TITLE:

DEVELOPMENT CONSTRUCTION GUIDELINE

SEWERAGE SYSTEM

July 2008

MACKAY REGIONAL COUNCIL

DEVELOPMENT CONSTRUCTION SPECIFICATION - SEWERAGE

REVISION RECORD

VERSION	AMENDMENT DETAILS	CLAUSES AMENDED	DATE ISSUED	AUTHORISED SIGNATURE
1	Original Version	-	15/03/2006	
2	Generally revised version with major upgrades	All	02/02/2008	

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APPENDICES:

ABBREVIATIONS

ABBREVIATION	INTERPRETATION
ABS	Acrylonitrile Butadiene Styrene
AHD	Australian Height Datum
AOP	Allowable Operating Pressure
AS/NZS	Australian / New Zealand Standard
DA	Development Approval
DICL	Ductile Iron Cement Lined
DIEL	Ductile Iron Epoxy Lined
DN	Nominal Diameter
EN	European Standard
EMP	Environmental Management Plan
ERS	Emergency Relief Structure
FBPE	Fusion Bonded Polyethylene (“Sintakote”)
GRP	Glass Reinforced Plastic
IDAS	Integrated Development Assessment System
IPA	Integrated Planning Act
ITP	Inspection and Test Plan
KL	Kilolitre
KPA	Kilopascal
KW	Kilowatt
L/S	Litres per second
MA	Milliamps
MAOP	Maximum Allowable Operating Pressure
MEN	Multiple Earthed Neutral
MGA	Map Grid of Australia
MH	Maintenance Hole
MPA	Megapascal
NPSHA	Net Positive Suction Head Available
NPSHR	Net Positive Suction Head Required
P&ID	Process and Instrumentation Diagram
PLC	Programmable Logic Controller
PN	Nominal Pressure Class
PVC	Polyvinylchloride
PVC-M	Polyvinylchloride modified
PVC-O	Polyvinylchloride orientated
PVC-U	Polyvinylchloride unplasticised
RPEQ	Registered Professional Engineer Queensland

RPZD	Reduced Pressure Zone Device
RRJ	Rubber Ring Joint
SCA	Switchgear and Control gear
SCADA	Supervisory Control and Data Acquisition
SCL	Steel Cement Lined
SEL	Steel Epoxy Lined
SS	Stainless Steel
WSAA	Water Services Association of Australia
WS-SPEC	Water Services Specification
WWSS	Wastewater Swirl Separator

DEVELOPMENT CONSTRUCTION SPECIFICATION- SEWERAGE

C402.01 APPLICATION OF THE SPECIFICATION

Application

This Planning Scheme Specification functions as part of the Integrated Development Assessment System (IDAS) under the Integrated Planning Act (IPA) and is applicable to the design of new sewerage infrastructure and/or upgrades of existing sewerage infrastructure within the Mackay Local Government Area.

C402.02 PURPOSE

Purpose

This Specification, has the following functions:

(a) To nominate the Water Services Association of Australia (WSAA) Codes and associated documents as the general requirements to be met for the Asset Creation process within the Mackay Regional Council Area of jurisdiction.
(b) To specify parameters, requirements and functions contained within the Codes that Council is to nominate or to amend.
(c) To specify additional technical and/or administrative matters (that are not otherwise specified within Australian Codes or Standards) pertaining to Operational Works applications made in accordance with the Queensland Integrated Planning Act (IPA).
(d) To specify any technical requirements not covered by the Codes.
(e) To identify materials, solutions and methods permitted by the Codes that are not acceptable to Council.
(f) To specify preferred options where the Codes provide for several methods to deal with a particular issue.

C402.03 STRUCTURE

Structure

This Planning Scheme Specification, is based upon compliance with the Sewerage Code of Australia (WSA-02) and the Sewage Pumping Station Code of Australia (WSA-04) and is complimented by the strategic product specifications and technical requirements contained within WS-SPEC National Water Industry Specifications.

WSA-02 & WSA-04 are available from the Water Supply Association of Australia (WSAA), email: info@wsaa.asn.au. WS-SPEC is available from the Saiglobal Webshop at www.saiglobal.com/shop.

C402.04 SUMMARY OF THE ASSET CREATION AND APPROVALS PROCESS

Approvals Process

For the Asset Creation process within the Mackay Regional Council Local Government Area the essential process is as follows:

(a) Pre-lodgement discussions and concept development
(b) Lodgement of an Operational Works Application with Council
(c) Scrutiny of conceptual design / development plan by Council
(d) Information request by Council if required
(e) Planning Approval by Council
(f) Submission of detailed design to Council
(g) Scrutiny of detailed design by Council
(h) Information request by Council if required
(i) Approval of the Operational Works Application by Council (as determined)
(j) Construction and commissioning work
(k) Final connection.
(l) Sealing of Plan of Survey, if applicable.
(m) Submission to Council of request for release of Maintenance Bond
(n) Remedial work as required
(o) Completion and handover
(p) Release of Maintenance Bond by Council.

C402.05 ENVIRONMENTAL MANAGEMENT

Environmental Management

Construction of infrastructure shall be planned and executed to minimise impact on the environment. Where a choice of alternative solutions is possible, an objective environmental risk assessment shall be undertaken to give due weight to reducing the risks to the environment resulting from the construction and operation of the infrastructure.

The Contractor shall prepare and submit an Environmental Management Plan (EMP) for the site of the works. This EMP shall be submitted to Council 14 days prior to the commencement of construction. Construction work shall not be permitted to commence until Council has advised the Contractor that the EMP is accepted by Council in regard to the proposed measures for environment protection. As a minimum, the EMP shall include:

(a) Stormwater management and erosion control
(b) Vegetation removal
(c) Stockpiling and reuse of materials on site
(d) Removal of excess material from the site
(e) Protection of existing flora and fauna
(f) Noise and dust control
(g) Management of Excavation in Acid Sulphate and Contaminated Soils
(h) Management of excavation in tidal areas
(i) Management of excavation in environmentally sensitive areas

C402.06 CONNECTIONS TO COUNCIL'S INFRASTRUCTURE

Connections to Existing Infrastructure

The connection of new sewerage infrastructure to Council's existing system forms part of the infrastructure realisation to be carried out at the Developer's expense. Normally, the Contractor shall carry out the connection unless:

(a) Council, in exceptional circumstances, decides to carry out the connection work. Such circumstances may include connection to trunk mains, complex systems and connection in areas with operational difficulties.
(b) The Developer requests that Council makes the connection on the understanding that the connection work will be carried out at Council's convenience subject to its other work commitments.
(c) Council's representative believes that the Contractor is not competent to make the connection or that the Contractor is not adhering to safe working practices.

When Council makes the connection, an estimate of cost will be provided to the Developer and the connection will not be made until the payment is received.

Where the Contractor is to make a connection, the Designer is to co-ordinate the work and the processes for inspection and payment. Council shall be given 5 working days notice of the work to enable Council to provide staff to operate valves and isolate pumping stations as necessary and to monitor the Contractor's work. An estimated cost of the monitoring shall be agreed prior to notice being given. The estimated cost and a signed undertaking to pay the actual costs of the work when completed shall accompany the notice.

The Contractor's are not permitted to operate Council's infrastructure unless written approval has been obtained from–Council. The placement and removal of plugs within live sewers must be done under direct monitoring of Council's representative.

Council reserves the right, on advice of its representative, to stop, or take over a connection being undertaken by a Contractor, if in the representative's opinion the Contractor is incapable of completing the connection work in a reasonable time without causing damage to Council's infrastructure or undue inconvenience to the public.

Property connection requirements shall be met by providing a connection point to each property in accordance with Clause 5 of WSA-02 as amended herein.

C402.07 DEFINITIONS

Definitions

Asset Creation means any or all aspects of the planning, design, construction, supervision of construction, testing and commissioning and eventual handover of sewerage infrastructure

Contractor means a private contractor approved by Council to construct sewerage infrastructure on behalf of a Developer.

Council means Mackay Regional Council and the Mackay Water & Waste business unit of Mackay Regional Council.

Designer means a Professional Engineer who is qualified in Queensland (currently met by a person being registered as a Registered Professional Engineer Queensland (RPEQ) and is competent to perform the engineering works required for the Asset Creation process on behalf of a Developer.

Developer means the person who has submitted a planning application for the provision of infrastructure under the Asset Creation process or for the utilisation of existing sewerage infrastructure.

IDAS means the Integrated Development Application System under the IPA

IPA means the Queensland State Integrated Planning Act 1997.

Surveyor means a licensed surveyor, endorsed in the Register of Surveying Associates, Surveying Graduates, Surveyors (Body Corporate) and Surveyors (Individual) who is competent to perform the surveying work required for the Realisation of Infrastructure on behalf of the Developer.

Sewer Reticulation means pipe work less than DN375 and for which connections are permissible.

Switchgear and Control gear Assembly means main switchboard, main distribution board, distribution board, control board, electrical kiosk, electrical panel, control panel or similar enclosure

Trunk Mains means pipe work equal to or greater than DN 375, and for which no connections are permissible.

The Code means the Sewerage Code of Australia (WSA-02) and the Pumping Station Code of Australia (WSA-04), both published by the Water Supply Association of Australia (WSAA).

WS-SPEC means the national standard water industry specifications published by NSW Department of Public Works and Services.

C402.08 SCOPE

Scope

The work to be executed under this Specification consists of the construction, commissioning and handover to the Council of a constructed sewerage system, as either a stand-alone project or part of a development and its integration into the existing sewerage system.

The work shall be undertaken under Council's Asset Creation process which shall comply in all respects with relevant Statutory Legislation, Codes of Practice, Australian Standards and with Councils local laws, policies and guidelines.

The Contractor shall ensure that all works procured in the Asset Creation process shall comply in all respects with the requirements of and/or intent of this specification and referenced documentation.

This Specification contains procedures for the construction of the following elements of a water supply system.

(a) Gravity sewers, including trunk mains and reticulation sewers,
(b) Junctions and property connections.
(c) Maintenance holes and other structures.
(d) Rising mains.
(e) Pump stations, including odour control facilities, emergency storage, emergency backup power, monitored emergency relief structure and other ancillary facilities to effect a fully operational pump station.

The Contractor shall provide all necessary plant, equipment, labour, and materials that are required to meet the intent and / or the requirements of this specification and referenced documentation.

C402.09 ORDER OF PRECEDENCE

Where discrepancy or contradiction in documentation may occur, the order of precedence for documents specifying the works to be undertaken (from highest to lowest order of precedence) shall be as follows:

(a) This specification
(b) Mackay Regional Council Standard Policies Specifications and Drawings
(c) Sewerage Code of Australia (WSA-02) and the Sewage Pumping Station Code of Australia (WSA-04) (equal)

C402.10 REFERENCE DOCUMENTS

Documents referenced in this Specification are listed below. The Contractor shall possess, or have access to; the latest edition of all documents required to comply with this Specification, including all current amendments and supplements of those documents. The Contractor shall include all relevant specifications and requirements of these documents into the design of the works.

a) Council Planning Scheme Policies

15.14 Development Design Specification - Sewerage

b) Council Policy Documents

Council Policy - MW16 Clearance to Water and Sewerage Assets
Council Policy - MW02 Building Over or Adjacent to Sewers
Council Policy –PSP16.03 Developer Contributions
Council Policy –D20 Drawings and Documentation Guidelines

c) WSAA Codes of Practice,

WSA-02 – Sewerage Code of Australia
WSA-04 Sewage Pumping Station Code of Australia

d) WS-SPEC Water Services Specification,

e) Australian Standards

References in this Specification or the Drawings to Australian Standards are noted by their prefix AS or AS/NZS

The Designer shall use the latest edition of all relevant Australian Standards, including all current amendments, supplements and replacements applicable thereto.

Australian Standards are listed within WSA-02 & WSA-04

(f) Council Standard Specifications

Council Standard Specification for Electrical Assets

g) Other Documents

Institute of Public Works Engineering Australia (IPWEA) Streets Opening Conference. Information Bulletin on Codes and Practices (Sections 3 and 4, detailing locations and depths of other services and preferred location for sewerage pipes).

Water Resources Guidelines for the Planning and Design of Sewerage Systems". Department of Natural Resources

h) Council Drawings

C402.11 COMPLIANCE AND AMENDMENTS

The construction of gravity sewers shall comply with the Water Services

Compliance

Association of Australia's publication SEWERAGE CODE OF AUSTRALIA (WSA-02) unless specified otherwise herein. Amendments made by MACKAY REGIONAL COUNCIL to WSA-02 are included below. Where conflicts occur between the requirements of this table and other documents, the requirements of this table shall prevail. The design of pump station and rising main components shall comply with the Water Services Association of Australia's publication PUMPING STATION CODE OF AUSTRALIA (WSA-04) unless specified otherwise herein. Amendments made by MACKAY REGIONAL COUNCIL to WSA-04 are included below. Where conflicts occur between the requirements of this table and other documents, the requirements of this table shall prevail.	***with and Amendments to WSA-02 & WSA-04***

Amendments to WSA-02 Note: The Clause numbers given below correspond to the relevant Clause numbers given in the Sewerage Code of Australia WSA-02 (2002).	***Clause No. in WSA-02***
The definitions of service reticulation and trunk main shall be as per **Clause C402.07 Definitions** above.	***Glossary***
GENERAL All pipeline materials used for sewerage infrastructure shall comply with the relevant sections of WS-SPEC and the specific project requirements of Council as detailed herein. Council's minimum requirements for gravity reticulation pipe work are as follows: (a) mPVC, uPVC or oPVC: rubber ring jointed, SN8/SN10. (b) PE: electrofusion or butt fusion, minimum SDR 17 (c) DI: rubber ring jointed, polyethylene sleeved, SR type cement or epoxy lined, minimum Class 21. (d) GRP: rubber ring jointed couplings, minimum SN10000 stiffness. (e) VC: spigot and socket type using roll on rubber ring (elastomeric) joints. All products and materials used for the creation of infrastructure shall comply with the relevant sections of WS-SPEC as applicable for the respective pipe materials. **PVC PIPE AND FITTINGS (GRAVITY PIPES)** PVC gravity pipes and fittings shall be compliant with Section SP4 of WS-SPEC. The Contractor shall ensure that PVC pipe specified is compatible with ductile iron (DI) pipe where necessary. Pipe shall have smooth external wall to AS1260 for less than or equal to DN150mm. Ultra rib is acceptable for pipes greater than DN150mm. Pipes and fittings shall be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage	***10.6 Pipe Material and Specifications***

and type of cover. All exposed uPVC pipe work shall be painted to protect it from UV light using a water based acrylic paint. **DUCTILE IRON PIPE AND FITTINGS (GRAVITY PIPES)** Ductile iron pipes and fittings shall be compliant with Section SP2 of WS-SPEC. Pipes cast into concrete shall be power-tool cleaned to AS 1627. **VITRIFIED CLAY (VC) PIPES AND FITTINGS (GRAVITY PIPES)** VC pipes and fittings shall be compliant with WS-SPEC, section SP7**.** Pipe and fitting shall be spigot and socket type using roll on rubber ring (elastomeric) joints. Natural rubber shall not be used in rubber ring joints. **POLYETHYLENE PIPE AND FITTINGS (GRAVITY PIPES)** PE Pipes and Fittings shall be compliant with WS-SPEC, section SP6. PE pipes shall be manufactured in either PE80B or PE100 polymer material. **GLASS REINFORCED PLASTIC(GRP) PIPE AND FITTINGS (GRAVITY PIPES)** GRP pipes and fittings shall only be used with prior approval of Council. If approved, GRP pipes and fittings shall be compliant with Section SP5. Pipes and fittings shall be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of cover. All exposed GRP pipe work shall be painted to protect it from UV light using water based acrylic paint.	
The Contractor shall not change the pipeline alignment without prior concurrence of Council. The Contractor shall provide full details, of any proposed changes to the pipeline alignment to Council prior to undertaking any such works. This action constitutes a **HOLD POINT**. The Contractor shall obtain the decision of Council prior to the release of the hold point.	***13 General Construction***
The Contractor shall all ensure that all reasonable care is taken during the construction of the works to ensure that existing utility services are protected against damage or interference whatsoever. If existing utility services are damaged during the course of the works, through any cause whatsoever, the Contractor shall be fully responsible for all costs associated with rectification of the utility services, to the satisfaction of the Council or the utility service owner as appropriate, regardless of the accuracy of any prior location advice given by Council, the utility service owner or its agent. Where it is necessary to relocate or alter existing utility services, the Contractor shall make all necessary arrangements with the appropriate	***13.5.2 Protection of Other Services*** ***Damage*** ***Relocations and / or***

authorities concerned.

