1-2	Pump 1 Override Run	105,106
DO 1-3	Pump 2 Run	203,204
DO 1-4	Pump 2 Override Run	205,206
Analogue Inputs		
AI-1	Well Level	60,61
AI-2	Pump 1 Current	62,63
AI-3	Pump 2 Current	64,65
AI-4	Spare	66,67
PDS AI-1	Flow	68,69

In addition the telemetry system at the pump station will provide the following information and control functions: -

1. Pump station high well level
2. Pump station overflow level
3. Spill management functions based on the sewerage network configuration as supplied by Council.
4. Overall Pump Control

1.4 Level Control

Pump unit operation shall be controlled in 'Auto' mode by the PLC/telemetry system supplied by Serck Controls Pty Ltd based on a Koyo DL205/240 PLC. PLC units will consist of the following minimum requirements: -

- One (1) DL205/240 CPU
- One (1) D2-06B 6 Slot base unit
- Two (2) D2-08ND3 Digital Input Modules
- One (1) D2-08TR Digital Output Module
- One (1) F2-04AD-1 Analogue Input Module

The PLC program shall be the Standard Developer Pump Station Program NSTD.prj as developed by Serck Controls Pty Ltd. The level signal shall be an analogue input to the PLC directly from a Vega Well 72 series hydrostatic pressure sensor supplied by the Electrical Contractor. The level transducer shall be loop powered from the telemetry 24volt-power supply.

The PLC, as well as signalling pump-operating levels, shall initiate a high wet well level alarm on the SCADA. The alarm level shall be 600mm above normal TWL. The alarm shall deactivate once the well level falls below Standby pump cut-in level. The PLC shall also initiate an 'Overflow Alarm' on the SCADA at 100mm below actual overflow invert level.

An Overflow Float Switch will be installed by the Electrical Contractor. This switch provides the Overflow Float Switch input to the Telemetry system.

The automatic pump control system shall have the following positions (descending):

- Station Overflow level
- Hard wired pump start (Overflow Float Switch)
- Well Overflow alarm
- Hard-wired pump stop (Overflow Float Switch)
- High Level Alarm
- Standby pump unit start
- Duty pump unit start
- Standby and Duty Pump unit stop.

1.5 Radio Repeater

The pump station is to communicate through the most suitable Repeater as determined by the radio signal path and Council Officers. (Subject to radio survey, a store and forward repeater may also be required for the station and, if so, will be supplied and installed at the Contractor's cost)

1.6 SCADA System Modifications

The CMF and RMF use Hunter Watertech Series 6000 SCADA software. The DEC Alpha computers will be required to have new screens configured for the pump station. This will entail a new View Screen, Control Screen and changes to the Overview Screen and Communications Screen to include the new station and any associated Store and Forward Repeater.

The SCADA control and operating software will also need modifications to include the new station. This will entail changes to the spill management software, reporting system, and any other changes necessary to make it similar in all respects to the existing SCADA system. The following lists, but is not limited to, the major software routines that need to be included.

- **Well Level** – The well level is to be displayed as both a percentage and as a bar graph on the View Screen. The type of level device (Vega) shall be displayed on the foreground of the View Screen.

- **Pump Status** – The current statuses of the pumps at each pump station are to be displayed on the View Screen in the Status Box. The box is to display Pump Available/Unavailable, Pump Duty/Standby, Pump Normal/Fault and Pump Running/Stopped.

- **Out of Service Tag** – All of the alarms at a particular pump station are to be inhibited when the Out of Service Tag is selected to 'On' at the CMF or RMF for that pump station.

- **Rainfall** – The total rainfall amount for today and yesterday is to be displayed on the View Screen. Where a pump station does not have a Raingauge, the value of rainfall for today and yesterday is to be recorded from the allocated Raingauge station.

- **Rainfall Alarm Inhibits** – When rainfall occurs at the rate of 5mm in the previous 12 hours the excess starts and excess runtime alarms are to be inhibited for the next 12 hours. Rainfall at the rate of 10mm in the previous 24 hours shall inhibit the daily runtime alarm for the next 24 hours. Both the rainfall quantity and time period shall be Operator adjustable.

- **Efficiency Calculation** – Efficiency figures are to be calculated using an Amp Hours per Kilolitre pumped efficiency figure based on the pump running current and measured flow information. This calculation is to be performed on an hourly basis and checked against an Operator adjustable setpoint. This calculation is not to be performed at pump stations without a flowmeter.

- **Efficiency Display** – The value of efficiency for the previous hour and also the previous days average efficiency is to be displayed on the View Screen. If the previous hours efficiency is outside the setpoint an alarm is to be displayed beside the calculated figure and on the Alarm Screen.

- **Pump Station Override/Inhibit** – The pumps at each pump station shall be capable of being forced to run or inhibited from running via Operator input at the CMF and RMF.

- **Pump Duty** – The duty of the pumps at each pump station shall be capable as being selected to Duty 1, Duty 2 or Cycle from the CMF and RMF.

- **Excess Runtime on a Start** – The runtime on a start is to be logged and compared with an Operator adjustable setpoint. If the runtime exceeds this setpoint, an alarm is to be generated and displayed on the Alarm Screen and on the View Screen.

- **Excess Daily Runtime** – The total runtime for each pump is to be logged for a 24-hour period and compared with an Operator adjustable setpoint. If the runtime exceeds this setpoint, an alarm is to be generated.

- **Excess Starts** – The number of starts per time period is to be logged and compared with Operator adjustable setpoints for the number of starts and the time period. If the number of starts exceeds this setpoint an alarm is to be generated on the Alarm Screen and on the View Screen

- **Runtime and Number of Starts Totalisation** – The total daily runtime and daily number of starts are to be recorded and displayed on the View Screen.

- **Pump Current Alarms** – The running current of each pump is to be recorded locally at the RTU and compared with an Operator adjustable setpoint set at the CMF or RMF. If the current is either greater or lesser than this setpoint, an alarm is to be generated.

- **Flow Totalisation** – The flow from a pump station fitted with a flowmeter is to be displayed as an instantaneous flowrate and also as a daily-totalised figure on the View Screen.

- **Level Sensor Type** – The type of Level Sensor, Vega, is to be displayed underneath the well level percentage on the View Screen. (Vega shall be used on all new stations)

- **Compressor** – At pump stations with a compressor installed the Total Daily Hours Run and Number of Starts and compressor status is to be displayed on the View Screen.

The View Screens will be configured to have the following alarms in the alarm summary table unless advised otherwise by Council staff. Where an alarm is not required, it is to be shown as NA on the screen.

Alarm	Required
Power/Phase	Yes
High Well	Yes
Float Switch	Yes
Overflow	Yes
Sump Pump	No
Odour Control	No
Vent Fan	No
Telemetry	Yes
PLC Comms	Yes

(Council use only)

Application for Sewerage Pump Station SCADA Facilities

General

Pump Station Identification.....
View Screen Title.....
PLC Program.....
Repeater Link.....
Raingauge Station Link.....

Spill Management

Diagram No.....
Upstream Pump Stations 1).....
2).....
3).....
Downstream Pump Stn - Normal.....
Downstream Pump Stn - Reverse.....
Proposed Overview Diagram is attached..... Y/N [ ]

PLC Register Values *Vega RL.....* *Overflow RL.....*

Ident	Description	RL	Prop Register Value
V4160	Well Multiplier	.....	.....
V4210	Duty Cut-in	.....	.....
V4211	Standby Cut-in	.....	.....
V4212	Cut-out	.....	.....
V4121	High Level Alarm	.....	.....
V4130	Overflow Alarm	.....	.....

Ancillary equipment

VEGA Transducer Y/N [ ] Loop powered Y/N [Y]
Flowmeter Y/N [ ] Loop powered Y/N [N]
Flowmeter Full Range.....
Current Transducers Y/N [ ] Loop powered Y/N [Y]

Transducer Ratio : 4- 20mA = ...amps
Antic Normal Run Current.....amps

Compressor Y/N [ ]
Compressor Vent Fan Y/N [ ]
Sump Pump Y/N [ ]
Odour Control Y/N [ ]
Raingauge Y/N [ ]
Other..... Y/N [ ]

(These items relate to setup of the station view screen at the CMF/RMF. Provision shall be made in the RTU for these inputs regardless of immediate requirement)

Approved Electrical Contractor: .....
Phone..... Fax.....
Contact Name.....

Council Authorising Officer:.....Phone.....

4.16 APPENDIX 4C – PUMP STATION ASSET MANUAL

ASSET MANUAL FOR SEWAGE PUMPING STATION NO. . . . . .

TABLE OF CONTENTS

1. SEWAGE PUMPING STATION ASSET REGISTER

Pumping Station No. ……

Location: .....

New installation/upgrade: ……

Commissioning Date: ……

Noosa Council files: .....

File Name:.....

2. AS CONSTRUCTED PLANS DRAWINGS (A3 FORMAT)

Description	**Consultant Plan No.**	**Noosa Council** (Council Use Only)	**Plan No.**
General Arrangement	……..		……..
Pump/system curves	……..		……..
Pressure main plan	……..		……..
Pressure main long section	……..		……..
Electrical equipment	……..		……..
Pump well diameter	…..……M		

Pressure main material, diameter, class of pipe, length:.....

.....

.....

3. EMERGENCY STORAGE AND OVERFLOW STRATEGY ENGINEER'S HYDRAULIC AND ODOUR CALCULATIONS

i) System storage between alarm and overflow levels ..... litres

ii) System overflows to.....

iii) System storage between alarm and overflow levels: .....

..... hours at ADWF

Calculations and Overflow Strategy

Attached are:-

a) hydraulic calculations

b) odour calculations

c) emergency storage calculations

d) overflow design philosophy and emergency overflow strategy

Design Loadings Pumping Station No.....……...

Design ultimate ET i) internal catchment . . . . . .

ii) external catchments . . . . . .

1. PS ....

2. PS ....

3. PS ....

4. PS ....

5. PS ....

TOTAL ET

(Note: Detached Housing Zone 3.3 EP/ET)

4. PUMPING EQUIPMENT REGISTER

PUMPS:	**Pump 1**	**Pump 2**
Manufacturer	. . . . .	. . . . .
Model No.	. . . . .	. . . . .
Serial No.	. . . . .	. . . . .
Year	. . . . .	. . . . .
Duty L/s (single)	. . . . . Head	m . . . . .
Duty L/s (dual)	. . . . . Head	m . . . . .
H-Q curve No.	. . . . .	. . . . .
Impeller dia.	. . . . .	. . . . .
Motor kW	. . . . .	. . . . .
Amps	. . . . .	. . . . .
No. of Poles	. . . . .	. . . . .
RPM	. . . . .	. . . . .
Motor Frame size	. . . . .	. . . . .
Discharge Riser pipework dia	. . . . .	. . . . .

COMMISSIONING FLOW TESTS **DATE :**……

		Pump 1	Pump 2
Single			
i.	draw-down time	. . . . . secs	. . . . . secs
ii	average pump rate	. . . . . L/s	. . . . . L/s
iii.	current reading	. . . . .	. . . . .
iv.	operating head	. . . . .	. . . . .
	shut-off head	. . . . .	. . . . .
Parallel			
i.	draw-down time	. . . . . secs	
ii	average pump rate	. . . . . L/s	
iii	current reading	. . . . .	
iv	operating head	. . . . .	

5. COPIES OF PUMP WORKS TESTS, TABLES AND GRAPHS

- Attached are copies of Pump Works Tests, Tables and Graphs.

6. DESIGN CRITICAL LEVELS TO AHD

Pumping Station No.....

- PSM level . . . . . .
- Top of station . . . . . .
- Overflow level (actual) . . . . . .
- Hard wired pump start . . . . . .
- Hard wired pump stop . . . . . .
- Valve pit floor . . . . . .
- High water alarm . . . . . .
- Inlet pipe level . . . . . .
- Standby pump cut-in (SWL) . . . . . .
- Duty pump cut-in (TWL) . . . . . .
- Duty pump cut-out (BWL) . . . . . .
- Floor level of wetwell . . . . . .

7. STATION CONTROL AND SCADA OPERATION

Pumping Station No.....

- Level control system .....
- Manufacturer .....
- Model number .....
- Ranged to (m) .....
- Transducer depth .....……..m from top of stn
- Transducer 4mA RL (AHD).....ie RL bottom of Vega
- PLC Program Filename .....
- I/O Std Drawing No .....
- C/T Installed (Y/N)..... full scale current = 20mA
- Analogue Card (Y/N).....
- Flowmeter (Y/N).....

PLC Register Values		Original	Amended
• V4210	Duty Cut-in	.....	.....
• V4211	S/By Cut-in	.....	.....
• V4212	Pump Cutout	.....	.....
• V4121	High Level Alarm	.....	.....
• V4130	O/Flow Alarm	.....	.....
• V4160	Well Multiplier	.....	.....

Register values may require amendment by Council during service due to changes in average flows or other operational conditions.