Alterations

The Designer is to ensure that all known utility services detailed on the engineering drawings are accurately located by non-destructive field location immediately prior to construction, and it is the Contractor's responsibility to have such services confirmed in the field prior to any excavation commencing in their vicinity of the works.

Field Locating of services

The Contractor shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits. Any materials showing any visible signs of delamination, deflection, cracking, or other defect as per the manufacturers guidelines shall be immediately rejected.

14.2 Rejected Products and Materials

All concrete work shall be compliant with WS SPEC Sections SP43, 44 & 45 and TR10. Classes of concrete used for the construction of the works shall be as follows:

14.5 Concrete Works

Application	**Grade (F'c at 28 days**	**Min cement content (kg.m3)**	**Max w/c ratio**
Blinding concrete, mass concrete	N15	-	-
Surface footpaths and driveways	N25	-	-
Unreinforced thrust blocks, anchor blocks, bulkheads, and conc. encasement in all environments	N25	-	-
Reinforced thrust blocks, anchor blocks, bulkheads, and conc. encasement in all environments	N32	-	-
Maintenance holes and benching – all environments	S40	380	0.50
Valve chambers and flowmeter pits in non–aggressive environments	N32	-	-
Valve chambers and flowmeter pits in aggressive soil and groundwater environments	S40	380	0.50
Underground pumping station wells - in all environments.	S40	380	0.45

Aggressive environments are defined as exposure to :
1. Seawater, anaerobic waters, swamp water tidal flats, sewage, effluent and the like, including exposure to intermittent saturation.
2. relatively high levels of chlorides, sulphides and /or sulphates, relatively high or low pH, levels, as defined within Appendix B of SW-SPEC Section SP-43, exposure classification 3 (moderate) and above.

Cementitious materials for concrete shall comply with Appendix B of WS-SPEC SP-43.

For other than water retaining structures, cover to reinforcement shall comply with the relevant Exposure Classifications within AS3600 but shall not be less than B1 normally, or C for aggressive conditions.

For water retaining structures, cover to reinforcement shall comply with the

requirements of AS3735. Concrete surfaces exposed to aggressive environments shall be provided with a protective coating compliant with WS-SPEC Section TR-20. The protective coating applied shall be in addition to the concrete cover requirements.	
The Contractor shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the Drawings, or as directed by Council, within the specified tolerances. The Contractor shall comply with all requirements of the appropriate Authority including having regard for drainage, dewatering, silt control, noise abatement, proximity to existing buildings and generally for the amenity of adjacent owners When excavation of the trench has been completed the Contractor shall obtain the Council's approval prior to commencing pipe laying, jointing and bedding. This action constitutes a **HOLD POINT**. The Council's approval of the excavated trench is required prior to the release of the hold point. All excavation, bedding and backfilling for pipe laying operations in adequate foundations shall be compliant with Council Drawing No. A3-854 revision A All excavation, bedding and backfilling for pipe laying operations in inadequate and poor foundations shall be compliant with A3-854 revision A Drawing.	***15 Excavation***
The Contractor shall install safety fencing to Statutory requirements along the edges of open excavations to isolate them from the public. The Contractor shall provide fenced walkways and vehicular crossways across trenches to maintain access at all times from carriageway to individual properties or within individual properties and advice beforehand all affected residents. All such installations shall be of adequate size and strength and shall be illuminated to prevent accidents. The Contractor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open	***15.1 Safety***
The Contractor shall leave a clear space of 600mm minimum between the edge of any excavation and the inner toe of stockpiles. No excavated materials shall be stockpiled against the walls of any building or fence without the written permission of the owner of such building or fence. The Contractor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open. The Contractor shall locate, protect and repair, as necessary, all services affected by the Works at the Contractor's expense. Where the Drawings provide for a trench to be excavated across a paved surface, the width of the trench shall be kept to a minimum. Bitumen and concrete surfaces shall be carefully cut, by saw cutting or other means approved by the Superintendent, so as to provide a neat straight line free from broken ragged edges. The Contractor shall widen the trench where necessary for the installation of valves and fittings and application of protective coating systems. The minimum clear width of trench (inside internal faces of timbering or	***15.2 Limits of Excavation***

sheet piling, if used) to a height of 150mm above the top of the pipe shall be as shown in Table below:

NOMINAL SIZE OF PIPE (DN)	MINIMUM CLEAR WIDTH OF TRENCH (mm) (inside timbering or sheet piling, if any)
100	600
150	600
200	600
225	600
250	600
300	900
375	900
400	900
450	950
500	1200
525	1200
600	1200

Where the Drawings provide for a trench to be excavated across a paved surface, the width of the trench shall be kept to a minimum. Bitumen and concrete surfaces shall be carefully cut, by saw cutting or other means approved by Council, so as to provide a neat straight line free from broken ragged edges.

The Contractor shall widen the trench where necessary for the installation of valves and fittings and protective coating systems.

The Contractor shall ensure that suitably qualified trained personnel are engaged to undertake all work associated with shoring and support, specifically in compliance with statutory obligations (refer specifically to Sections 203-212 of the WH&S Act). All temporary support shall be appropriately designed, be adequate and effective to maintain stability of excavation, having account for all possible loadings that could occur. The Contractor shall adequately support all excavations as the works proceed. When withdrawing supports, the Contractor shall exercise every precaution against slips or falls. The Contractor shall ensure that timber support be left in place where its removal may endanger structures in the vicinity of the excavation. Where steel shoring is used, such shoring shall comply with AS4744.1.	***15.6 Support of Excavations***
Where foundation material shows any signs of movement, groundwater ingress or any other possible instability, and such instability cannot be controlled by conventional means, the foundation material shall be assessed by the Designer for adequacy of structural support. If ground conditions dictate the need for remedial works, such works shall be of a detailed nature provided in writing by the Designer to the Contractor.	***15.8 Foundations and Foundation Stabilization***
Topsoil from excavations shall be stockpiled separately and utilised to restore the site after backfilling. Excess spoil shall be removed from the site and disposed off site at an	***15.9 Surplus Excavated Material***

approved landfill location. Excess acid sulphate and contaminated soils disposed off site shall be treated as per the environment management plans for such materials prior to disposal.	
Refer to Council drawing No A3-854 revision A	***16 Pipe Bedding***
The Contractor, employees, or subcontractors, engaged in excavations, including tunnelling, are to be accredited for the work. Proof of accreditation constitutes a HOLD POINT. The Approval of Council, to the supplied documentation, shall be required prior to the release of the hold point.	***17 Pipe Laying and Jointing***
The minimum depth of cover to be provided for water supply pipe work measured vertically from the finished ground level to the top of any socket shall be in accordance with Council Standard Drawing No A3-854 revision A Lesser covers may be provided where special protection of the pipelines has been shown on the Drawings or as directed by the Council's representative.	***17.1 Installation of Pipes*** **Cover over pipelines**
The Contractor shall ensure that the interior of the pipeline is clean and free from obstructions. Plugs shall be used to prevent foreign matter entering sections of pipeline which are left uncompleted overnight. Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Contractor and jointly by Council. The Contractor shall suspend each pipe length in a sling to enable Council to inspect it. For field cuts, a mechanical pipe cutter shall be used, except that PVC/PE pipes may be cut using a power saw or a fine toothed hand saw and mitre box. For field cuts of ductile iron or steel, the Contractor shall ensure that fire fighting equipment, in working order, is on the site prior to the field cuts being made. If the Contractor proposes to use a petrol engine pipe cutter in an excavation, the Contractor shall ensure that a safe atmosphere is maintained in the excavation at all times. The Contractor shall prepare the ends of any pipes cut in the field to the manufacturer's written instructions, or as directed by Council. Where pipes are cut in the field, the Contractor shall make a witness mark on the pipe using a felt-tip marking pen at the length specified by the manufacturer from the end of the pipe. The Contractor shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the Contractor shall refer to the socket manufacturer for the correct marking depth. Cut surfaces in metallic pipes shall be suitably protected from corrosion by end treatment with equivalent protective coatings and linings as originally provided by the manufacturer. Cut surfaces in GRP pipes shall be suitably protected from deterioration by end treatment with a resin layer to the manufacturer's guidelines.	***17.1.2 Cleaning Inspection & Joint Preparation*** ***Examination*** ***Pipe Cutting***

For valves, if directed by Council on examination, the Contractor shall oil valves and repack valve glands.	
After laying and jointing of a pipeline has been completed the Contractor shall present the laid and jointed pipes for inspection by Council prior to the commencement of trench backfilling. This action constitutes a **HOLD POINT**. Council's approval to the laid and jointed pipes is required prior to the release of the hold point. Backfill shall not be placed until Council has given approval.	***Inspection of laid pipes by Council***
The Contractor shall make the joint such that the witness mark shall, at no point, be more than 1mm from the end of the socket.	***17.1.4 Laying Witness Marks***
Where PVC pipes are to be joined to ductile iron pipes, the joints shall be made by inserting a PVC spigot into a ductile iron socket. Ductile iron spigots shall not be joined to PVC sockets. Alternatively, multi-fit mechanical couplings or flanged adaptor couplings may be used to join pipes of different materials.	***Dissimilar Materials***
The Contractor shall conform to the relevant Statutory and OH&S requirements when cutting and disposing of asbestos cement pipes.	***Existing AC Pipe***
Unless otherwise directed by Council, the Contractor shall lay pipes on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface.	***Grade***
Detectable identification tape shall be laid along the line of non-metallic mains within 150mm of the finished surface.	***Detectable Tape***
Flexibly jointed pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The Contractor shall comply with the manufacturer's written recommendations in respect of maximum deflection for each joint provided that no joint shall be deflected to such an extent as to impair its effectiveness.	***17.2.2 Joint Deflection***
The maximum angle of deflection between adjacent pipes shall be limited to 2^{o} or 0.035 radian in areas subject to mine subsidence or slippage.	***Limit of Joint Deflection***
The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. The Contractor shall remove any temporary supports prior to completion of backfilling.	***17.4 Flotation Control***
Construct trenchstops as detailed in WS-SPEC Section TR-14.	***17.5 Trenchstops***
Construct bulkheads as detailed in WS-SPEC Section TR-14.	***17.6 Bulkheads***
The Contractor shall provide junctions spigots into end of line manholes and property connection sewers or risers to properties to serve existing and future dwellings in accordance with this Specification and the Drawings. Such junctions shall be inserted along pipelines in locations shown on the Drawings or directed by Council, with the service connection, where not	***17.7 Property Connection Sewers*** ***Location***

shown on the Drawings, provided at a depth no deeper than 1.0m provided the property still has service to the sewer, as follows: (a) For existing dwellings, at the most practical point not outside the property boundary to facilitate the connection, considering existing sewage outlets. Separate connections shall be provided for dual occupancies. (b) For vacant blocks, at the most practical point not outside the property boundary to facilitate the connection, considering topography and likely positioning of sewage outlets.	
Where the sewer is intended to serve a large block and/or where the sewer line is located more than 75m from the premises, the Contractor shall extend the property connection sewer onto that block such that the maximum horizontal measurement in a straight line between the sewer connection point and the premises on the block is not more than 75m. All property connection sewers and junctions shall have a minimum diameter of 100mm and have a screwed access cap. Property connection sewers shall have a maximum length of 6m.	***Long Property connection sewers***
The Contractor shall clearly mark the position of each riser, junction or end of a property connection sewer on completion of backfilling. The marking shall be made by one of the following methods but the location of the mark or peg shall be consistent with the method(s) in use by the Sewer Authority and to the approval of Council.	***17.9 Marking of Property Connection Sewers and Dead Ends***
Where the position of a riser, junction or the end of a property connection sewer is at a substantial boundary fence or structure located on the boundary, a neatly stencilled letter "J" 50mm high shall be painted thereon. An underground identification tape, as specified hereafter, shall finish flush with the existing ground surface as close to the boundary fence or structure as possible.	***Adjacent to Fence***
Elsewhere, the Contractor shall drive into the ground, a peg, 75mm x 50mm x 600mm long at that position, and left flush with the surface of the surrounding ground. The Contractor shall connect the peg to an underground identification tape as specified hereafter.	***Peg***
The Contractor shall tie the identification tape to the junction or end of the property connection sewer and hold the tape in a vertical position during backfilling. The Contractor shall spike the top end of the tape by the junction peg immediately upon completion of backfilling. (WSA 02 Part 3, section 17.9)	***Tape Position***
The identification tape shall be 75mm wide red coloured polyethylene tape with the inscription "Caution - buried sewer line", printed in heavy black letters every 200mm.	***Identification Tape***
Ductile iron pipe work shall be provided with protective polyethylene sleeving installed in accordance with the pipeline manufacturer's instructions or epoxy coating as specified in the design. Steel pipe work shall be protected by fusion bonded polyethylene (FBPE, known commercially as Sintakote) or epoxy coating. At welded joints, the pipeline shall be protected from corrosion by the application of either polyethylene heat shrink sleeves or by a suitable petrolatum tape wrap system in accordance with the manufacturer's installation requirements.	***17.10 Corrosion Protection of Ductile Iron and Steel Pipes***