8. CHEMICAL DOSING ASSET REGISTER

Pumping Station No. ……

Location: .....

Commissioning Date:.....

Chemical: .....

Storage Container

Manufacturer:.....

Date of Manufacture: .....

Material: .....

Lining Description: .....

Capacity (l).....Serial No……

Bunding Capacity – Enclosure (l): .....

Bunding Capacity – Delivery Area (l): .....

Chemical Dosing Pumps

Manufacturer: .....

Model: ..... Serial No. ……..

Type: .....

Flow Rate (if fixed): .....

Flow Rate Range (if variable): .....

Motor kW: .....

Council Use Only	
Design Dose rate for System (Mg/l)	……
Design Ultimate Dose Vol/d (l)	……
Design Ultimate Dose Vol/m (kL)	……
Design Dose Vol/pump cycle (l)	……
Dose Pump Cycle Time (secs)	……

9. COMPRESSOR ASSET REGISTER

Pumping Station No:.....

Location: .....

Commissioning Date:.....

Noosa Council Plans:

Description:.....Plan No .....

General Arrangement: .....

Electrical Schematic: .....

Compressor

Type:……

Manufacturer:.....Model No .....

Serial No…….Receiver Capacity ……..…. …...

Design Load Cycle %.....Design Starts / hr .....

Design cut-in pressure.....Design cut-out pressure .....

Design discharge pressure to rising main .....

Design flowrate to rising main.....

Filters Brand and Stock No

Prefilter .....

Post 1.....

Post 2.....

Recommended Oil.....Volume.....

Commissioning Setup :

Receiver Pressure (a) Min.....(b) Max.....

Regulator Pressure.....

Flow Metre Reading.....

Bleed-downtime…….Recovery time .....

Actual Load Cycle %……Actual Starts/hr.....

10. ODOUR CONTROL UNIT

Commissioning Date .....

Manufacturer

.....

System Type

.....

Model

.....

Carbon Type

.....

Carbon Volume

.....

Electrical Dwg No.

.....

Electrical Drawings are attached.

11. FLOWMETER

Commissioning Date .....

Supplier

.....

Type

.....

Code .....

Serial No. .....

Primary Sensor Dia.

.....

Full Scale Flow Range

.....

Output

.....

Calibration Sheet for this instrument is attached

12. ASSET VALUATIONS

AS27 requires that Local Authorities document all new asset values. This requirement applies to assets created for new subdivisions or developments.

Sewerage Pump Station.....

General Description	Inclusions	Replacement Value ($)
Pumpwell	Wetwell, Valve Chamber roof, hardstand, ventpole base	
Metalwork	Hatches, ladders, handrails, RPZD/Telemetry cubicle, RPZD equipment, sprinkler, ventpole	
Pipework	Discharge pipe work and valves, inlet valve (internal only)	
Pumps	Pump units, stands, guide rails, installation and commission	
Switchboard	Electrical cubicle complete. Vega transducer, telemetry equipment, installation and commission	
Chemical Dosing Facility	Enclosure, bulk storage tank dosing pump, pipework installation, and commissioning	
Compressor	Compressor unit air receiver, filters, ventilation equipment, pit or enclosure installation and commission	
Odour Control	Activated Carbon Odour Unit	
Flowmeter	Instrument, primary element, pit	
Engineering	Design, Supervision, Inspection	
	TOTAL VALUE	

13. MAINTENANCE MANUALS

- Attached are maintenance manuals for all equipment installed at the station.

  (List)

5 CONSTRUCTION PHASE

5.1 SUPERVISION AND CERTIFICATION BY DEVELOPER'S ENGINEER

The developer shall engage a Consultant Engineer to supervise construction of the subdivisional or development works.

The name of the proposed contractor who is to carry out the work shall be submitted to Council for approval before construction works commence.

The Consulting Engineer and the actual Contractor approved to carry out the works shall attend the prestart construction meeting and the 'on maintenance' inspection meeting.

On completion of the construction of the work, the developer's Consultant shall certify that the works have been carried out properly and in accordance with the approved construction plans and specifications and any conditions of approval in relation to construction. The Consultant is to arrange and supervise any testing of pipelines and is to certify that it is carried out in accordance with the appropriate Australian standard.

The developer shall lodge a certificate signed by a Consulting Surveyor stating that, after completion of all works associated with the subdivision, survey marks were reinstated where necessary and all survey marks are in their correct position in accordance with the plan of survey as of a particular date.

5.2 COUNCIL INSPECTION

Council Works Inspectors will attend construction prestart meetings with the contractor and engineering Consultant. The Inspectors shall inspect and approve the works at certain stages and the developer's Consultant shall liaise with the Council Inspector on these matters.

5.2.1 Construction Prestart Meetings

1. A construction prestart meeting shall be arranged by the Consultant following receipt of drawing approval from Council. Work shall not commence prior to the prestart meeting.

2. At the prestart meeting, the Inspector will check that drawings held by the contractor are the approved plans and issue number. The contractor will be required to have copies of any relevant Council Standard Drawings. Advice will be given regarding Notice of Entry to private property and compulsory inspections required throughout the construction period.

5.2.2 Compulsory Inspections

The contractor shall contact the Works Inspector by phone to arrange inspection at the following times during the course of construction -

i) Upon delivery of pipes, fittings and bedding material prior to construction commencing;
ii) Initial excavation to determine suitability of proposed bedding;
iii) Construction of first manhole base;
iv) Prior to construction of any amendment to approved drawings;
v) Pressure testing of pipelines.

5.2.3 On-Maintenance Inspections

A 'Water and Sewerage Inspection Report' form shall be issued to the Consultant with drawing approval and shall detail the various inspections and certifications required to be addressed by the Consultant during the works to achieve acceptance 'on maintenance' by Council. A copy of this form can be found at the end of this Section (refer 5.16).

5.2.4 Release of Plans of Survey

Plans of Survey shall not be released by Council until all water and sewerage works, including pump stations, are accepted On Maintenance. This shall include submission of acceptable as-constructed information.

5.3 NON-COMPLIANCE WITH COUNCIL STANDARDS OR PROCEDURES

Any contractor who does not comply strictly with Council conditions of approval, engineering design standards, or procedures shall be formally cautioned in writing for intentional breach. After two such cautions, the contractor shall be formally requested to show cause why he should be permitted to carry out any further contract or development works in the former Noosa Shire.

Breaches shall include -

a) commencing works without formal approval
b) intentional use of unapproved or substandard materials
c) noncompliance with Workplace Health & Safety practices or Traffic Safety procedures
d) noncompliance with Council Works Inspectors' reasonable directions.

5.4 TESTING OF WATER MAINS

Water mains shall be subjected to a static pressure test following the procedure of AS2032. Testing work is to be performed by the Contractor and witnessed by the Consulting Engineer.

Alternatively, the Consultant will provide a Certificate stating the results of the test that has been witnessed. In either case, the Council Inspector is to be notified when all tests are to take place.

Additionally, each valve and hydrant installation shall be checked by the Works Inspector prior to acceptance 'on maintenance' with particular attention to the following:-

Hydrants

a) AS3952-1991 FBE or Thermoplastic, polyamide coated to manufacturer's specification
b) Maximum depth 350mm from top of box to mushroom
c) Minimum 12 bricks correctly set out in two courses
d) Surface box installed centrally over centre of hydrant
e) Hydrant lugs to be in line with direction of main
f) Hydrant cover to be installed square and with longest edge parallel with main, 40mm proud of surface level if unturfed, flush with surface level if turfed
g) Hydrant mushroom clear of sand or spoil
h) Hydrant post correctly labelled including distance to hydrant, placed outside property and painted industrial yellow
i) Hydrant lid, kerb apron and triangle on road painted industrial yellow and correctly positioned and sized.

Valves

a) Coated resiliant seated valve of approved type and manufacturer
b) Surface fittings placed centrally over valve stem
c) Top of valve stem to protrude within valve surface box or extension spindle to be fitted
d) Post painted white, correctly positioned and labelled.

5.5 TESTING OF WELDED MAINS

A) MSCL pipes 150mm dia to 375mm dia are to be tested using magnetic particle testing of all weld joints by properly qualified and experienced technicians. Companies available to carry out this service are ETRS (Ph. (07) 3275 2633) or Intico (Ph. (07) 3390 8900). Dye penetrant testing shall not be acceptable as an alternative to magnetic particle testing.

Following magnetic particle testing, hydrostatic testing to AS2032 shall also be carried out.

B) MSCL pipes in excess of 375mm dia shall be inspected for defects at each joint using radiographic testing followed by hydrostatic testing to AS2032.

5.6 FLUSHING & STERILISATION

5.6.1 Stages

Flushing and sterilising shall be carried out in three (3) stages on all newly laid mains:

- preliminary flushing (Clause 5.6.2)
- chlorinating (Clause 5.6.3)
- final flushing (Clause 5.6.4).

5.6.2 Preliminary Flushing

The main shall be flushed prior to chlorination so that a minimum velocity of 0.76m/sec. is obtained in the main. Where possible scour valves and hydrants shall be used for this purpose.

If insufficient valves and hydrants are available, a hydrant tee shall be installed at the end of the main and fitted with an orifice plate of the size listed below.

The following table gives the required orifice diameter to flush pipelines at 285 kPa pressure:

Pipe Size	*0.76m/sec. Flushing Velocity*	
(mm)	Flow (L/sec)	Orifice Diameter (mm)
100	6	22
150	13	33
200	24	44
250	37	55
300	54	66

5.6.3 Sterilising

Sodium hypochlorite solution (10% available chlorine) or other approved chlorine-bearing agent shall be used for chlorination of the main. The agent shall be added as a water mixture.
The dose of chlorine shall be at least 20 mg/L.
When the main is completely filled with chlorinated water, the section shall be closed and a contact period of 24 hours allowed.
Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.
In the process of chlorinating, all valves, hydrants and other appurtenances in the newly laid pipe section shall be operated while the pipeline is filled with the chlorinating agent.
If added as a water mixture, the sodium hypochlorite shall be diluted to approximately 1 percent chlorine solution (10,000 mg/L) which is prepared in the following proportion:

1 kg of sodium hypochlorite to 10 litres of water.

The following table gives the chlorine requirements for 100 metre lengths of pipe:

Pipe Size (mm)	*Volume of 100m Length (m^3)*	*Amount required to give 20mg/L chlorine using 1% chlorine water solution (litres)*
100	0.79	1.6
150	1.77	3.5
200	3.14	6.3
250	4.91	9.8
300	7.07	14.1

The preferred point of application of the chlorine-bearing water mixture is at the beginning of the pipeline extension or any valved section of it and through a cock inserted in a tapping band. The required dose is added as each section of the main is filled. In a new system, application of chlorine may be made at an elevated tank, standpipe or reservoir providing these are properly cleaned first and with due allowance for the volume of water in the tank, standpipe or reservoir.

5.6.4 Final Flushing

Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipeline at its extremities.
Care should be taken in disposal as the solution is aggressive and toxic. Dechlorination may be required prior to discharge.

Kg of Chemicals required to neutralise various residual chlorine concentrations in 1,000 kL of water				
Residual Chlorine Concentration (mg/L)	*Sulphur Dioxide SO_2*	*Sodium Bisulphite $NaHSO_3$*	*Sodium Sulphite Na_2SO_3*	*Sodium Thiosulphate $Na_2S_2O_3.5H_2O$*
1	1.0	1.4	1.7	1.4
2	2.0	3.0	3.5	2.9
10	10.0	15.0	17.5	14.4

5.7 CONNECTION OF WATER MAINS

Connection of new reticulation mains to Council's system shall be carried out by Council staff at the developer's full cost following approval by Council's Works Inspectors. Council shall supply all necessary fittings for the connection and the cost of these will be charged to the developer. The contractor shall ensure that any new mains approach the existing main to which it is to be connected at the same vertical level to avoid the use of unnecessary bends or sloping tee branches.

5.8 TESTING OF SEWERAGE RETICULATION MAINS

All pipelines shall be subjected to an internal hydrostatic or pneumatic test after completion of pipelaying. This test shall be carried out after backfilling takes place although the contractor may elect to carry out an additional test at his own expense at the completion of pipelaying.

The contractor shall supply all the equipment necessary to carry out the specified tests which shall be conducted in the presence of the Works Inspector and Consultant.

The test shall be conducted on the full length from manhole to manhole with house connection branches adequately capped. For house drains, the longest practicable length shall be tested and all joints shall be tested. For other pipelines the condition of the test shall be determined by the Superintendent.

5.8.1 Hydrostatic Testing

For hydrostatic testing, each end of the pipeline shall be sealed with a suitable water tight plug, and the pipes filled with water. All trapped air shall be removed from the pipeline.

The hydrostatic test shall be carried out with the surface of the water not less than 600mm above natural surface or not less than 2 metres above the crown of the pipe at the head of the line. The test shall be maintained until the volume of the make-up water on completion of a 30 minute test period is not more than 2.5 litres/100mm dia per 100 metres length of line but the time from the initial filling of the pipeline to the end of the test period shall not exceed 25 hours.