Where a pipeline crosses a Main or State road, creek or involves features shown on the Drawings, under the control of any Authority, the Contractor shall carry out the work in accordance with the requirements of that Authority. The Contractor shall provide written notification to the Authority of the intention to carry out the work, and pay the appropriate fees. The Contractor shall obtain the written approval from the Authority prior to commencement of work. Such written approval shall be supplied to Council if requested. This action constitutes a **WITNESS POINT**. Council shall advise at the time of notification by the Contractor whether the option to request the written approval is to be exercised. Where shown on the Drawings, the Contractor shall use trenchless methods for the installation of the sewer mains. The installation of the sewer main by open trenching shall not be permitted over the lengths designated for trenchless installation. The Contractor shall address, in its Method Statement for trenchless conduit installation, the following:- (a) General description of method and sequence of operation. (b) Size, depth and position of temporary pits required. (c) Use of specialist subcontractors. (d) Specialist equipment to be used. The enveloper pipe shall be as detailed on the Drawings. The encasement pipe shall extend 1.0m behind the back of the kerb on either side of the carriageway. The carrier pipe shall be positioned on support cradles and the carrier pipe shall be centrally located within the enveloper pipe. After installation and pressure testing of the carrier pipe, the Contractor shall fill the annular space between the carrier pipe and the enveloper pipe as directed by council Where the carrier pipe is ductile iron cement lined (DICL), any length of pipe which is enclosed within the encasement pipe need not be wrapped in polyethylene tubing.	***17.12 Bored Pipes under Roads*** ***Crossings*** ***Contractors responsibility*** ***Existing Road Crossings*** ***Trenchless Installation Methodology*** ***Enveloper Pipe*** ***Support Cradles*** ***Wrapping***
Construct maintenance holes with concrete using Type SR cement. Fly ash additive to a maximum 20 per cent may be used. Cement used shall be no older than three months since manufacture.	***18 Maintenance Holes Concrete***
Preformed maintenance hole components shall comply with AS/NZS 1477 for PVC, AS 2033 for PE, AS 3518 for ABS, AS 3571 for GRP and AS 4198 for concrete. Preformed maintenance holes may be used in lieu of cast in-situ systems with prior approval of Council. Preformed system components shall not be delivered to the site before satisfactory documentary evidence has been submitted to Council that quality tests have been carried out. This action constitutes a **HOLD POINT**. The Council's Approval to the quality test	***18.4 Preformed Maintenance Holes and MS Systems*** ***Approval***

documentation is required prior to the release of the hold point.	
The Contractor shall supply components that make a watertight system and have a satisfactory surface finish.	***Water tight components***
Generally, preformed maintenance holes shall be made up in accordance with the Drawings, with components consisting of a base section, shaft sections of section lengths such as to minimise the number of joints required, a cone section, cover and frame. Make-up rings may be used between cone sections and frames to make up height differentials up to a maximum height of 200mm. The wall thickness of any reinforced component below the frame shall not be less than 84mm.	***Component Assembly***
The installation of all preformed components shall be in accordance with the Manufacturers' recommended procedures and requirements.	***Manufacturer's Procedures***
Backfill for all preformed maintenance holes and maintenance shafts shall be placed and compacted evenly around the maintenance hole to a level 300mm above the top of the highest incoming pipe and for the full width of the excavation. If necessary, the Contractor shall import and compact non-cohesive granular material.	***Backfill***

Cast iron maintenance hole covers and frames shall comply with AS 3996 and shall be suitable for concrete filling. The size and class shall be as shown on the Drawings.	***18.9 Maintenance Holes and Frames***
Concrete covers and frames shall comply with AS 4198 and shall be of the size and, either Heavy or Light, class as shown on the Drawings.	***Cast iron***
Covers and frames shall not be warped or twisted. Surfaces shall be finished such that there are no abrupt irregularities and gradual irregularities shall not exceed 3mm. Unformed surfaces shall be finished to produce a surface that is dense, uniform and free from blemishes. Exposed edges shall have a minimum 4mm radius. Covers and frames shall not be delivered to the site before satisfactory documentary evidence has been submitted to Council that quality tests have been carried out. This action constitutes a **HOLD POINT**. Council's approval to the quality test documentation is required prior to the release of the hold point.	***Concrete*** ***Standard***
Tolerances for the dimensions on the COVER shall be - 3mm + NIL.	***Cover Tolerance***
Tolerances for the dimensions on the FRAME shall be -3mm +3mm.	***Frame Tolerance***
Maintenance hole covers shall be finished flush with the surface in roadways, footpaths and paved surfaces of any type. Elsewhere, covers shall be finished 25mm above the surface of the ground where not shown otherwise on the drawings, or such other level as directed by Council, in a manner designed to avoid as far as possible, the entry of surface water.	
In locations where shown on the Drawings or directed by Council, the Contractor shall install a cast iron cover and frame instead of the standard concrete maintenance hole cover. Where it is evident, or otherwise shown on the Drawings, the Contractor shall install bolt down frames and covers in areas subjected to 1 in 100 year flooding. Cast iron covers and frames shall be manufactured in accordance with AS 3996, and shall be installed and filled with concrete, as necessary, in accordance with the manufacturer's written requirements.	***Cast Iron Cover***

The Contractor shall connect pipelines to maintenance holes, structures or embedded concrete by means of 600mm long pipes such that two flexible joints are provided, the first joint being at or within 150mm of the face of the structure. Where flexible joints cannot be made with cut pipes, the Contractor shall select pipes from the various lengths provided in order to make the second joint within 300mm of the position shown on the drawings. The Contractor may vary slightly the positions of maintenance holes shown on the Drawings, subject to final approval by the Council immediately prior to construction, to suit changes, such as erection of structures, growth of flora and Installation of services. The positioning of a maintenance hole shall be such as to comply with occupational health and safety requirements for access by maintenance staff, providing a proper working area around the top and access into the hole.	***18.10 Connections to MH and Structures*** ***Flexible Joints*** ***Maintenance***
Preformed maintenance shaft and terminal maintenance shaft components shall comply with AS/NZS 1477 for PVC, AS 2033 for PE, AS 3518 for ABS, AS 3571 for GRP and AS 4198 for concrete. Generally, preformed maintenance shafts shall be made up in accordance with the Drawings, with components consisting of a base section, shaft sections of section lengths such as to minimise the number of joints required, cover and frame. (WSA 02 Part 4,).	***19 Preformed MS and TMS***
Except where concrete encasement is ordered by Council, the Contractor shall sand compact backfill around risers to the top of the socket or coupling on the highest branch off the riser, for the full width of trench and for a minimum distance of 500mm upstream and downstream of the riser. Compaction density shall be as for the requirements for the trench pipeline.	***20.3 Compaction***
Junction for risers shall be encased in 20 MPa concrete complying with the relevant specification.	***20.6 Concrete Encasement***
Above the pipe embedment overlay, the trench shall be backfilled and compacted with select fill material. Placement, material requirements and compaction of trench fill shall be compliant with WS-SPEC Section TR-14 Pipeline Installation (Non-Pressure) and AS 2166.2 Buried Flexible Pipelines (Part 2: Installation). Where the trench is within a roadway, proposed roadway, or footpath area, the trench shall be: (i)Backfilled to within 0.5m of the road pavement sub grade level with a non-cohesive granular material, with a grading falling generally within the limits detailed for pipe bedding and compacted to a Density Index of 70% when determined in accordance with AS1289.5.4.1 for cohesionless materials (ii)Backfilled with excavated material, and compacted to 100 per cent of the standard maximum dry density of the material when determined in accordance with AS1289.5.7.1, when within 0.5m of the road surface, but excluding the road pavement layers. (iii)Backfilled with road base and sub-base material as per existing or proposed pavement layers and compacted to 100 per cent of the standard maximum dry density of the material when determined in accordance with	***21.1 Trench fill*** ***Pipes Laid in Roadways***

AS1289.5.7.1	
The Contractor shall subject all sewers and maintenance holes to an initial test as soon as practicable after construction and before backfilling is commenced. An acceptance test shall be carried out before the issue of the Certificate of Practical Completion and not earlier than one month after completion of construction of all sewers and maintenance holes in a section. Sewers or maintenance holes failing any test shall be repaired and the test repeated. The process of testing, repair of defects and retesting shall continue until a satisfactory test is obtained.	***22 Acceptance Testing***
All lines shall be clear and free from soil, slurry, liquids and other foreign substances at the time of initial and acceptance testing.	***Initial Test Before Backfill***
Initial test of Gravitation Sewers	
The Contractor shall make the initial testing of gravitation sewers with compressed air. Before the initial test is performed, all pipe laying on the section shall be completed, and backfill shall be compacted to the level of the centre of the pipe barrel and Council is notified. This action constitutes a **WITNESS POINT**. Council shall advise at the time of notification by the Contractor whether the option to inspect the initial testing is required.	***Cleaning***
The initial test may be carried out before risers and/or property connection sewers are constructed so that the main line can be backfilled. However, the Contractor shall carry out an initial test on the risers and property connection sewers as soon as they are completed.	
Where Council approves the construction of pipelines in other than full lengths between maintenance holes, each length of pipeline shall be tested before backfilling together with the downstream portion of the maintenance hole length under construction.	
The Contractor shall rectify any fault detected and obtain a satisfactory test before the remainder of backfill is placed.	
The Contractor shall supply and keep all necessary testing equipment in a condition acceptable to Council.	
The Contractor shall test pressure gauges prior to use by static water column.	
Compressed air shall be supplied by a compressor of the rotary vane type capable of supplying at least 1 m^3/minute at 35kPa. The air shall be fed through a pressure-reducing valve capable of reducing pressure from that supplied to 28kPa ± 4kPa. The air shall then pass through an airtight line fitted with a pressure gauge reading from 0 to 50kPa, a pressure relief valve that shall be set to blow off at 28kPa ± 4kPa and a gate valve to the pipeline to be tested.	
The method of setting up and carrying out the test shall be as follows: (a) Insert a blank plug at one end and a disc with air-hose connection at the other end of the line. Care shall be taken to ensure that the force due to pressure on the disc is not taken by pipe joints, but is taken by struts bearing on the disc or on the end pipe in the line. (b) Couple test equipment to line under test and compressor or airline.	***Method***

(c) Slowly increase the air pressure in the line from 0 to 28kPa (over one minute approximately).
(d) Hold air pressure at 28kPa for three minutes for stabilising temperature.

(e) Close gate valve to shut off air supply to test equipment.

(f) Measure the time it takes for the pressure to drop from 25kPa to 18kPa. If this time is less than that permitted or if the line cannot be pressurised to 28kPa, then the test is unsatisfactory and the pipeline shall be checked for leaks.

(g) To check pipelines for leaks:

I. Open the gate valve from the air supply sufficiently to maintain a Pressure of 14 to 23kPa in the pipeline.

II. Move along the pipeline coating it with detergent solution. Bubbles will indicate a point of leakage. Special attention should be paid to joints, discs and horns of junctions.

(h) If leaks are detected, they shall be repaired to the satisfaction of Council.

(i) Re-test as above until the time taken for the pressure to drop is greater than that shown below.

Allowable Pressure Drop Times

1. The time taken for the pressure to drop from 25 kPa and 18 kPa shall be greater than:

   (a) 100mm pipe – 1 minute
   (b) 150mm pipe – 2 minutes
   (c) 225mm pipe – 4 minutes
   (d) 300mm pipe – 6 minutes
   (e) 375mm pipe – 8 minutes
   (f) 40mm pipe – 11 minutes
   (g) 525mm pipe – 14 minutes
   (h) 600mm pipe – 17 minutes

2. Pressure drop times which are less than these may indicate leakage or excessive air permeability through unsaturated pipe walls with some materials. Vitrified clay pipes, in particular, suffer from excessive air permeability under dry summer conditions. When this occurs, pipes shall be thoroughly saturated with water before testing or a hydrostatic test applied.

3. In any case, where the allowable pressure drop time cannot be attained and there are no visible leaks, the Contractor shall apply a hydrostatic test.

The Contractor shall make the acceptance test on all components in the	***22.1 Acceptance***

section of the sewer in the same manner as the initial test. The submission, to Council, of satisfactory test results constitutes a **HOLD POINT**. The approval of Council is required prior to the release of the hold point.	***Tests of Gravitation Sewers and Maintenance Holes***
Council may permit hydrostatic or vacuum testing as an alternative to compressed air testing for acceptance of gravitation pipelines.	***Alternative***
Council may reject any pipeline or maintenance hole in which there is visible or detectable leakage.	***Rejection***
The Contractor shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.	***22.3.4 Trench Fill***
The contractor shall carry out compaction tests 75mm to 100mm below the level being tested.	***Compaction Testing***
The Contractor may compact backfill by trench flooding only where: (a) The ground and backfill material is cohesionless sand. (b) Water for flooding has been sourced at the site. (c) The process will not create mud which would be moved off site by vehicles or construction plant. (d) Additives are not used.	
The Contractor shall test each maintenance hole for leakage, as soon as practicable after the maintenance hole is constructed and the maintenance hole cover surround fitted. (WSA 02 Part 3, section 22.4.4)	***22.4.4 Initial Testing of Concrete Maintenance Holes***
The test shall be made by plugging all pipe openings in the walls and by filling the maintenance hole with water to the lowest point on the top of the maintenance hole cover surround. The plugs shall be positioned in the pipes as near as practicable to the internal face of the maintenance hole.	***Method***
After allowing an interval for absorption, to be determined by Council, the Contractor shall refill the maintenance hole and measure the loss of water during the following 30 minutes. The test on the maintenance hole will be considered satisfactory provided the water lost is less than 3mm depth in the top section of the maintenance hole for each 1m depth of maintenance hole. The depth of maintenance hole is to be taken from the bottom of the maintenance hole cover recess in the cover surround to the invert of the outlet from the maintenance hole. The plug of the outlet shall be fitted with a suitable release for emptying the maintenance hole on satisfactory completion of the test.	***Duration***
Alternatively, the maintenance hole may be tested in conjunction with the downstream section of main or undertaken using the vacuum method or use of compressed air. In either case, the Contractor shall provide details of the alternative method proposed, for approval by Council, prior to its use.	***Alternative Tests***
Whenever, in the case of acceptance testing, the pipeline is subjected to a significant head of groundwater (i.e. 1500mm or more above the soffit of the sewer main provided that groundwater is at least 150mm above any property connection sewer included in the test), the tests previously prescribed may be dispensed with in favour of visual inspection and	***22.5 Infiltration Testing***

measurement of infiltration or vacuum testing.

In such circumstances, the Contractor shall propose full details of the method by which the infiltration is to be measured.

If Council approves of an inspection and infiltration test being performed for the purposes of acceptance, Council shall determine, the duration over which infiltration is to be measured. The rate of infiltration shall not exceed that determined by the following formula:-

$$\mathbf{Q.I. = 0.65 (L_1d_1h_1 + L_2d_2h_2 + L_nd_nh_n) + H_a}$$

Where:

Q.I.	=	rate of infiltration in litres/hour
L	=	length of pipe in metres
D	=	Nominal size of pipe in metres
H	=	average head of groundwater over the invert level of the pipe in the section under test
H_a	=	head of groundwater above the invert level of the outlet pipe of the maintenance hole when the maintenance hole is included in the infiltration test.

The Contractor shall determine the head of groundwater, at the Contractor's expense, by a method approved by Council.

22.6 Ovality Testing

Prior to backfilling and compaction operations, the Contractor shall undertake ovality tests of all pipelines for any abnormalities in pipe shape and rectify any unsatisfactory sections found to the satisfaction of Council. The test results of such tests shall be made available to Council. This action constitutes a **WITNESS POINT**. Council shall advise at the time of notification by the Contractor whether the option to inspect the test results is required.

Initial Ovality Tests of Gravitation Sewers

1. The Contractor shall undertake ovality testing as follows:

(a) All sewers to DN 300 shall be tested to determine any excessive ovality using a proving tool approved by the Council. Ovality testing shall be undertaken after all earthworks on the subdivision are complete and no sooner than 28 days after backfill of trenches has been completed. Sewer pipes having excessive ovality shall be replaced and the line retested.

(b) The proving tool shall be rigid and non-adjustable having an effective length of not less than its nominal diameter. The minimum diameter at any point along the length shall be:

NOMINAL SIZE (DN)	MINIMUM PROVER DIAMETER (mm)
	uPVC PIPE
100	99.7
150	142.6
225	222.9
300	280.8

(c) The proving tool shall be fabricated from steel and have pulling rings at each end. The prover shall be marked to indicate the nominal pipe size

<table>
<tr><td>and the prover outside diameter.

(d) Maximum Allowable Deflection = 3% of Mean Outside Diameter.

(e) The testing shall require a “prover” to be pulled through each section of the pipeline by hand winching to demonstrate that the maximum allowable deflection is not exceeded.</td><td></td></tr>
<tr><td>The maximum horizontal deviations to either side from the design axis of a gravitational pipeline shall be 15mm for all sizes of pipes.</td><td>23.1 Horizontal Tolerances</td></tr>
<tr><td>Once the final position of a maintenance hole has been established, construction shall be subject to the following requirements:
For deviations from the design levels of maintenance holes as shown on the Drawings or as directed by Council during construction, the following tolerances shall apply:

(i) Where the difference in levels between the inlet pipe and the outlet pipe in a maintenance hole is 100mm or less:

<table><tr><th>Pipe</th><th>Tolerance</th></tr><tr><td>Inlet</td><td>nil; + 5mm</td></tr><tr><td>Outlet</td><td>5mm; + nil</td></tr></table>
(ii) Where the difference in levels, as above, is greater than 100mm:

<table><tr><th>Pipe</th><th>Tolerance</th></tr><tr><td>Inlet</td><td>10mm; + 10mm</td></tr><tr><td>Outlet</td><td>10mm; + 10mm</td></tr></table>
Allowable lateral deviations from the final design position of maintenance holes shall be +/- 300 mm.</td><td>23.2 Vertical Tolerances</td></tr>
<tr><td>For gravitational pipelines the invert level shall not deviate from the design grade line by more than 10mm.</td><td>23.2.3 Grade</td></tr>
<tr><td>Council shall complete all necessary Works on “live” maintenance holes (that is, accesses to sewer system that is currently in service) All Works undertaken by Council at “live” maintenance holes in delivering the Works under the Contract shall be a cost to the Contractor.</td><td>24 Connection to Existing Sewers</td></tr>
<tr><td>The Contractor shall clean pavements, lawns and other improved areas and leave them in the same order as they were at the commencement of the Works. The Contractor shall restore any fencing removed during construction and shall restore lawns with turf cut and set aside from the original surface and with imported turf from a source approved by Council.

The Contractor shall immediately restore any damaged or disturbed private property and services.</td><td>25.1 Restoration of Surfaces

General

Restoration</td></tr>
</table>

The Contractor shall provide notice to affected property.	***Property Owner Advice***
Immediately the backfilling of a trench excavated through a pavement has been completed, the Contractor shall temporarily restore the pavement. Where the trench crosses bitumen or concrete pavement, the surface is to be protected from deterioration. A pre-mixed asphaltic material may be used for such temporary restoration. The Contractor shall maintain the temporary restoration until final restoration is carried out. Final restoration of the pavement shall be carried out to restore the pavement and its sub-base to no less than the original condition. Final restoration may include, if required by Council, the removal of temporary restoration. Should the Contractor elect to tunnel under paving, kerb and gutter or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces, and payment shall be made for the restoration of the surfaces as though they had been removed and replaced. The Contractor shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the Defects Liability Period.	***25.2 Pavements*** ***Tunnelling***
In other than roadways, the Contractor shall place the backfill sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the Defects Liability Period in order that the surface of the completed trench may then conform to the adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the Contractor. Where dry weather conditions have persisted after the original backfilling, including during the Defects Liability Period, the Contractor shall take all necessary steps to consolidate the trench before removing surplus materials from the site. In locations where, in the opinion of Council, surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench to the satisfaction of the Superintendent in such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Contractor shall maintain the backfill and adjacent ground until the expiry of the Defects Liability Period. Where, within public or private property, the reasonable convenience of persons will require such, Council may order the Contractor to level trenches at the time of backfilling. The Contractor shall make good any subsequent settlement, as required by placing additional fill.	***25.6 Provision for Settlement*** ***Backfill*** ***Disposal of Surplus Material*** ***Settlement***
The Contractor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the Defects Liability Period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the Defects Liability Period. The Contractor shall maintain pavements with crushed igneous rock, gravel or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement.	***25.7 Maintenance of Restored Surfaces***

The Contractor shall submit to Council work-as-executed Drawings showing the actual location and alignment of pipelines, maintenance holes and junctions, all pump station details together with operating and maintenance manuals.	***26 Work As Constructed Details***
Details shall include the size, type, levels, grade of pipelines, maintenance hole, and maintenance shaft location, types and cover details, easement requirements for maintenance, pump details, switchboard equipment details and station structural details.	***Additional Detailed Requirements***
The Contractor shall record on work-as-executed Drawings the area of side fill which should not be disturbed in future without special precautionary measures where side fill construction is part of the structural integrity of a constructed pipeline of a diameter more than 225 mm.	***Special Precautions***
The Contractor shall ensure that a Registered Surveyor certifies the plans showing location and alignment.	***Survey***
The Contractor shall provide records, for the Sewer Authority's Asset Register, to Council at the time of practical completion of the Contract. The records are to be in a form consistent for inputting into the Asset Register as directed by Council.	***Asset Register***
All drawings and documentation to be submitted to Council for approval shall conform to the requirements of Council's *Drawings and Documentation Guidelines*. A copy of these Guidelines will be made available upon request. Failure to comply with Council's *Drawings and Documentation Guidelines* may result in the drawings and/or documentation being returned to the designer without comment.	***Guidelines***
All amendments to WSA-02 Drawings are detailed on Council's Versions of the applicable drawings.	***Amendments to WSA 02 Std Drawings***

Amendments to WSA 04 Note: The Clause numbers given below correspond to the relevant Clause numbers given in the Sewerage Pumping Station Code of Australia WSA-04 (2005).	***Clause No. in WSA-04***
Council's minimum requirements for pressure main pipe materials are as follows: (a) mPVC, uPVC or oPVC: rubber ring jointed, minimum Class 16 Series 2, blue in colour, fittings for pvc pipe shall be DI. (b) PE: electrofusion or butt fusion or compression fittings, minimum PN16 pressure class. (c) DI: rubber ring jointed or flanged, polyethylene sleeved, cement or epoxy lined, minimum Class 21 (d) Steel: rubber ring jointed, flanged or welded, FBPE or epoxy coated, cement or epoxy lined, minimum steel barrel wall thickness of 6mm or diameter/120 whichever is the greater (e) GRP : rubber ring jointed couplings, minimum SN10000 stiffness,	***16 Materials***

PN16 pressure class

(f) ABS : solvent welded, minimum PN16 pressure class.

(g) Cu: copper pipes shall be to AS1432 in the range of DN6 to DN200 Type A. Compliance with AS3500.

All products and materials used for the creation of infrastructure shall comply with the relevant sections of WS-SPEC as applicable for the respective pipe materials.

The Contractor shall not use any damaged or defective materials, including coatings and linings, outside the manufacturers recommended limits.

STEEL PIPES AND FITTINGS (PRESSURE PIPES)

Steel pipes and fittings shall be compliant with WS-SPEC Section SP1.

Steel pipes shall be provided with cathodic protection if required in accordance with geotechnical recommendations.

Flanges shall be to Figures B7, B8 & B9 of AS4087, as appropriate.

Flanges shall be provided with SS316 bolts and SS304 nuts and washers.

Pipes and fittings are to be handled, transported and stored as per manufacturer's guidelines.

DUCTILE IRON PIPE AND FITTINGS (PRESSURE PIPES)

Ductile iron pipes and fittings shall be compliant with WS-SPEC Section SP2.

Flanges shall be to Figures B5 & B6 of AS 4087, as appropriate.

Flanges shall be provided with SS316 bolts and SS304 nuts and washers.

Pipes and fittings are to be handled, transported and stored as per manufacturer's guidelines.

PVC PIPES AND FITTINGS (PRESSURE PIPES)

PVC Pipes and Fittings shall be compliant with WS-SPEC Section SP4.

Pipes and fittings are to be handled, transported and stored as per manufacturer's guidelines.

Pipes and fittings shall be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of shelter.

GRP PIPES AND FITTINGS (PRESSURE PIPES)

GRP pipes and fittings shall only be used with prior approval of Council.

If approved, GRP pipes and fittings shall be compliant with Section SP5.

Pipes and fittings are to be handled, transported and stored as per manufacturer's guidelines.

Pipes and fittings shall be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of shelter. **POLYETHYLENE PIPES AND FITTINGS (PRESSURE PIPES)** PE Pipes and Fittings shall be compliant with Section SP6. PE pipes shall be manufactured in either PE80B or PE100 polymer material. Fittings up to DN110mm shall be PE in accordance with AS4129. Fittings larger than DN110mm shall be ductile iron in accordance with AS2280 and coated internally and externally with polyethylene in accordance with AS4129. The Contractor shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown in the Design drawings. Pipes and fittings are to be handled, transported and stored as per manufacturer's guidelines. Pipes and fittings shall be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of shelter. **ABS PIPE AND FITTINGS (PRESSURE PIPES)** ABS pipes and fittings shall be joined in accordance with the manufacturer's instructions using solvent cement. Pipes and fittings are to be handled, transported and stored as per manufacturer's guidelines. **COPPER PIPE AND FITTINGS (PRESSURE PIPES)** Copper tube shall be specified to be manufactured in accordance with AS 1432 in the range of DN6 to DN200 for Type A or Type B. Capillary and compression fittings shall be specified to comply with AS 3688 and de-zincification resistant. Capillary fittings shall have silver brazed joints or solder insert capillary joints. Copper pipe work shall be insulated from ferrous mains.	
The Contractor shall not change the pipeline alignment without prior concurrence of Council. The Contractor shall provide full details, of any proposed changes to the pipeline alignment to Council prior to undertaking any such works. This action constitutes a **HOLD POINT**. The Contractor shall obtain the decision of Council prior to the release of the hold point.	***19.1 General***
The Contractor shall ensure all reasonable care is taken during the construction of the works to ensure that existing utility services are protected against damage or interference whatsoever.	***19.5.2 Protection of Other Services***

If existing utility services are damaged during the course of the works, through any cause whatsoever, the Contractor shall be fully responsible for all costs associated with rectification of the utility services, to the satisfaction of the Council or the utility service owner as appropriate, regardless of the accuracy of any prior location advice given by Council, the utility service owner or its agent.	***Damage***
Where it is necessary to relocate or alter existing utility services, the Contractor shall make all necessary arrangements with the appropriate authorities concerned.	***Relocations and / or Alterations***
The Designer is to ensure that all known utility services detailed on the engineering drawings are accurately located by non-destructive field location immediately prior to construction, and it is the Contractor's responsibility to have such services confirmed in the field prior to any excavation commencing in their vicinity of the works.	***Field Locating of services***
The Contractor shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits. Any materials showing any visible signs of delamination, deflection, cracking, or other defect as per the manufacturers guidelines shall be immediately rejected.	***20.2 Rejected Products and Materials***
All nuts and bolts shall be manufactured in accordance with AS/NZS 1111 and AS/NZS 1112, 150 metric series and fitted with washers beneath bolts heads and nuts. All bolts shall be stainless steel to AS 1449 and AS 2837, minimum grade 316 with grade 304 nuts and washers.	***20.8 Fasteners***
All concrete work shall be compliant with WS SPEC Sections SP43, 44 & 45 and TR10. Classes of concrete used for the construction of the works shall be as follows:	***20.10 Concrete Works***

Application	**Grade (F'c at 28 days)**	**Min cement content (kg.m3)**	**Max w/c ratio**
Blinding concrete, mass concrete	N15	-	-
Surface footpaths and driveways	N25	**-**	**-**
Unreinforced thrust blocks, anchor blocks, bulkheads, and conc. encasement in all environments	N25	**-**	**-**
Reinforced thrust blocks, anchor blocks, bulkheads, and conc. encasement in all environments	N32	-	-
Maintenance holes and benching – all environments	S40	380	0.50
Valve chambers and flowmeter pits in non–aggressive environments	N32	**-**	**-**
Valve chambers and flowmeter pits in aggressive soil and groundwater environments	S40	380	0.50

Underground pumping station wells - in all environments.	S40	380	0.45

Aggressive environments are defined as exposure to :
3. Seawater, anaerobic waters, swamp water tidal flats, sewage, effluent and the like, including exposure to intermittent saturation.
4. relatively high levels of chlorides, sulphides and /or sulphates, relatively high or low pH, levels, as defined within Appendix B of SW-SPEC Section SP-43, exposure classification 3 (moderate) and above.

Cementitious materials for concrete shall comply with Appendix B of WS-SPEC SP-43.

For other than water retaining structures, cover to reinforcement shall comply with the relevant Exposure Classifications within AS3600 but shall not be less than B1 normally, or C for aggressive conditions.

For water retaining structures, cover to reinforcement shall comply with the requirements of AS3735.

Concrete surfaces exposed to aggressive environments shall be provided with a protective coating compliant with WS-SPEC Section TR-20. The protective coating applied shall be in addition to the concrete cover requirements.

All valves are to be anti-clockwise close type.

24 Valves

Valves shall be installed such that:

Installation

(a) Manual operation of the valves may be carried out with ease and without the need for any other extra equipment.
(b) All valves and their actuators shall be easily accessible for maintenance purposes and shall be capable of being removed from their location in a pipeline without obstruction by the pipeline or other equipment.
(c) Valves shall be located in positions where they may be readily exercised and maintained. All valves shall be closed by an anti-clockwise rotation of the hand wheel or handle. The face of each hand wheel shall be clearly marked with the words OPEN and SHUT with arrows adjacent to indicate the direction of rotation to which each refers.
(d) Spare parts shall be readily available.