If the result does not comply with these requirements for make-up water within the 25 hour period, the pipeline shall be deemed to have failed the test. Pipelines should not normally be subjected to a hydrostatic head exceeding 9 metres. There shall be no visible leakage at joints or in the body of the pipes.

5.8.2 Air Testing

For air testing, each end of the pipeline shall be sealed with a suitable airtight plug. The air shall be added to the line to slowly raise the air pressure to a maximum of 50kPa. After allowing the air temperature to stabilise by holding this pressure for 10 minutes, the time taken for the pressure to fall from 45kPa to 40 kPa shall be recorded. The test shall be accepted if the time taken does not exceed the time limit as set out below:

Size of Pipeline (mm dia)	Minimum Permissible Time (Minutes) for the Pressure to fall from 45 kPa to 40 kPa per 100 metres length of line
100	6
150	14
225	30
300	54
375	85
450	122
525	165
600	216
675	273
750	338
825	408
900	486

The pressure gauge shall be calibrated for reading between 0 and 70 kPa. It shall be accompanied by a calibration certificate issued by an approved testing authority within the preceding three months. The gauge shall be preceded by an approved pressure reducing valve set to reduce pressure at 60kPa +/- 5kPa. An apparatus shall be provided to enable the pressure gauge to be checked against a water column, and such a check shall be carried out at the Superintendent's direction. The pressure gauge shall be immediately followed by a pressure relief valve with an adjustable operating pressure up to 60kPa.

5.9 TESTING OF SEWERAGE MANHOLES

Testing of sewerage manholes shall be carried out in accordance with the Vacuum Testing Procedures listed in Clause 5.9.1. All manholes not tested by the Vacuum Test Method shall be tested by either the Infiltration Method or the Exfiltration Method described in Clauses 5.9.2 and 5.9.3 respectively.

5.9.1 Vacuum Testing

(a) ***General***

Concrete manholes to be tested shall be selected by The Water Agency, independently of the Constructor.
Vacuum test not fewer than the number of manholes as shown in Table 5.9.1(b). Where projects contain both precast concrete and cast in-situ manholes, view each type as a separate population and the criteria of Table 5.9.1(b) shall apply to each population separately within the project. If any of the sample manholes fails the initial test, test all remaining manholes in that population.

Any manhole showing evidence of cracking, leaks, or any other defect that, could compromise the integrity of the manhole, shall be Vacuum Tested in addition to the requirements listed in Table 5.9.1(b). Such testing shall be carried out at the Constructor's cost at any time nominated prior to or during the On-Maintenance Period.

Test after placement and compaction of embedment surround.

(b) ***Manhole Testing Frequency***

5.9.1.1.1 Table 5.9.1(b)

Concrete Manhole Testing Frequency

Number of each type of MHs in the project	Minimum percentage tested initially	
	Cast in-situ concrete	Pre-cast concrete
≤ 5	20%	100%
6 to 10		50%
11 to 20		33%
> 20		25%

(c) ***Test Method***

Apply an initial test vacuum pressure (negative pressure) of approximately 37 kPa to the top of the manhole. Close the valve on the vacuum line and shut off the vacuum pump. Allow the air pressure to stabilize for at least 3 minutes to identify any initial leakage.

When the pressure has stabilized and is at or below the starting test vacuum of 33.8 kPa of mercury, commence the test by allowing the gauge pressure to drop to 33.8 kPa, at which point initiate time recording. Record the time for the vacuum to drop to 30:4 kPa.

Accept the manhole under test if the time for the vacuum reading to drop from 33.8 kPa to 30.4 kPa meets or exceeds the relevant time in Table 5.9.1 (d).

If the time is less than the minimum specified in Table 5.9.1(d), re-apply the vacuum to identify any leaks.

Rectify all defects prior to conducting any further testing.

Rectify any visible or audible faults even if the vacuum testing is satisfactory.

(d) ***Minimum Test Times for Concrete Manholes***

5.9.1.1.2 Table 5.9.1(d)

Minimum Test Times for Concrete Manholes

MH Depth (metres)	Manhole Diameter (mm)				
	900	1050	1200	1500	1800
	Time * (seconds)				
2.4	14	17	20	26	33
3.0	18	21	25	33	41
3.7	21	25	30	39	49
4.3	25	30	35	46	57
4.9	29	34	40	52	65
5.5	32	38	45	59	73
6.1	35	42	50	65	81
6.7	39	46	55	72	89
7.3	42	51	59	78	97
7.9	46	55	64	85	105
8.5	49	59	69	91	113
9.1	53	63	74	98	121

NOTE: *Times for intermediate diameters and depths may be interpolated.*

(e) Vacuum Testing to be carried out by a certified testing agency such as “Pipeline Testing Services”, 31 Smallwood St, Underwood Q 4119, phone 3841 5100, or any other agency certified to carry out such testing.

Test results are to be submitted to Council prior to acceptance of works On-Maintenance.

5.9.2 Infiltration Method (High Groundwater)

All inlet and outlet pipes shall be plugged. If infiltration of water exceeds 7 litres in a 24-hour period, the manhole will be deemed to have failed.

5.9.3 Exfiltration Method (Well Drained Ground)

Manholes and inspection chambers shall be tested for water tightness by plugging off the connected sewers and house drains and filling the manhole with water. The test shall be satisfactory if the level does not drop by more than 25mm in 24 hours. If the manhole concrete is dry at the time of the test, the Manager Sewerage may permit a preliminary period of soaking prior to measuring the drop in water level.
The Council Works Inspector shall determine which method of hydrostatic testing is most suitable for the site ground conditions.

5.9.4 Failure of Tests - Pipes and Manholes

In the event that a pipeline fails either test, the contractor shall locate the leaks and take the necessary steps to repair these leaks. The test shall be repeated until the pipeline complies with the above standards to the satisfaction of the Manager Sewerage.

In the event that a manhole fails a Vacuum test, infiltration or exfiltration test, the manhole is to be dismantled to the leaking construction joint and rebuilt, or completely reconstructed to the approval of the Manager Sewerage.

5.10 CLOSED CIRCUIT TELEVISION TESTING (CCTV)

Following visual inspection and pressure testing, all sewerage reticulation mains and sewerage pressure mains (i.e rising mains) shall be inspected by closed circuit television (CCTV) prior to acceptance 'on maintenance'.

CCTV inspection will be carried out by Council's annual CCTV contractor and arranged by Council following satisfactory completion of construction works. The developer will be responsible for the full cost of CCTV inspection, including any additional inspection necessary following defect identification and rectification. This charge is payable within 14 days of commencement of works and will be determined on the unit rate basis current at the time of approval.