The Contractor shall ensure that the valves and hydrants supplied are compatible with the pipe work such that proper sealing is provided between the pipe flanges and the valve. Concrete lining in pipe work shall not be chipped away or reduced to provide clearance from the working parts of valves.

Compatibility with pipe work

Valves shall be located to avoid conflict with driveways, telephone house service pits, underground electrical boxes and any other street side furniture.

Location

Location of valves and hydrants shall be marked with a Council approved marking post or alternatively a stainless steel kerb marker. The location of pipes crossing roads shall be indicated by a stainless steel kerb marker.

The valve shall be capable of opening against full unbalanced head and closing against full flow and shall open and close smoothly without vibration or cavitations. The maximum effort required at the hand wheel shall not exceed 135 N under the worst conditions of differential head or unseating force. Flange connections for valves shall be to AS4087, minimum pressure rating PN16. Bolts shall be SS316. Nuts and washers shall be SS304. All ferrous alloy (cast iron, spheroidal graphite cast iron, plain carbon and alloy steel) valves shall have protective epoxy coatings complying with WS-SPEC Section SP-30 Protective Coatings for Valves. **Knife Gate Valves** Knife gate valves shall be compliant with WS-SPEC Section SP23. Valves shall be flanged unless shown otherwise on the Drawings. **Air Valves** Air valves shall comply with WS-SPEC Section SP-27. Minimum size of air valve is DN80mm. Each air valve shall be provided with an isolating sluice valve. Council's nominated brand of air valves is Ventomat. **Sluice Valves** Sluice valves shall be provided to each pump connection pipe work in the valve pit. Valves shall be flanged unless shown otherwise on the Drawings. Sluice valves shall be resilient seated compliant with WS-SPEC Section SP-21. **Non Return Valves** Non-return valves shall be provided to each discharge pipe in the valve pit. Non return valves shall be resilient seated Flexichek type. Council's nominated brand of reflux valves is Crevet. **Ball Valves** Ball valves shall be compliant with WS- SPEC Section SP-22. Valves shall be flanged unless shown otherwise on the Drawings. **Butterfly Valves** Butterfly valves shall only be used with prior approval of Council. If approved, butterfly valves shall comply with WS-SPEC Section SP-24.	***Sluice Valves*** ***Non-Return Valve*** ***Ball Valves*** ***Butterfly Valves***

Valves shall be flanged unless shown otherwise on the Drawings. **Scour Valves** Valves shall be sluice valves. Scour valve assemblies shall be as shown on the Drawings.	***Scour Valves***
Bolts on all flanges will protrude no more than 10mm past the nut when tightened. The Contractor shall apply sufficient anti-seize/anti-galling material to the threads of all stainless steel fasteners. The material shall be Polytetrafluroethylene (PTFE), either tape to AS 1272, dipped or sprayed, or molybdenum disulphide. Flanges shall comply with AS 2129 to the class shown on the Drawings.	***24.2 Flanged Joints*** ***Anti-Galling, Anti-Seize*** ***Flanges***
The Contractor shall provide one direct mounted bottom connected pressure gauge, minimum gauge face 100mm diameter, complying with AS 1349, per pump installation. For pressure gauge details refer to Council Standard Specification for Electrical Assets. Gauges and fittings shall be screwed into the pipe wall of steel and ductile iron pipes of DN150mm and larger. In steel and ductile iron pipe work less than DN150mm, gauges and fittings shall be screwed into a tapping band. In pipes other than steel or ductile iron, tapping bands shall be used. The Designer shall provide a pipe tee on the main to install the pressure gauge. An isolating ball valve shall also be provided to allow release of pressure prior to removal of the gauge. The pressure gauge range for single or parallel pumps duty shall be 0 to 1.7 times the closed valve head of the pumps.	***24.4.1 Pressure Gauges***
The Contractor shall install rising mains, air release valves and inspection pipes where shown on the Drawings or directed by Council. All rising mains shall be topped with an appropriate identification tape. The Contractor shall provide marking plates bearing the letters "AV" for air valves, "SCOUR" for scour pipes and "SRM" for sewage rising main at changes of direction and at such chainages that the location of the main is marked, at least once each 100 metres, as specified hereinafter. In urban areas, the kerb adjacent to each fitting is to be painted with two (2) coats of non-slip paint coloured black. Where, in the opinion of Council, a valve or fitting is at too great a distance from any existing wall, fence or post to which the notice plate could be conveniently fixed, the Contractor shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting. The distance to the fitting in metres, to an accuracy of 0.1m, shall be permanently marked on the plate with legible numbers a minimum 80mm high. Wooden posts are not to be used where there is evidence, by rotting or termite activity, that the integrity of the posts will be affected.	***30.14 Location Markers Location*** ***Marking Plates*** ***Marking Posts***

The post shall conform to the following requirements: (a) The post shall be of sufficient length to be set firmly in place under saturated ground conditions. (b) When installed, the post shall project 1000mm above the ground, provided that where tall grass or crops are likely to obscure the post, or where directed by Council, its height above the ground shall be increased to 1500mm. (c) The post shall be painted with 2 coats of white enamel for exterior use.	***Post Details***
Preformed components or systems, complying with the Drawings, if any, Otherwise complying with AS 3518, AS 3571 or AS 4198 may be used in lieu of in-situ construction provided: (a) Preformed concrete wall units are to be manufactured to AS 4058 except as modified as for the requirements for precast maintenance hole units. (b) Joints shall be internal flush (c) The Contractor shall supply components that make a watertight system and have a satisfactory surface finish. Package pump stations may be supplied and installed provided: (a) All components comply with the requirements of this Specification (b)The units are at least equivalent to the requirements of this Specification and the Drawings.	***31.4 Preformed Concrete Systems*** ***Package Units***
The Contractor shall carry out the hydrostatic test by connecting to the pipeline or section thereof under test, a pipe or hose terminating in a 150mm diameter container not less than 100mm deep. All other open ends of the pipeline shall be plugged. The pipeline under test, and the pipe or hose with container, shall be filled with Water until the free surface is level with the top of the container, when that container is suspended in accordance with the requirements set out below. The test container shall be suspended at a level such that the test head applied to the pipeline is as follows: (a) (i) For initial test when no property connection sewers or risers are constructed – a minimum head of 2 metres above the pipe invert at the upstream end of the line under test, or (ii) For initial test where property connection sewers and/or risers are constructed – a minimum head of 2 metres above the highest invert in the line under test, including its risers and property connection sewers. (b) For acceptance test, a minimum head of 2 metres above the highest invert in the line under test, including its risers and property	***36.5 Hydrostatic Testing***

connection sewers, or above the free standing level of ground-water in the vicinity whichever is the higher. (c) Such other lesser head as Council, at Council's discretion, may direct. The Contractor shall determine, at the Contractor's expense, the free standing level of groundwater, by a method acceptable to Council. After allowing an interval for absorption, to be determined by Council, any fall of the free water surface shall be made good by adding extra water to the container. The Contractor shall measure the fall in water level during thirty minutes thereafter. The pipeline will be regarded as satisfactory if there are no visible leaks, and if the fall in water level is not more than 25mm for each standard test length of the pipeline under test including property connection sewers and/or risers. A standard test length in metres is defined as 1370m divided by the effective diameter of the pipeline in millimetres. Where the pipeline under test is all of the same size, the effective diameter shall be the nominal size of that pipeline. where the pipeline under test has property connection sewers and/or risers of smaller nominal size than the main sewer line, then the effective diameter shall be calculated as the product of the length and the nominal size of the larger pipe added to the product of the length and the nominal size of the smaller pipe; this sum shall be divided by the total length of pipeline under test; the result shall be the effective diameter.	
Testing of Rising Mains The contractor shall pressure test rising mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. The submission, to Council, of satisfactory test results constitutes a HOLD POINT. The approval of Council is required prior to the release of the hold point.	***Testing of Rising Mains***
Pipelines shall be tested in sections approved by Council as soon as practicable after each section has been laid, jointed and backfilled, provided that: (a) If so specified or if the Contractor so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of Council; and (b) The pressure testing shall not be commenced earlier than seven days after the last concrete thrust or anchor block in the section has been cast.	***Timing***
For the purpose of this clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing, e.g. by means of main stop valves.	***Section Definition***
Pressure testing shall not be carried out during wet weather unless otherwise approved by Council.	***Wet Weather***
During pressure testing, all field joints which have not been backfilled	***Field Joints***

shall be clean, dry and accessible.

Stop Valves

During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one side of the valve in closed position with no pressure on the other side for at least 15 minutes.

Filling with Water

Before testing a pipeline section, the Contractor shall clean it to the satisfaction of Council and fill it slowly with water, taking care that all air is expelled. Purging of air from rising mains shall be promoted by opening air valves. In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing.

Test Pressure

The hydrostatic test pressure which shall be applied to each section of the pipeline shall be equivalent to the pressure rating of the pipe specified.

Duration of Test

The Contractor shall maintain the specified test pressure for as long as required by Council, while the Contractor examines the whole section. In any case, the specified test pressure shall be maintained for not less than 8 hours. For the purpose of determining the actual leakage losses, the Contractor shall carefully measure and record the quantity of water added in order to maintain the pressure during the period of testing.

Results

The pressure testing of a section shall be considered to be satisfactory if:

(a) There is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;

(b) There is no visible leakage; and

(c) The measured leakage rate does not exceed the permissible leakage rate as determined by the following formula:

$$Q_1 = (0.000532 + C\,D.L.\,(H)^{0.5} / L_p)$$

Where:

Q_1 = permissible leakage rate (litres per hour)

C = a coefficient as specified hereunder for the particular pipe material and type of joint

D = nominal diameter of pipe (mm)

L = length of section tested (km)

H = average test head (m)

L_p = average pipe length – L / n (m)

Where “n” is the total number of pipes and fittings in the section tested.

(d) The measured leakage rate does not exceed that rate calculated by the simplified formula for the type of pipe tabulated hereunder, in which event determination of the permissible leakage rate on the basis of the formula specified in I above shall not be necessary. The simplified formulae are based on the coefficient “C” and average pipe lengths contained in that tabulation.

Pipe Type	Simplified Formula	Coefficient "C"	Average Pipe Length (m)
D.I.	$Q_1=0.0105\ D.L\ (H)^{0.5}$	0.0548	5.5
PVC	$Q_1=0.01\ D.L(H)^{0.5}$	0.0568	6.0

Rectification

Any failure, defect, visible leakage and/or excessive leakage rate, which are detected during the pressure testing of the pipeline or during the Defects Liability Period, shall be rectified by the Contractor at the Contractor's expense. Where a thrust block or an anchor block fails, and such thrust block or anchor block has been constructed in accordance with the Drawings and the failure is not, in the opinion of Council, the fault of the Contractor, the thrust or anchor block shall be strengthened or reconstructed as directed by Council. The cost of strengthening or reconstruction of such thrust or anchor block and the cost of retesting shall be paid as a Variation to the Contract, at such rates as are determined in accordance with the provisions of the General Conditions of Contract.

Alternative Tests

Alternatively, the rising main may be tested by the use of compressed air. In this case, the Contractor shall provide details of the alternative method proposed, for approval by Council, prior to its use.

37.2.1 Pump Station Requirements for Commissioning

The Contractor shall test and/or inspect all materials, equipment, installation and workmanship to prove compliance with the Specification requirements. The submission to Council of satisfactory test results constitutes a HOLD POINT. The approval of Council is required prior to the release of the hold point. Tests and inspections shall comply with the relevant Australian Standards.

37.2.2 Pre-Commissioning

Pre-commissioning is the preparation of plant or equipment so that it is in a safe and proper condition and ready for commissioning and operation. It includes all aspects of plant operation such as safety, electrical, mechanical and instrumentation.

Sequence

The Contractor shall conduct pre-commissioning in a logical sequence in accordance with the programme prepared by the Contractor and approved by Council.

Record Sheets

The Contractor shall prepare pre-commissioning record sheets for each item of equipment to ensure results of tests are satisfactorily recorded and that all necessary checks or tests have been performed.

Requirements

Specific requirements for pre-commissioning shall include, but are not limited to:-

(a) Initial charges of lubricant in addition to any special lubricant requirements for initial flushing or treatment of the system or for "running in".

(b) Physical checks and tests such as completeness of assembly, rotational tests (including checking that the rotation of electrical motors is in the correct direction), alignment checks, balancing and vibration checks, temperature, pressure and flow measurements, clearances, belt alignment and tension, etc, depending on the type of equipment.

(c) Electrical and instrument installation tests, including motor insulation tests and checking instruments against certified instruments and correcting as necessary. (d) Tests of the correct functioning of automatic and manual control and protection equipment, including simulating danger conditions, mal- operations or failures, to check that all instruments and controls function correctly. These tests shall also include adjusting instrument set points and alarm settings and proving correct operation of alarms. (e) Equipment and system operating tests. The Contractor shall certify compliance of each item and submit a signed copy to Council prior to commissioning. The Contractor shall carry out pre-commissioning tests to the satisfaction of Council and shall record the results of the tests on the appropriate Pre-commissioning Record Sheet. The Contractor shall furnish Council with one signed copy of each completed Pre-commissioning Record Sheet countersigned by Council's Representative who witnessed the test. ***Refer to Appendix A***	***Recording*** ***Submission*** ***Pre-commissioning Check sheets***
Commissioning is the running of the plant and equipment to ensure flow through the pumping system, carrying out any necessary testing and adjustments until it is ready and suitable for normal starting and running under service conditions. The Contractor shall give Council five (5) working days notice of the Contractor's intention to undertake commissioning and supply to Council three copies of each of the pre-commissioning record sheets and three copies of the Operational and maintenance manuals at the time that notice of commissioning is given .This action constitutes a **WITNESS POINT**. Council shall advise at the time of notification by the Contractor whether the option to attend the commissioning is to be exercised. The Contractor shall conduct commissioning in a logical sequence in accordance with a programme prepared by the Contractor and approved by Council. Throughout commissioning the Contractor shall be responsible for the test programme. The Contractor shall provide continuous supervision by personnel experienced in the operation of the equipment and shall have qualified personnel in attendance to carry out all necessary adjustments and/or remedial work during the commissioning tests. The Contractor shall prepare schedules, test record sheets and programmes for approval by Council prior to each stage of the overall commissioning. The Contractor shall carry out final testing and commissioning (min 1 day duration) of the electrical services in conjunction with the mechanical equipment (e.g. pump, etc) including setting and adjustment of equipment	***37.2.3 Commissioning Notification*** ***Sequence*** ***Responsibility*** ***Supervision*** ***Documentation*** ***Final Testing***

in accordance with MEW E101. The Contractor shall arrange for all testing, commissioning and any adjustments to be carried out by qualified personnel. ***Refer to Appendix A***	***Qualified Personnel*** ***Commissioning Check sheets***
The Contractor shall fulfil the following requirements before the Certificate of Practical Completion is issued: (a) Receipt by Council of a certificate of approval from the relevant statutory authorities. (b) Pump station is in working order as demonstrated by the testing and commissioning. (c) Approval by Council of Operating and Maintenance manuals. (d) Receipt by Council of As-Built Drawings of the pump station.	***37.2.4 Practical Completion***
All amendments to WSA-04 Drawings are detailed on Council's Versions of the applicable drawings.	***Amendments to WSA 04 Std Drawings***

C402.12 SEWAGE PUMPS

C402.12.1 NEW SEWAGE PUMPS

New Sewage Pumps

General

Pumps shall be submersible type, either:

KSB Forrers, or ITT Flygt

Other pumps may be considered with Council Approval.

Pump shall be capable of operating at the required duty point for the application. Pump shall be

(a) capable of operating near optimal efficiency within the range of operating conditions;
(b) continuous operation;
(c) having non-overloading characteristics beyond the duty point close to zero head;
(d) having starting characteristics acceptable to the electricity supply company and the Council;
(e) Having a minimum of 4 poles unless approved otherwise by Council.

Standby

STANDBY:

Standby pumping capacity shall be provided such that if one pump is out of service, the pump station will remain able to supply the required transfer capacity.

ELECTRICAL STANDBY:

Unless otherwise advised by Council the Contractor shall provide a permanent on-site generator for each site and shall provide for connection of same. Also refer to Section C402.14 Electrical Works of this specification.

Installation

INSTALLATION:

The design of the wet well submersible pumping unit shall be such that the complete pumping unit can be readily removed from the wet well by means of a simple lifting device, without the necessity of either de-watering the wet well or disturbing the permanent connection to the discharge pipe work, and without the need to descend into the wet well.

No portion of the pump shall be permanently fixed to the base of the wet well. The wet well units shall be supported off the discharge 'duck-foot' bend which shall be of a rigid design to take the complete pumping unit load and provide sufficient sealing.

Each submersible pump shall be checked for the operation against a closed discharge (shut-off head) to prove the effectiveness of the seal between the pump and the discharge bend.

When two or more similar pumps are supplied under the same Contract, the interchange ability of the units and the discharge bends shall also be checked.

The pump shall have suitable guide rails for withdrawal from and lowering into the wet well. When lowered down the guide rails the pump shall automatically connect to the discharge bend.

PRESSURE GAUGES The Contractor shall provide one direct mounted bottom connected pressure gauge, minimum gauge face 100mm diameter, complying with AS 1349, per pump installation. Gauges and fittings shall be screwed into the pipe wall of steel and ductile iron pipes of DN150mm and larger. In steel and ductile iron pipe work less than DN150mm, gauges and fittings shall be screwed into a tapping band. In pipes other than steel or ductile iron, tapping bands shall be used. The Designer shall provide a pipe tee on the main to install the pressure gauge. An isolating ball valve shall also be provided to allow release of pressure prior to removal of the gauge The pressure gauge range for single or parallel pumps duty shall be 0 to 1.7 times the closed valve head of the pumps. For pressure gauges details refer to Council Standard Specification for Electrical Assets.	***Pressure Gauges***
LEVEL CONTROL The Contractor shall provide one (1) continuous level measuring device in each wet well. The output of each level measuring device shall be in a form of 4-20 mA and shall be an input to the pump station controller. The Contractor shall also provide two (2) float switches for the HH level alarm and HHH level alarm for each pump station. The digital signals corresponding to each of high level alarms shall be wired up to the pump station telemetry system. For details of continuous level measuring device and the level switches refer to Council Standard Specification for Electrical Assets.	***Level Measuring Devices***
ELECTROMAGNETIC FLOWMETERS AND FLOW SWITCHES: An electromagnetic flowmeter shall be provided at each pumping station. The flowmeter shall be housed within the pumping station or in a separate dedicated concrete structure. The flowmeter converter shall be housed in the pump station electrical switchboard and shall provide an input into the site telemetry system. For the flowmeter details refer to Council Standard Specification for Electrical Assets. Each pump shall be provided with IFM Effector flow switch for the flow detection. For details refer to Council Standard Specification for Electrical Assets.	***Flow meters***
ELECTROMAGNETIC FLOWMETERS AND FLOW SWITCHES: An electromagnetic flowmeter shall be provided at each pumping station. The flowmeter shall be housed within the pumping station or in a separate dedicated concrete structure. The flowmeter converter shall be housed in the pump station electrical switchboard and shall provide an input into the site telemetry system. For the flowmeter details refer to Council Standard Specification for Electrical Assets.	***Electrical Design***
Each pump shall be provided with IFM Effector flow switch for the flow detection. For details refer to Council Standard Specification for Electrical Assets.	***Upgrades to Existing Pumps***

ELECTRICAL DESIGN: Power supply requirements, electrical equipment design and telemetry shall comply with the requirements of Council Standard Specification for Electrical Assets. Pump data and selection criteria shall be documented in **Appendix B Pump Asset Registration Data in Development Design Specification – Sewerage (D12).** ***C402.12.2 UPGRADES TO EXISTING PUMPING STATIONS*** The provisions of this specification for new pumping stations as detailed above shall also be applicable to the upgrade of any existing pumping stations that may be required to be undertaken as a result of the development works.	

C402.13 ELECTRICALLY OPERATED ACTUATORS

Electrically Operated Actuators Design

The Contractor shall be responsible for the design, manufacture, supply, and performance of the actuators.

Power

Electric motor actuators shall be 3 phase with a rated voltage 415 50 Hz and shall be suitable for operation over a phase voltage range of 400 to 440 V. Phase rotation protection shall be provided integral with 3 phase actuators.

IP Rating

The actuators shall be suitable for indoor and outdoor installation. The actuator enclosures, including all auxiliary enclosures, shall be a minimum of IP56 to AS 60529

Motor Sizing

Actuator motors for penstocks and valves shall be specifically designed for penstock or valve actuator service and winding insulation shall be Class F. It shall be the Contractor's responsibility to determine the rated output (kW) of the motor, in conjunction with the gear reduction unit used, to suit the operational requirements of the respective penstock or valve.

Operating Times

The rated speed and the direction of rotation of the motor, in conjunction with the gear reduction unit used, shall suit the operational requirements of the penstock or valve. The time to operate the penstock from fully closed to fully open and vice versa shall range between 2 to 3 minutes. The time to operate a valve from fully closed to fully open and vice versa shall range between 4 to 6 minutes.

Interchange ability

Where possible, actuators shall be selected to be interchangeable with existing actuators at the plant.

Design Calculations

The Contractor shall have the valve and penstock suppliers prepare calculations of the maximum opening and closing torques for each penstock and valve. These calculations shall be submitted to Council as verified design for acceptance. Actuators shall be sized for non-overload operation at these loadings.

Mounting

Electric actuators shall be mounted directly on the valve or penstock capstan so that all forces are confined to the valve or penstock. All electric actuators shall be suitable for remote operation from the PLC. All electrical connections, controls, and the like shall be accessible from platforms or walkways.

Switches

The actuators shall be position and torque switches which shall be arranged to stop the actuator at the extremes of travel.

Hand wheel

All actuators shall be provided with a manual override which shall be a hand wheel. Hand wheels shall be located not more than 1000 mm or less than 700 mm above the operating floor level and shall not exceed 600 mm diameter. The hand wheels must be of a diameter which shall require a force of no more than 130 Newtons at the rim to operate the penstock or valve from fully open to fully closed under all operating conditions. Where this cannot be achieved due to the limit on the hand wheel diameter, a gear reduction unit shall be used. Minimum hand wheel size shall be 500 mm and minimum clearance 150 mm for penstocks

Hand wheels shall be rotated clockwise to close the valve, and shall be clearly marked with the words "OPEN" and “CLOSE” and arrows in the appropriate directions. The rims of the hand wheels shall be machined to a smooth finish.

Each actuator shall have integral open and close contactors, local open/close/emergency stop control pushbuttons and Local/Remote control selector switch together with all ancillary equipment such as control transformers, relays and other components as required. Contactors for modulating duty actuators shall be solid state type.	***Contactors***
Each actuator shall be supplied with an integral reversing DOL starter and associated control equipment. It shall be possible to control electrically actuated valves and penstocks either locally manually or remotely. Each penstock or actuated valve shall be fitted with the integral OPEN / CLOSE push buttons, a padlock able LOCAL /REMOTE rotary selector switch, and an emergency stop push button.	***Remote & Local Operation***
Operation of the emergency stop push button shall stop the valve or penstock regardless of selector switch position.	***Emergency Stop***
The actuators shall be fitted with open, close and stop interposing relays which shall enable the actuators to be opened and closed by the control system when remote is selected.	***Interposing Relays***
The actuators shall be provided with voltage free contacts for remote connection of monitoring signals including the following: • Open and close status; • Actuator available (i.e. voltage present and remote selected); • Actuator fault – e.g. over torque, motor overload/over temperature fault	***Signals***
Actuators shall have a local mechanical position indicator. Where specified the actuators shall have a position signal transmitter with an isolated 4 to 20 mA output suitable for connection to the PLC.	***Indicator***
Each actuator shall be fitted with a Grade 316 stainless steel nameplate, in accordance with AS 1359.	***Nameplate***
Actuators shall be fitted with temperature sensing devices which shall be embedded in the motor phase windings and shall be arranged to prevent motor overload. Non-modulating actuators shall be rated for 60 starts (reversals) per hour.	***Sensors***
Actuators shall be fitted with 240 V ac anti-condensation heaters.	***Anti-Condensation***

C402.14 ELECTRICAL WORKS

Electrical Works

COMPLIANCE WITH AUTHORITIES, STATUES, REGULATIONS AND STANDARDS

Compliance

All electrical works shall be carried out in accordance with the requirements of:

a) AS/NZS 3000 and other relevant Australian Standards;

b) Power Supply Authority Service Rules and Regulations;

c) Other relevant Statutory Authorities;

d) Council Standard Specification for Electrical Assets

The scope of electrical work shall include but shall not be limited to the following:

Scope

a) Negotiations with Power Supply Authority unless another power supply Authority is nominated in the project specification. The name and the phone number of the Power Supply Authority contact shall be as indicated in the project specification. The Contractor must fill all relevant application forms and pay all relevant fees.

b) Supply and installation of consumer mains;

c) Supply and installation of electrical switchboard;

d) Supply and installation of all instrumentation and field mounted control equipment;

e) Supply, installation and termination of all cabling;

f) Supply and installation of all telemetry equipment including aerial and aerial mast;

g) Supply and installation of all junction boxes, conduits, cable trays, cable ladders and fittings;

h) Supply and installation of a standby diesel generator set for backup power to ensure continuity of service, or provision of connection facilities for same, as required by Council at the development approval stage;

i) Carry out factory testing of the switchboard;

j) Carry out site testing and commissioning;

k) Provide “As Constructed” design documentation and also Operation and Maintenance Manuals;

l) Provision of Defects Liability Period;

m) Liaison with Council;

n) Any other work as required in the project specification.

Power Supply

INCOMING POWER SUPPLY

Incoming Power Supply

The Contractor must carry out all works as required by Power Supply Authority to provide 3 phase 415V, 50 Hz power supply to site;

The Contractor must upgrade or provide new metering facilities at each site as required by Power Supply Authority.

The Contractor must ensure the minimum power factor of 0.9 at each site. The prospective fault level of each electrical installation shall be as nominated by Power Supply Authority but in any case the minimum fault level shall be as follows:

- Not less than 15kA for 1 second for the Main Switchboards rated 100 Amp or less, and
- Not be less than 25kA for 1 second for the Main Switchboards rated over 100 Amp.

If VSD drives are used the level of total harmonics distortion (THD) at the point of common coupling (PCC) must be as required by Power Supply Authority;

The consumer mains with a cross section greater than 120 mm^2 shall consist of single core XLPE/PVC cables;

The current carrying capacity of the consumer mains shall suit the maximum demand plus 30% spare capacity;

The consumer mains shall be sized to ensure the voltage drop at the incoming terminals of the switchboard does not exceed 2.5% under maximum demand conditions plus 30% spare capacity;

Power supply metering must be provided as required by Power Supply Authority.

STANDBY DIESEL GENERATOR

Standby Diesel Generator

For the diesel generator details refer to Council Standard Specification for Electrical Assets.

Where provisions only are required for the standby diesel generator these provisions must be in a form of external weather and vandal proof socket inlet or a junction box rated for the full load of the relevant switchboard and as required in the Project Specification.

Sufficient space shall be allowed for the mobile diesel generator installation.

POWER SUPPLY CHANGE-OVER ARRANGEMENT

Power Supply Changeover Arrangement

Where a permanent diesel generator is required to be provided on site, the main switchboard shall be fitted with an automatic transfer switch (ATS) to facilitate an automatic transfer between the power grid and the generator supplies. For all other sites where only provisions for connection of mobile diesel generators are required the changeover switch shall be manual switch. For details of ATS refer to Council Standard Specification for Electrical Assets.

EARTHING

Earthing

The Contractor must provide M.E.N. earthing system at each site. The earthing system must comply with requirements of AS/NZS3000 and Power Supply Authority Service Rules.

Each earthing rod must be a minimum 16 mm stainless steel copper clad rod with a minimum length of 3 metres. Each earthing cable must be provided with a PVC sleeve. Bare earthing conductors must not be used. All earthing cable connections to earthing rods must be by means of approved earthing clamps

The Contractor must provide an earth inspection pit at each rod. Each pit must be marked for easy identification.

LIGHTNING AND SURGE PROTECTION

Lighting and Surge Protection

The need for lightning protection shall be assessed for each site and shall comply with the requirements of AS1768.

Suitable surge protection must be provided at each site to protect equipment against lightning strikes, motor starting and stopping or sudden loss or application of power supply. Surge protection devices must be provided as follows:

- Inside each Main SCA or Switchboard/Panel/Distribution Board across incoming power supply
- Across power supply to all instrumentation loops mounted outside in the field
- All signal lines run to and from outside. Instrument surge diverters must be provided on both ends of each loop.
- On all data and cable communication lines.

Minimum size surge protection earth cable must comprise stranded, 16 mm^2 or as recommended by the manufacturer, green/yellow PVC insulated cable installed such that it is segregated from all other cables.

For details of surge protective devices refer to Council Standard Specification for Electrical Assets.

STARTING OF PUMPS

Starting of Pumps

DOL starting of the pump motors shall be with Ergon Energy approval only. Otherwise, all motor starters must be either soft starter or VSD (Variable Speed Drive) as required by the process.

The maximum number of starts per hour shall be 12 starts.