5.11 CONNECTION OF SEWERAGE MAINS

Connection of sewerage mains to council's live sewerage system shall be performed by Council or specific contractors approved by Council following all cleaning of lines, inspections and acceptance 'on maintenance'. The full cost of the works shall be borne by the developer. The developer's contractor shall supply all required fittings and pipes for the cut-in as well as carrying out excavation, trench support, dewatering, bedding, backfilling and full restoration of site following completion of works.

5.12 TESTING OF SEWERAGE PRESSURE MAINS

Testing of sewerage pressure mains i.e. rising mains shall be hydrostatically tested as per the method used for testing of watermains detailed in Clause 5.4.

Hydrostatic testing is to be carried out following acceptance by Council of CCTV inspection reports. Adequate provision for entry of CCTV equipment is to be made in the pipeline during construction. Entry points should be located at suitable intervals and be sealed using long sleeve gibault joints. All gibault joint locations shall be accurately detailed on as-constructed drawings. The Developer shall be fully responsible for opening and closing of CCTV entry points during inspection.

5.13 TESTING OF SEWERAGE PUMP STATIONS

Following completion of all works and certification of electrical connection by the electrical contractor, Council's Sewerage Operations Manager shall perform drawdown testing to determine actual flow rates of the installed pumping equipment.

Clean water from Council's mains shall be used or alternatively the contractor shall arrange and pay for a tanker to supply water for testing purposes.

The pump station shall be deemed to have failed commissioning tests if the flowrate of each single pump unit does not perform to the approved design pump duty.

5.13.1 Anti-Backflow Equipment

RPZD and associated equipment shall be tested by an accredited licenced plumber commissioned by the contractor and a certified test certificate submitted to Council, together with a copy of the plumber's accreditation to test such devices.

5.13.2 Telemetry

The contractor shall be fully responsible for installation, connection and precommission testing of SCADA equipment to ensure that the pump station is satisfactorily connected to Council's telemetry system. This shall involve simulation of faults and monitoring at the Council's Central Monitoring Facility (CMF). The contractor shall liaise with Serck Controls Pty Ltd to identify and rectify any problems or defects identified. The station shall not be commissioned until telemetry is fully operational.

Council's nominated radio path specialist shall be engaged by the contractor to undertake precommission testing of the radio signal path back to the CMF/RMF and to provide Council with a printed test sheet certifying radio signal path acceptability.

5.14 MAINTENANCE PERIOD

The defects liability and maintenance period shall be a minimum of fifty two (52) weeks for all water supply and sewerage works. The maintenance period shall be extended for any significant defects requiring rectification during this period.

5.15 MAINTENANCE BONDS

Maintenance bonds accompanied with certification of contract sums shall be lodged to Council by the developer. Such bond must be lodged by, and shall only be accepted from, the developer for the works. The amount of the maintenance bond for water supply and sewerage works shall be 5% of the agreed value of the development obligations or $1,500, whichever is the greater amount. (Development obligations refers to all conditions of approval relative to

the development permit. This includes, but is not limited to, water & sewerage works, 'as constructed' information, and test certificates.) The bond shall be held for the duration of the maintenance period and shall only be released following acceptable performance of the works and release ‘off maintenance’ by Council.

5.16 APPENDIX 5 – WATER & SEWERAGE INSPECTION REPORT FORM

NOOSA COUNCIL

WATER & SEWERAGE INSPECTION REPORT FORM

Job Name: ..... **File:** .....

Consultant: ..... **Contractor:** .....

	Date	Officer	Remarks
Approved Drawings Rec'd			
Insurances Checked			
Pre-start Meetings			
Approved Plumber			
Pressure Tested Sewer			
Manholes Tested			
Pressure Tested Water			
Water Service Inspection			
CCTV			
Cert. Practical Completion			
On Maintenance Inspection			
Pump Station Inspection			
OK for Cut-ins			

Defects

Details Rectified			
As Con Drawings Accepted			
Survey Marks in Place			
Blocks, Easements Pegged			
Accepted Off Maintenance			

Comments

6 AS CONSTRUCTED REQUIREMENTS

6.1 GENERAL

Council requires as constructed information for water and sewerage reticulation works to be submitted in two formats:

A. A3 size paper drawings at a scale of 1:1000

The hardcopy "As Constructed" drawings (A3 size) for all sewer and water are to be signed and certified by the developer's consultant for lodgement to Council's Water & Sewerage Department.

Note: Normally, A3 size paper is submitted for checking prior to submission of digital format.

"As Constructed" A3 paper drawings for all water supply and sewerage works are to be lodged with Council prior to acceptance 'On Maintenance'.

B. Digital format using *ADAC* (Asset Design & As Constructed) routine as supplied by Council.

6.2 PART A - PAPER DRAWINGS, ASSET VALUATIONS

6.2.1 As- Constructed

The linetype representing constructed works is to be prominent and at least one or two thicknesses greater than lines for property boundaries and the like.

For multi-stage developments, Council requires copies of plans at every stage of development.

6.2.2 Sewerage As Constructed

Paper on A3 sheets at 1:1000 are required of plan view only.

6.2.3 Requirements for Sewerage As Constructed

i. Street names and Lot numbers

ii. Sewerage easements detailing setback distances

iii. Asset Register Key for each sheet. The key would be unique to each 1:1000 sheet to limit the number of Asset Attribute code numbers used.

iv. "As Constructed" contours at a suitable contour interval (generally 1M), or on level sites, i.e. where crossfall on the allotment is less than 600mm), RL's at each corner of allotment and building setbacks.

v. HCB details.

vi. As Constructed invert levels of MH inlets and outlets.

vii. As Constructed manhole to manhole distances.

viii. Asset Attribute number for each manhole length (or change in Attribute if a later stage takes off from a dead-end cap, not a manhole. Asset Attribute number refers to the set of attributes - material, class, date laid.

ix. Manhole positions other than 1.5 x 1.5 from real property boundary to be dimensioned. Manhole as constructed top of lid levels. Manhole types - insitu, Precast, Non Access (GRP, Polyprop., PVC)

x. Rising mains should be noted with material, class and date laid. UPVC rising mains should also be noted either AS2977 (Blue Brute and Vinyl Iron) or AS1477. The Asset Attribute number system should only contain the Catchment number.

xi. Manholes should be numbered with the Council adopted system detailed in Clause 3.7 that has a unique number for each manhole within a pump station catchment.

xii. Title block should detail:
- Name of Subdivision
- Name of Consultant
- Name of Surveyor
- Date of Construction

6.2.4 Water Reticulation As Constructed

A3 paper sheets at 1:1000 are required.