Where electronic starters are used the disturbance to the electrical supply system shall not exceed limits set down in AS61000.3.6 and AS61000.3.7. Radio interference external to the electronic starters shall not exceed limits set down in AS/NZS CISPR 11:2004. A suitable R.F.I. filter shall be provided to ensure compliance with AS/NZS CISPR 11:2004.

The level of total harmonic distortions at the point of common coupling (PCC) must be limited to planning levels as set by Power Supply Authority. Appropriate harmonic filters shall be provided on each VSD unit to comply with Power Supply Authority requirements.

NOMINATED SUBCONTRACTORS Refer to Council Standard Specification for Electrical Assets for the details of nominated equipment suppliers and service providers.	***Nominated Subcontractor***

APPENDIX A COMMISSIONING, PRE-COMMISSIONING AND TESTING OF ELECTRICAL AND MECHANICAL EQUIPMENT

TESTING **Definitions** Inspection is defined as inspections during the construction of equipment to be supplied. Inspections are to be carried out by the Contractor to ensure that the construction is in accordance with the specified and tendered requirements. Testing is defined as tests by the Contractor prior to demonstration. Testing includes both works testing, at the manufacturer's facilities and site testing. Inspection and Testing Program (ITP) is the Contract Program, which must include the times for inspection and testing, and lists all tests and test procedures.	***Definitions***
Works Testing Witnessed works testing is required for the flow measuring equipment, some of the mechanical equipment and electrical switchboards and control panels. The Council reserves the right not to witness the testing of any of this equipment. Forward certified test reports and test certificates to the Council. All the electrical switchboards and control panels must be tested in Australia. Provide type test certificates for all Main Switchboards. The switchboards must be type tested to AS3439.1 or AS1136 by any NATA accredited testing facility. Use a NATA accredited testing facility to carry out all flowmeters and other measuring instruments tests and calibration and provide test certificate for each item of instrumentation.	***Works Testing***
FACTORY INSPECTION AND TESTING OF SCA'S **Factory Inspections** Each SCA will be inspected by the Council or its representative during manufacture and prior to delivery. The following are specific milestones for witnessed inspection: • First Inspection - Metalwork finished • Second Inspection - Metalwork finished and painted • Third Inspection - All electrical equipment installed • Final Inspection. Inspections, other than the final inspection, are intended to maintain constructional standards and are not intended, unless otherwise	***Factory Inspections of SCA's***

arranged, as functional tests, therefore the manufacture of the SCAs must not cease during these inspections. The Contractor must notify the Council at least seven (7) working days before each inspection is required. Any work carried out by the Contractor beyond or in excess of the work necessary for the final inspection must be at the Contractor's risk. If any inspection is called for by the Contractor before work has reached a stage where the inspection is warranted, the cost of the premature inspection must be paid by the Contractor or deducted from the Contract sum. **Factory Testing** Testing as specified must be performed during the final inspection. All tests must comply with the requirements of AS3439.1 The Contractor in the presence of the Council must perform the following tests as a minimum for each SCA: • Visual inspection, equipment mounting and wiring termination checks; • Insulation tests before and after power (high pot) tests, including each phase to earth, each phase to neutral, between phases using a minimum of 1000 V megger; • Power tests (high pot) with ac voltage of 2.5 kV; • Operational test of all protective devices; • Simulated functional tests for all drives and electrical equipment in manual model and in automatic mode where applicable **Test Certificates** Following completion of all tests the Contractor must submit to the Council a full set of test certificates for each SCA.	***Factory Testing of SCA's***
FACTORY INSPECTION AND TESTING OF MECHANICAL EQUIPMENT **Factory Inspection** The following are specific milestones for witnessed inspection by the Contractor of specifically fabricated items: • First Inspection - Metalwork finished. • Second Inspection - Metalwork finished and painted. • Third Inspection - Fully assembled equipment. • Final Inspection. Inspections, other than the final inspection, are intended to maintain construction standards. The Contractor must supply a brief report on each inspection. **Factory Testing** Testing at the factory for materials and of major items of equipment supplied by the Contractor under this contract must be carried out on the following as a minimum: • Pumps with motor sizes greater than 11 kW must be works tested	***Factory Inspections of Mechanical Equipment*** ***Factory Testing of Mechanical Equipment***

at the supplier's factory in accordance with AS2417.2 (Pumps Hydraulic Performance Acceptance Test);
- All other mechanical equipment as nominated in the Tender Document.

Test Certificates

Test Certificates

Following completion of all tests the Contractor must submit to the Council a full set of test certificates for each item of mechanical equipment.

TESTING OF VALVES

Knife Gate Valves

Testing of Knife Gate Valves

Knife Gate valves shall be tested in accordance with the test procedures of the WS-SPEC SP 23, Appendix A.

Air Valves

Testing of Air Valves

Air valves shall be tested in accordance with the test procedures of the WS-SPEC SP 27, Appendix A.

Reflux Valves

Testing of Gate, Non return Valves

The Contractor shall carry out the following tests at his own cost in the works of the Valve Manufacturer before the valves are shipped.

Test No.1 — Body Test.

The valve shall be blanked off at both ends and a body test pressure of 1.5 times the valve rated pressure shall be applied for 5 minutes with the plug in the partially open position. No leakage shall be visible.

Test No.2a — Plug or Gate Test

The valve shall be blanked off at the upstream flange only, and a test pressure of 1.5 times the valve rated pressure shall be applied for 5 minutes with the valve in the closed position. There shall be no visual evidence of structural damage to the plug or of leakage through the plug itself.

Test No.2b

While the valve is set up in this position a test pressure equal to the working pressure specified shall be applied and the valve shall be partially opened to prove that the rim force required on the hand wheel does not exceed 180N.

Test No.3 — Seat Test

The valve shall be blanked off at the downstream flange and a test pressure equal to the valve rated pressure shall be applied for 5 minutes with the valve in the closed position. No leakage past the valve seat shall be observed when the test is made. All tests shall simulate a valve in a terminal position held rigidly at one end only. In this condition, the valve shall be blanked off in such a manner that the axial hydraulic force is not externally restrained. This simulates a valve in a fully differential pressure situation held rigidly at one end only.

SITE TESTING

General

1. When the Works are substantially completed and the equipment is in a condition to be tested, site testing may begin.
2. Arrange inspections with the relevant statutory authorities having jurisdiction over the works to ensure that all equipment has been installed and functions in compliance with their requirements.
3. Submit to the Council a program for testing two (2) weeks prior to the commencement of any site testing. The program must clearly indicate the dates proposed to conduct each phase of site testing. The Council may alter the proposed dates or specify any additional tests not included in the program to be carried out.
4. All testing equipment, labour and necessary facilities for all tests must be supplied by the Contractor.
5. All plant maintenance and clean-up must be undertaken by the Contractor.
6. Have representatives present on site during all site tests and have available the necessary labour and equipment to carry out all repairs and modifications that may be required during the site testing period. Site testing of all equipment must be supervised by the Contractor and representatives of the relevant sub-contractors.
7. Site testing must be conducted in three distinct phases, as follows:-

(a) A static and dimensional inspection to establish that all items of equipment are complete and the equipment is ready for no-load operation;

(b) No-load operation to demonstrate that all equipment functions successfully, both separately and as components of integrated systems;

(c) Design load/acceptance operation to demonstrate that all equipment can successfully and reliably operate under working conditions.

8. Notify the Council in writing of successful completion of phase 1 of testing, giving at least 48 hours notice before commencing phase 2. The Council will arrange for the Council's specialist personnel to be present on site during phase 2 and 3 to witness their successful completion.
9. Prior to commencement of the design load/acceptance operation (phase 3), ensure that the system is functioning correctly, with no known deficiencies or faults that could impair the load testing.
10. If it is not possible to activate any electrical protective equipment or device, use a simulate test.
11. Site testing must include, but not be limited to the following:-

(a) Performance tests of the mechanical and electrical equipment

(b) Adjustments and setting of all field control and safety devices

(c) Noise level measurements

(d) Electrical and control tests as detailed below

(e) Functional check of all control and instrument loops and logic testing of circuitry and programs

Site Testing

(f) Verification of calibration of all flowmeters (g) Setting and calibration of all other instrumentation (h) MEN Earthing: Conformation of effective earthing of exposed metal of electrical equipment. In addition, perform all other checks and tests that may be required by the Australian Standards and Power Supply Authority. ***Electrical and Control Tests*** 1. The Contractor must be responsible for site testing of the completed electrical installation at each pump station. 2. The following works must be carried out as a minimum: **Calibration** All process instrument loops. **General** Circuit continuity, point to point checks, termination checks and component installation checks. **All SCAs and Panels** (a) Check all terminations installed under this contract for tightness (b) Check earthing cables and connections (c) Check insulation resistance at 1000V between phases and to earth of busbars, with all isolators closed after ensuring disconnection of all electronic devices. (d) Check mechanical operation of all switch devices and interlocks **Control and Operation including SCADA** (a) Point to point testing of all I/Os (b) Functional operation of all equipment as specified. (c) Operation of all hardware and software as required. **0.6/ 1 kV Cables** (a) Point-to-point checks (b) Bell all cores (c) Check insulation resistance of 0.6/1 kV cables with 1000 V megger (phase-to-phase, phase-to-neutral, phase-to-earth) (d) Check earth or shield continuity, where applicable (e) Test insulation resistance of all control cores in a cable, as a group, to earth (f) Check for correct identification of cable markers (g) Check for compliance with AS 3008.1 where cables have been derated (h) The Contractor must be responsible for ensuring that megger testing	***Electrical and Control Tests***

does not damage any electronic equipment.

Motors

(a) Manual turning of the rotor to ensure mechanical freedom

(b) Insulation resistance at 1000V between phases and each phase to earth

(c) Continuity of earth connections, and check on phase and earth connections in terminal boxes

(d) Continuity of all hard-wired control and monitoring circuits associated with respective motors

(e) Functional check of all control circuits and devices to ensure correct operation before motors are energised

(f) Local start/stop operation and/or control station operation to check direction of rotation

(g) Check motor for run and direction

(h) Record no-load currents.

Uninterruptible Power Supply

(a) Operational tests on all items of equipment including simulation of all alarms to prove correct operation.

(b) Simulation of supply failure, charger failure, inverter failure, battery failure and static switch failure to prove that the output remains within specified requirements at all times under any condition.

(c) Voltage levels of each cell must be measured during charging and under float conditions to prove that all cells voltages are within allowable limits.

(d) A full load test must be conducted on the complete UPS system to prove that the unit can deliver full rated output for the specified time with battery end voltage not lower than the specified minimum.

Earthing

(a) This Contractor must demonstrate that the continuity of the earthing system is in compliance with the requirements of AS 3000 and the relevant standards and that all specific installation requirements have been adhered to.

(b) The Contractor must:

(i) Check the earthing resistance for each section of the earth after isolating sections of the earth from the relevant test points.

(ii) Test all earthing conductors for continuity after installation.

(iii) Check all earth connections for correct termination.

(iv) Provide an earthing report showing:

- Resistance to earth of each earth electrode.
- Resistance to earth of each installation when all bonds are connected.

Lightning Protection System

All sites tests as required in AS 1768**.**

Light and General Power

The Contractor must test and demonstrate the operation of the complete lighting and general power installation for compliance with the drawings and must:

(a) Test all light fittings and record lux levels throughout the plant.

(b) Test the operation of the switching circuits and the Emergency Lighting Installation

(c) Test all power outlets and confirm phase rotation and circuit connections as applicable

(d) Test all RCDs and earth leakage devices.

Field Mounted Equipment

(a) The Contractor must perform component integrity and terminations check.

(b) Any defects associated with the supplied equipment and incorrect installation instructions disclosed during testing must be rectified by the Contractor, and fresh tests must be carried out if required. The Contractor must meet all the costs of remedial work and tests.

(c) The Contractor must provide all testing and calibration equipment and instruments as necessary.

(d) Test results must be recorded and submitted as test certificates.

# PRE-COMMISSIONING **GENERAL** The Contractor shall test and/or inspect all materials, equipment, installation and workmanship to prove compliance with the Specification requirements. The submission to the Council of satisfactory test results constitutes a HOLD POINT. The approval of the Council is required prior to the release of the hold point. Tests and inspections shall comply with relevant Australian Standards. Testing shall include pre-commissioning, field testing and performance testing of each part of the whole installation.	***Precommissioning General***
PRE-COMMISSIONING Pre-commissioning is the preparation of plant or equipment so that it is in a safe and proper condition and ready for commissioning and operation. It includes all aspects of plant operation such as safety, electrical, mechanical and instrumentation. The Contractor shall conduct pre-commissioning in a logical sequence in accordance with the programme prepared by the Contractor and approved by the Council. The Contractor shall prepare pre-commissioning record sheets for each item of equipment to ensure results of tests are satisfactorily recorded and that all necessary checks or tests have been performed. Specific requirements for pre-commissioning shall include, but are not limited to: (a) Initial charges of lubricant in addition to any special lubricant requirements for initial flushing or treatment of the system or for "running in". (b) Physical checks and tests such as completeness of assembly, rotational tests (including checking that the rotation of electrical motors is in the correct direction), alignment checks, balancing and vibration checks, temperature, pressure and flow measurements, clearances, belt alignment and tension, etc, depending on the type of equipment. (c) Electrical and instrument installation tests, including motor insulation tests and checking instruments against certified instruments and correcting as necessary. (d) Tests of the correct functioning of automatic and manual control and protection equipment, including simulating danger conditions, mal-operations or failures, to check that all instruments and controls function correctly. These tests shall also include adjusting instrument set points and alarm settings and proving correct operation of alarms.	***Precommissioning***

(e) Equipment and system operating tests. The Contractor shall certify compliance of each item and submit a signed copy to the Council prior to commissioning. The Contractor shall carry out pre-commissioning tests to the satisfaction of the Council's Representative and shall record the results of the tests on the appropriate Pre-commissioning Record Sheet. The Contractor shall furnish the Council with one signed copy of each completed Pre-commissioning Record Sheet countersigned by the Council's Representative who witnessed the test.	