6.2.5 Requirements for Water As Constructed

i. Lot layout

ii. Lot numbers and RP/SP on each lot

iii. Street name

iv. Conduit (100 upvc) crossing position, water service and water meter locations

vi. Asset attribute data –

- diameter
- date commissioned
- material
- class
- fittings (uncoated, coated)
- long water service (copper)

vii. Valve, tee, hydrant positions.

viii. A table of water meter serial numbers on the plan detailing Lot No. and RP/SP number for each lot installed.

6.2.6 Sewerage Pump Station As Constructed

As Constructed requirements, including asset valuations, for sewerage pump stations are detailed in Clause 4.11.

6.2.7 Asset Valuations

AAS27 requires that Local Authorities document all new asset values. This requirement applies to assets created for new subdivisions or developments.

A. Watermain

Size (mm)	Replacement Value ($ per m)	Length Laid
100		
150		
200		
.....		

B. Sewermain

Size (mm)	Replacement Value ($ per m)	Length Laid
150		
225		
.....		

C. Sewer Rising main

Size (mm)	Replacement Value ($ per m)	Length Laid
100		
150		
.....		

D. Manholes

Manholes	Average replacement value (each)	Number Constructed
1,070mm dia.		

If Consultants use the ***ADAC*** Data Utilities (detailed Clause 6.2) for the presentation of design data on the construction drawings and there is no additional "As Constructed" information due to construction being within tolerance, then the information would be acceptable for "As Constructed" submission.
However, Council still requires the submitted hardcopy drawings to be marked "As Constructed" and signed and certified by the developer's consultant.

6.3 PART B – DIGITAL FORMAT

6.3.1 Data Format

The "As Constructed" data is to be submitted on, CD-ROM, or emailed in PC compatible format to The Water Agency at email address idasreferrals@sunshinecoast.qld.gov.au .

The digital formal shall be *DWG*. Information stored in such files shall be compiled using the *ADAC Data Utilities* in accordance with the *ADAC User Guidelines* – refer 6.3.2).

6.3.2 ADAC Data Utilities

Council has adopted the use of the *ADAC Data Utilities* for the generation of digital as constructed asset plans in partnership with other regional Local Authorities (the former Maroochy, Caboolture, Caloundra Shire Councils and the Brisbane City Council). This partnership intends to achieve a uniform standard for the submission of digital data across the region.

The ADAC Data Utilities and User Guidelines are available to all consultants free of charge and can be downloaded from the ADAC website. Any party downloading the utilities and/or guidelines will be registered for software licensing control and for ease of provision of upgrades.

The ADAC Data Utilities are primarily AutoCAD based with modules to cater for the input of Roads, Stormwater Drainage, Water Supply, Sewerage, and Cadastral information. The ADAC data utilities automate the process of linking textural attribute information to the graphical asset features created during design or gathered with field survey.

7 PLAN PRESENTATION AND DOCUMENTATION

7.1 DETAILS OF CONSTRUCTION DOCUMENTS

The construction documents shall comprise, but shall not be limited to the following:

1. Construction plans, containing relevant Council Standard Drawings
2. Specifications for construction of the works
3. Department of Transport (Main Roads Division) approvals where applicable
4. Department of Environment Waste Discharge approvals where applicable.

7.2 CONSTRUCTION PLANS

The construction plans drawn in accordance with AS1100 shall be prepared and signed by the consultant and shall be submitted for all sewerage reticulation, sewer pump stations and water supply reticulation works.

The construction plans generally shall contain sufficient information to allow adequate checking of the plans and for the construction of works. This means the plans should normally incorporate the following:

- Title Block
- Locality Plan
- Layout and Stage Plan
- Plan of each new road
- Detailed plan of proposed sewer reticulation (refer Section3.3.3.9 for details)
- Proposed sewer pump details (refer Section 4 for details)
- Longitudinal sections of sewer lines
- Detailed plan of proposed water supply reticulation (refer Clause 2.3.3.1 for details)
- Extent of existing vegetation and proposed clearing limits

7.3 DETAILS TO BE INCLUDED ON CONSTRUCTION PLANS

Without limitation, the following information should be included in each of the above depending on the size and layout of the subdivision.

7.3.1 Title Block

- Estate name (if any) and Council Application reference number
- Real property description
- Locality
- Developer's name• Scales
- Plan number and sheet number
- Schedule and date of amendments

- Signed checked and approved by the Consultant
- Survey datum and identification of survey mark used in the design
- North point when appropriate

7.3.2 Locality Plan

Location of the subdivision in relation to adjacent towns, main roads, major street etc. For minor developments this may be shown as an inset on the detail plan.

7.3.3 Layout and Stage Plan

For large subdivisions, the layout plan should show the relationship of all new roads to each other, and to existing roads adjoining the subdivision. Where development is to be carried out by stages, the boundaries of proposed stages should be shown on this plan, and the stages identified by numbering.

All site cut/fill earthworks including existing and finished surface contours shall be shown on the layout plan.

For small subdivisions, where all new roads can be shown on one detailed plan, the layout plan may be omitted.

7.3.4 Water Supply and Sewerage Construction Plans

Drawings submitted to Council for approval shall be similar to the samples for Noosa Waters Development which appear at the end of this Section as Appendices 7 (a) to (f):

(a)	Water Master Plan	Dwg 1754/0-10
(b)	Sewer Master Plan	Dwg 1754/0-9
(c)	Water Reticulation	Dwg 1754/17-11
(d)	Sewerage Reticulation	Dwg 1754/17-8
(e)	Sewerage Longitudinal Section	Dwg 1754/15-25
(f)	Pump Station Layout	Dwg 1754/18-C3

7.3.5 Water Reticulation Drawings

Water reticulation drawings are to include roads and road names, kerb and channel location, Lot layout and Lot numbers, location of conduits and water meters, electrical pillars, existing and proposed water mains including all valves and fire hydrants. Do not include contours, stormwater pipelines, sewerage pipelines or other services. Drawings should contain all general construction notes as detailed on sample Water Reticulation Plan 1754/17-11 (Appendix 7(c)).

7.3.6 Sewerage Reticulation Drawings

Sewerage reticulation drawings are to include contours at suitable intervals to adequately assess landfall of allotments without being cluttered, roads including road names, Lot layout and Lot numbers, stormwater layout, sewerage reticulation layout including manhole

numbers, house connection branch location, HCB type and design and I.O. level. For any proposed development where there exists significant vegetation, a tree location survey is to be submitted detailing the proposed clearing limits.

Sewerage longitudinal sections are to include chainage, surface and invert levels, pipe size, type of material and class, location and levels of other services, proposed cut and fill profiles and house connection branch type, location and inspection opening level for each Lot serviced. Refer Clause 3.3.41 for details.

7.3.7 Sewerage Pump Station Drawings

A pump station site plan drawing is to be submitted and is to include the pump station location in relation to roads and allotments and incoming sewerage lines, access road location suitably dimensioned detailing construction material, vent pole and switchboard location, rising main location and longitudinal section, overflow pipe location and longitudinal sections.

These drawings should also include an access hatch arrangement for the particular station, system head curves and proposed duty point and structural and operating levels of the station.

7.4 PUMP STATION GENERAL ARRANGEMENT AND DETAILED STRUCTURAL DRAWINGS

Pump station general arrangement and detailed structural drawings are to be as per the most recent version of Council Standard Drawings 9823-9841, suitably edited to reflect actual levels of the proposed station. Autocad files of these Standard Drawings on diskette are available from Council upon request.

7.5 DRAWING SHEET SIZES

All engineering plans shall be submitted on standard sized sheets, the following sheet sizes only being acceptable:

Size	Scale	Overall Dimensions
A1	1:500	841mm x 594mm
A3	1:1000	420mm x 297mm

7.6 SCALES

i) Plan scales shall be 1:500. Where A1 sized drawings are reduced to A3 format the actual scale of 1:1000 is acceptable providing all details are legible. Actual plan scales of smaller than 1:1000 are not acceptable.

ii) Longitudinal sections shall generally be 1:1000 horizontal x 1:100 vertical on A1 sized drawings and may be reduced to A3 format (i.e. 1:2000 horizontal and 1:200 vertical) providing all details are legible.

iii) Other details should be scaled as appropriate in accordance with Standards Association and NAASRA namely 1:1, 1:2, 1:2.5 and 1:5 and multiples of ten of these scales.

7.7 DIMENSIONING OF PLANS

Linear dimensions on all plans will be in metres, with the exception of some detail plans of small structures (e.g. manholes) and some standard plans which may be in millimetres. Details of methods of dimensioning shall be in accordance with AS1155 - Appendix A - Metric Units in Construction.

7.8 CHAINAGE

Chainage on plans shall be expressed to two decimal places, i.e. 17.01(m).

7.9 LEVELLING

All levels shall be to Australian Height Datum, and indicated on the plans. In general, all levels on plans shall be expressed in metres to two decimal places. Reduced levels of Bench Marks and Reference Pegs shall be expressed to three decimal places (i.e. 0.001m).

7.10 APPROVAL OF CONSTRUCTION DOCUMENTS

7.10.1

Initial submissions of construction documents to Council for approval shall comprise two sets of relevant documents listed in Clause 7.1 with details as listed in Clause 7.2 including a list shown on the drawings of Council Standard Drawings and Specifications to be used for specifying the works.

7.10.2

Once engineering documents are considered satisfactory by Council, three (3) complete sets of construction documents, containing A3 sized plans, shall be lodged with Council for Council's records and for use by Council's Inspectors.

7.10.3

In approving documents for construction, Council does not accept any responsibility for the correctness and/or accuracy etc of the documents and it shall be the total responsibility of the Consultant to ensure that the designs detailed in the documents are workable. If any discrepancy arises during construction, between these Guidelines and the approved drawings, then the provisions of these Guidelines shall apply.

7.11 CONSTRUCTION OF THE DEVELOPMENT WORKS

Construction shall not commence prior to receipt of Council's approval. The Consultant shall give Council's Inspector 7 days notice of intention to commence construction and the name of the proposed contractor shall be submitted to Council for approval.

7.12 APPROVED CONTRACTORS

Only recognised, experienced civil engineering contractors shall be permitted to carry out water supply and sewerage construction works. Unknown experienced civil engineering contractors may be approved upon submission of acceptable references and satisfactory recommendations from other local authorities for previous work recently undertaken.

The names of any proposed contractors for works are to be submitted in writing by the developer's consultant, together with copies of current Public Liability and Workers compensation Insurances, for consideration for approval by the 7 days prior to prestart meetings and commencement of works. A separate letter will then be issued to the consultant approving the contractor (or otherwise) for the works. No other contractor or subcontractor shall be engaged to carry out the works or any part of the works without the written approval of the Water & Sewerage Capital Works Manager.

7.13 PRESTART MEETINGS

A prestart meeting shall be convened prior to commencement of any water or sewerage works. Construction prestart meetings are to be attended by both the supervising consulting engineer and the actual contractor or subcontractor engaged to physically carry out the works, and the Council's Works Inspector. Seven days notice shall be given prior to prestart meetings.

7.14 APPENDICES 7(A) - 7(F) - SAMPLE DRAWINGS

(copies of sample drawings can be obtained from council on request)

8 STANDARD DRAWINGS

(copies of Standard Drawings can be obtained from Council on request)

SUBMERSIBLE SEWAGE PUMPING STATION

9823B	Submersible Sewerage Pump Station - General Arrangement
9824B	Submersible Sewerage Pump Station - Fabricated Metalwork
9825	Reinforcement - Pressure Gauge Arrangement Air Release Pipework Details
9826K	Telemetry and Backflow Prevention Device Cubicle and Pumpwell Sprinkler System
9827	Disconnector Box and Base
9828B	Construction and Fabrication of 7.2m Vent Pole
9829B	Construction and Fabrication of 12.0m Vent Pole
9830	Aluminium Ladders

SEWERAGE PUMP STATION ELECTRICAL & TELEMETRY

9831L	Pumping Station Telemetry RTU Interface
9832H	Pumping Station Telemetry – RTU General Arrangement
9833H	Pumping Station Telemetry – RTU & PLC I/O Connection Diagrams (Schematic circuitry for telemetry hardware)
9834D	Pump Station Cubicle Layout 0 - 6kW
9835E	Pump Station Cubicle Layout 7.5 - 22kW
9836B	Standard Power Schematic 0-6kW D.O.L.
9837C	Standard Control Schematic 0-6kW D.O.L.
9838B	Telemetry Connections & Equip. List 0-6kW D.O.L.
9839D	Standard Power Schematic 7.5kW and above soft starter
9840E	Standard Control Schematic 7.5kW and above soft starter
9841E	Telemetry Connections & Equip. 7.5kW and above soft starter

POLICY HISTORY

PSP06 was adopted by Council 3 November 2005 and effective 3 February 2006