PRE-COMMISSIONING AND TESTING CHECKSHEETS

Date of Commissioning :	Job Name:	
	Job Number:	
Commissioning Check sheet Document No:	ITP Reference:	
Description :	Category :	

Mechanical Pre-Commissioning Check sheet			
DESCRIPTION:	**CIRCLE**	**CHECKED BY (SIGN AND DATE)**	**COMMENTS**
Check the installation of pump set & its associated instrument, equipment and fittings. Does it comply with Council specifications e.g. Layouts, P&IDs ?	Y/N/NA		
Is equipment safety adequate? (guards for all rotating parts, ladders, platforms, handrails, kick plates, safety showers etc)	Y/N/NA		
Check all holding down bolts are fastened and tight	Y/N/NA		
Visually check alignment of connections of drive systems	Y/N/NA		
Is the oil / grease level adequate?	Y/N/NA		
Checking correct selection of construction material	Y/N/NA		
Check site corrosion protection and that painting are adequate.	Y/N/NA		
Can pump be lifted clear of guide rails and steelwork where provided?	Y/N/NA		
Check that equipment labels and tag numbers are correct.	Y/N/NA		
Check that safety signs comply with specifications.	Y/N/NA		
Confirm that vendor Factory Testing Certificates or Type Test Certificates and pump curves have been obtained (attach copy of pump curve to this ITP)?	Y/N/NA		
Check motor shims such that vibration during operation will not cause movement or dislodge them?	Y/N/NA		
Confirm Motor frame and Terminal Boxes have been properly grounded?	Y/N/NA		
All valves operate from the closed to fully open position	Y/N/NA		
All valves seal when closed	Y/N/NA		
All valves are right handed, easy to operate and have no sharp protrusions on Hand Wheels	Y/N/NA		
All fasteners and mountings are tightened correctly	Y/N/NA		
Pressure gauge cocks provided on the pump side of each reflux valve and one on the rising main slide	Y/N/NA		
Drop tube and baffle wall installed	Y/N/NA		
No rubbish at the bottom of the well which is likely to damage the Pump when it is started	Y/N/NA		
General Comments			

COUNCIL'S COMMISSSIONING REPRESENTATIVE:	**Signed:**	**Date:**
CONTRACTOR'S REPRESENTATIVE:	**Signed:**	**Date:**
DEVELOPER'S	**Signed:**	**Date:**

REPRESENTATIVE:		

Date of Commissioning :	Job Name:	
	Job Number:	
Commissioning Check sheet Document No:	ITP Reference:	
Description :	Category :	

Electrical Pre-commissioning Check sheet

DESCRIPTION:	CIRCLE	CHECKED BY (SIGN AND DATE)	COMMENTS
Electric supply has been connected and energised	Y/N/NA		
Earth Electrode installed in specified connection box	Y/N/NA		
Earth pit, main earth electrode and water service bond installed	Y/N/NA		
Meter panels are equipped and wired to Supply Authority requirements	Y/N/NA		
Shielded cable used on VSD starters	Y/N/NA		
Motor wiring and earthing conductor is enclosed together in a continuous metallic sheath or conduit which has a good contact to both the motor and the invester chassis on VSD starters	Y/N/NA		
Cable supports for the pump cables and level instrumentation are correctly located and properly fixed	Y/N/NA		
Excess cable is supported clear of incoming sewer levels	Y/N/NA		
No cable stocking has more than one cable installed in it	Y/N/NA		
Motor cables are supported in the well so as to avoid damage when removing other pump/	Y/N/NA		
Motor cables in wells have minimal slack and do not present undue stress on motor cable glands	Y/N/NA		
Cable duct cover held captive under the edge of the concrete plinth by the sliding cover, and at switch board end	Y/N/NA		
Appropriate lugs fitted to all cables, and cables correctly identified terminations	Y/N/NA		
Motor terminations are in accordance with the connection diagram	Y/N/NA		
All power cable terminations tested for tightness	Y/N/NA		
All equipment checked against equipment schedules and marked up schedules adjusted as required	Y/N/NA		
All wiring holes are bushed	Y/N/NA		
Where parallel cables may be installed on site, provision has been Made to ensure only one cable lug needs to be installed on each side of terminal lug	Y/N/NA		
Labels identifying all neutral connections located adjacent to neutral link	Y/N/NA		
All unit isolating switches are labelled	Y/N/NA		
Rating of all fuse elements is marked by label adjacent to the respective fuse	Y/N/NA		
All labels fixed to insulating panels and enclosures are fixed with insulated bolts, nuts and fixings	Y/N/NA		
Station identification labels mounted at top of each	Y/N/NA		

outer door on outdoor pump station SCA's			
SCA rating plate complying with AS3439.1 has been fixed to indoor type SCA and all detail have been confirmed	Y/N/NA		
SCA tested for dielectric strength as specified	Y/N/NA		
All power cables in each soft starter tested with ohmmeter for Continuity. No cross-overs exist between starter, bypass contactor and thermal overload	Y/N/NA		
All control wiring terminated with crimp lugs or crimp ferrules	Y/N/NA		
Confirm sufficient terminals installed to allow an individual terminal For every incoming field wire	Y/N/NA		
Ratings for all motor starter equipment and ammeters checked Against Specification and information from pump/fan drive motor supplier	Y/N/NA		
Pump detail and rating plate installed and all pump details engraved on the plate have been confirmed against pump manufacturers info	Y/N/NA		
With Flygt pumps, ensure that an earth has been put on S2P	Y/N/NA		
Correct orientation and fixing of the switchboard.	Y/N/NA		
Switchboard plinth and all gland plates sealed	Y/N/NA		
All cables properly glanded at the switchboard	Y/N/NA		
Dust seals fitted to all outer door openings and fixed securely	Y/N/NA		
All locking bars on multi point lock systems are fixed securely into lock mechanism	Y/N/NA		
All rubbish, sand and dirt removed from cable trench	Y/N/NA		
Level probe support bracket to suit cable clamp	Y/N/NA		
level probe is minimum 300 mm clear of all concrete and metal components	Y/N/NA		
General Comments			

COUNCIL'S COMMISSSIONING REPRESENTATIVE:	**Signed:**	**Date:**
CONTRACTOR'S REPRESENTATIVE:	**Signed:**	**Date:**
DEVELOPER'S REPRESENTATIVE:	**Signed:**	**Date:**

Date of Commissioning :	Job Name:	
	Job Number:	
Commissioning Check sheet Document No:	ITP Reference:	
Description :	Category :	

Control Pre-commissioning Check sheet			
DESCRIPTION:	**CIRCLE**	**CHECKED BY (SIGN AND DATE)**	**COMMENTS**
Inspect telemetry and radio supply cable connections for correct polarity	Y/N/NA		
Check correct rating of protective devices for radio and telemetry	Y/N/NA		
Check for mains voltage rated insulation on data cables where mixed with mains voltage cables	Y/N/NA		
Measure telemetry supply voltage and back up battery voltage	Y/N/NA		
Check correct positioning of telemetry unit in relation to other PLC cards	Y/N/NA		
Check hardware configuration of telemetry unit	Y/N/NA		
Check software configuration of telemetry unit	Y/N/NA		
Check address switch (es) of telemetry unit for correct addressing.	Y/N/NA		
Visual check of antenna installation, clearance from surroundings and Mountings secure	Y/N/NA		
Check antenna magnetic bearing and polarisation (as specified on licence)	Y/N/NA		
Check antenna mounted with weep hole to bottom	Y/N/NA		
Check for secure earth on radio coax surge protection (if applicable) and Coax continuity	Y/N/NA		
Check telemetry transmit level to network device .Set as required by network device	Y/N/NA		
Check telemetry receive level from network device, and set as required by the network device (or if not adjustable, ensure level is below telemetry threshold level)	Y/N/NA		
Monitor radio audio clarity and set audio control off or to min. volume	Y/N/NA		
Monitor telemetry messages for error	Y/N/NA		
Enable RTU and check telemetry unit is configured correctly	Y/N/NA		
Check that correct locks are fitted to telemetry cubicle.	Y/N/NA		
General Comments			

COUNCIL'S COMMISSSIONING REPRESENTATIVE:	**Signed:**	**Date:**
CONTRACTOR'S REPRESENTATIVE:	**Signed:**	**Date:**
DEVELOPER'S REPRESENTATIVE:	**Signed:**	**Date:**

COMMISSIONING

Commissioning

After successful completion of testing and pre-commissioning the commissioning stage must be carried out.

During commissioning stage the completed pump station will be operated automatically and manually.

The following must be proved during each pump station trials:

1. Each fixed speed pump operates at flow and head required under all operating conditions to achieve the Performance Requirements;
2. Each variable speed pump operates at flow and head required under all operating conditions over the entire range of operating speeds to achieve the Performance Requirements; and
3. The power consumption at each pump station does not exceed the guaranteed power consumption.

Commissioning is not complete until the pump station has been run continually without any faults for a minimum of fifteen (15) days in accordance with required control and operation procedures. If during this period any mechanical or electrical equipment does not operate as specified then the commissioning must be repeated after rectification of defects. All rectification works and the cost of additional commissioning will be to the Contractor's expense.

Manufacturers Compliance Certificates

Manufacturer's compliance certificates for supply of pipes, valves, pumps, flowmeters and electrical equipment shall be provided to the Council's Commissioning Representative.

COMMISSIONING CHECKSHEETS

Commissioning Check sheet Document No:		Job Name:	
		Job Number:	
		ITP Reference:	
Description :		Category :	**Pumps**

General Information			
Equipment Tag No.:		Serial No.:	
Equipment Location:		Weight:	kg
Hazardous Area Rating:		Design Flow:	m3 /hr
Manufacturer:		Design Head:	m
Pump Type:		Liquid Description:	
Rated Motor Power:	kW	Paint Specification:	
Pump Speed:	rpm	Casing Material:	

Pump Motor Data			
Motor Manufacturer:		Motor Speed:	rpm
Model Number:		Speed if Fixed:	rpm
Serial No.:		Max Speed (VSD):	rpm
Full Load Current:	Amps	Min Speed (VSD):	rpm
Rated Volts:	V	Gearbox:	
Motor Weight:	kg	Ratio of gearing:	
IP rating:		Gearbox Weight: -	kg
General Comments:			

Wet-Commissioning Check sheet			
Description:	**Circle**	**Checked By (sign and Date)**	**Comments**
Have all pre-commissioning checks been signed of as per ITP.	Y/N/NA		
Have electrical pre-comm. Check sheets been completed or sign off	Y/N/NA		
Has manufacturer pre-comm. Check sheets been completed or sign off	Y/N/NA		
Check that adjustments and setting of no-flow, torque limit switches and thermal overload relays have been set.	Y/N/NA		
Test any associated field devices. Eg isolating switches and safety devices.	Y/N/NA		
Test pump for Field start / stop and emergency stop control.	Y/N/NA		

Uncouple motor and check direction of motor by jump-start. Is direction of rotation of pump correct?	Y/N/NA		
Test pump for Remote Manual start / stop control?	Y/N/NA		
Test pump for SCADA start / stop control?	Y/N/NA		
Check that the equipment Input / Output signals are consistent with the control system Feedback signals? Has Motor Been Re-coupled from direction test?	Y/N/NA Y/N/NA		
Have all dry-commissioning checks been signed of as per ITP?	Y/N/NA		
Is there any leakage in the system?	Y/N/NA		
Do up stream and downstream pressure gauges read the same?	Y/N/NA		

General Comments:

COUNCIL'S COMMISSSIONING REPRESENTATIVE:	**Signed:**	**Date:**
CONTRACTOR'S REPRESENTATIVE:	**Signed:**	**Date:**
DEVELOPER'S REPRESENTATIVE:	**Signed:**	**Date:**

Commissioning and Performance Testing

Description:	**Circle**	**Checked By (sign and Date)**	**Comments**
Have all wet-commissioning checks been signed of as per ITP?	Y/N/NA		
Is there any leakage in the system?	Y/N/NA		
Complete attached Performance Test sheet as per commissioning procedure.	Y/N/NA		
Does equipment fulfil its designed function under Wet-commissioning? (Delivers design flow rates, current draw etc.)	Y/N/NA		
Is equipment deemed ready for Process Commissioning / demonstration? (e.g. can be operated under Remote Manual control for a process cycle without tripping alarms)	Y/N/NA		

General Comments:

COUNCIL'S COMMISSSIONING REPRESENTATIVE:	**Signed:**	**Date:**
CONTRACTOR'S REPRESENTATIVE:	**Signed:**	**Date:**
DEVELOPER'S REPRESENTATIVE:	**Signed:**	**Date:**

Pump Performance Test

P&ID No.:
Location:
Date :

Job Name:
Job No:
ITP No:

Description	Current	Rated Motor Current	Current-draw acceptance ((1)-(2))/(2)<10 %	Flow Measurement					Flow rate		Vibration -visual observation
				Surface area Of Sump	Water Depth At Start	Water Depth At finish	Pumped Flow 4*(5-6)*1000	Duration of Test	Design (Units)	Measured (Units)	
	Amp.	Amp.	Y/N	m	m	m	L	S	L/sec	L/sec	Nor./abnor.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Pump No. (Tag. No.):											
Test 1											
Test 2											
Test 3											
Comments:											

Notes:
1 Pump curves or works tests results should be available before site test
2 Site test is not intended to reproduce pump curve, rather check if the pump can deliver adequate head under certain range of flow specified in designed by means of pump curve

Tested by: (Council Commissioning Representative) Signed: Dated:	Witnessed by: (Contractor's Representative) Signed: Dated:	Approved by: (Developer's Representative) Signed: Dated:

APPENDIX B OPERATION AND MAINTENANCE MANUAL

Manuals shall contain the following information: (a) Contractor's name, address and telephone number. (b) Client's Contract number, job name. (c) Pump station general arrangement drawing showing pumps, motors, valves, pipe work, switchboard and electrical installation.	***General***
Manuals for pumps shall contain the following information: (a) Manufacture. (b) Type and model number. (c) Serial number. (d) Dimensioned general arrangement drawing of pump and motor. (e) Sectional arrangement drawing with parts and list. (f) Dimensioned sectional arrangements detailing: (i) Maximum and minimum shaft/bearing clearance (radial) (ii) Maximum and minimum impeller/bowl clearance (radial) (iii) Maximum and minimum impeller/bowl clearance (axial) (iv) Impeller/bowl wear rings. (v) Motor/pump coupling - type, make and model number. (vi) Mechanical seals where applicable.	***Pumps***
Manual for motors shall contain the following information: (a) Manufacture. (b) Type and model number. (c) Serial number. (d) Dimensioned general arrangement drawing. (e) Sectional arrangement drawing for submersible motor power cabling where applicable. Gland sealing arrangement drawing for submersible motor power (f) cabling where applicable. (g) Cables where applicable. (h) Terminal block arrangement drawing where applicable. Manuals for valves shall contain a dimensioned sectional arrangement	***Motors***

drawing with parts and material list for all valves. Manuals shall contain the following test curves:- (a) Pump witnessed test curves. (b) Motor test curves. (c) Motor torque/speed/efficiency characteristic curves. The operating and maintenance manual shall include: (a) Safe working procedures: For switching and isolating the supply and distribution system; (b) Description of Operation; (c) Maintenance procedures: Recommended maintenance periods and procedures; (d) Tools: Particulars of maintenance equipment and tools provided, with instructions for their use. (e) Equipment: A technical description of the equipment supplied, with diagrams and illustrations where appropriate; (f) Dismantling: Where necessary, procedures for dismantling and reassembling equipment; (g) Spare parts: A list of the spare parts provided. Trouble shooting instructions shall be included for pumps, motors, valves and SCA. Step by step procedures for dismantling and reassembly of pumps, motors and Valves using any special tools shall be detailed together with step by step procedures for replacement of wearing parts such as bearing, seals, wear rings, etc	***Test Curves*** ***Other***