

Hunter Water Corporation A.B.N. 46 228 513 446
Standard Technical Specification for:

CONSTRUCTION OF SUBMERSIBLE SEWAGE PUMPING STATIONS

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AMENDMENTS

New Clause	Old Clause	Amendment
AMENDMENTS TO THE FEBRUARY 2010 VERSION		
Section 3	Section 3	Drawing references updated
Section 4	Section 4	WS Spec references amended to reference current product specifications – WSAA Product Specifications Hunter Water Version.
4.2	4.2	Clause amended
-	4.9-13. 13.2, 25.(1, 7,10,11,15) 26.(2-8,11), 26.15, 27	Sub clauses removed
4.13	4.18	Fly ash content amended to accept 20-30%
4.17	4.22	Requirements amended
4.18	4.23	b) requirements for Switchboard Equipment number labelling removed
5.1	5.1	Change of notice required from 3 to 5 working days
5.3	5.3	Rewording
6, 7.6, 12.4, 13.3, 14.(2-3,5) , 25.4, 26.(3,5, 7), 27, 28.4.5	6, 7.6, 12.4, 13.4, 14.(2-3,5) , 25.4, 26.(10, 13,16) 27, 28.4.5	Rewording
7.4-5	7.4-5	Clauses 7.4 and 7.5 renumbered
8.2	8.2	Pipework coating requirement updated to APAS specifications
11.2	11.2-3	Clauses merged. Requirements updated.
12.2	12.2	Clause updated. References to Product Specifications added
22,23.1	22,23.1	Clause amended
25.1	25.2	Rewording, Removal of some sizing requirements
25.3.1	25.4	Circuit Breakers paragraphs added under Switchboard clause
25.5	25.8	Paragraph regarding physical segregation removed
25.7	25.11	Rewording, Removal of 25.11.2 Equipment availability and 25.11.5 Specific Requirements for Soft Starters
25.8	25.12	Reference to design drawings, Minor rewording,
25.10	25.14	Change in reference to STS500, f) 18mA replaced by 30mA, n) Configure starter parameters and o) Configure circuit breaker settings added
26.3	26.3	Requirements updated
26.5	26.13	Clause updated and amended.
28.4.2	28.4.2	Removal of Thermistor selection paragraphs
28.4.2	28.4.2	DOL starting no longer permitted
		Minor Rewording of Schedule Technical Data
Appendix A	Appendix A	Commissioning checklists revised
AMENDMENTS TO THE FEBRUARY 2008 VERSION		

25.4.1	25.4.1	IP rating amended to IP56.
25.11.1	25.11.1	Amendments to requirements for circuit breakers and indicating lamps.
25.12.1	25.12.1	All labels to be screw fixed.
25.12.2	25.12.2	Amendments to requirements for danger notices.
25.13	25.13	Amended requirements and wording for PLC software.
26.11.2	26.11.2	Revised glanding requirements.
26.11.3	26.11.3	Inline wire joining connectors not to be used to extend wiring.
27.4	27.4	Minor rewording.
28.4.6	28.4.6	Motor overtemperature protection required for all motors where recommended by manufacturer and shown on drawings.
28.4.8	28.4.8	Amendment to requirements for relays.
AMENDMENTS TO THE AUGUST 2006 VERSION		
28.3	28.3	Guide bars and lifting chains to be stainless steel
AMENDMENTS TO THE DECEMBER 2005 VERSION		
Pump Sched	Pump Sched	Manufacturers names removed
AMENDMENTS TO THE OCTOBER 2005 VERSION		
2	2	Drawings SCP 920 to 922 deleted
22	22	Requirements replaced with reference to STS903
23.1	23	Clause only to apply when information package not provided
23.2	-	New format for Operation and Maintenance information
28.1	28.1	Reference to Approved Products and Manufacturers on web site added.
-	28.2	Clause "Approved Manufacturers/Suppliers" deleted
28.2 to 28.7	28.3 to 28.8	Re-numbered due to deletion
AMENDMENTS TO THE AUGUST 2005 VERSION		
28.2	28.2	New pump supplier added
AMENDMENTS TO THE AUGUST 2004 VERSION		
-	4.25	Clause "Telemetry Hardware" deleted
4.25	4.26	Clause "Lock Barrels" re-numbered
28.2	28.2	New pump supplier added
AMENDMENTS TO THE APRIL 2003 VERSION		
25.4.1	25.4.1	Addition of requirements for degree of protection for switchboards
25.11.1	25.11.1	Deletion of personal protection requirements
AMENDMENTS TO THE NOVEMBER 2002 VERSION		
11.3	11.3	Signaguard replaced with Sigmarite Primer and Sigmacover for wet well coating
AMENDMENTS TO THE SEPTEMBER 2001 VERSION		
All	All	General formatting, rewording and referencing changes to improve clarity but no change to technical requirements

1. GENERAL

1.1 Scope

This Standard Technical Specification details requirements for the construction of submersible sewage pumping stations of nominal diameter DN 1800 to DN 4600 including associated works such as valve pits, vents and flow relief structures.

1.2 Interpretation

Unless specifically stated otherwise, construction of submersible sewage pumping stations includes ALL functions described in this Standard Technical Specification and the provision of any minor materials or services which are not described but are reasonably necessary to produce a fully functional sewage pumping station.

Headings are for the convenience of the reader and shall not be used in the interpretation of this Standard Technical Specification.

Unless the context requires otherwise any expression such as "give notice", "submit", "approval", or "directed" means give notice to, submit to, approval by, or directed by the person nominated by the Principal or Purchaser.

2. REFERENCED DOCUMENTS

The following Hunter Water Corporation standard drawings are deemed to form part of this Standard Technical Specification:

SCP-500	Flow Relief Structure Type 1 for DN 150 to 375 Sewers
SCP-501	Flow Relief Structure Type 1 Screen and Bracket Details
SCP-502	Flow Relief Structure Type 2 for DN 150 to 375 Sewers
SCP-503	Flow Relief Structure Type 3 for DN 150 to 375 Sewers
SCP-504	Flow Relief Structure Type 3 Steelwork Details
SCP-505	Flow Relief Structure Type 4 for DN 150 to 375 Sewers
SCP-506	Flow Relief Structure Type 4 Steelwork Details
SCP-600	Sewage Pumping Stations Circular Valve Pit Covers Marking Plan
SCP-601	Sewage Pumping Stations Circular Valve Pit Covers Cover Plate Details
SCP-602	Sewage Pumping Stations Circular Valve Pit Covers Beams and Bracket Details
SCP-603	Sewage Pumping Stations Rectangular Valve Pit Covers Marking Plan
SCP-604	Sewage Pumping Stations Rectangular Valve Pit Covers Cover Plate Details
SCP-605	Sewage Pumping Stations Rectangular Valve Pit Covers Beams and Bracket Details
SCP-700	Sewage Pumping Stations DN 1800 to 3000 Duplex SPS Concrete Roof Slab Plan
SCP-701	Sewage Pumping Stations DN 1800 to 3000 Duplex SPS Concrete Roof Slab Sections
SCP-704	Sewage Pumping Stations DN 3800 Duplex SPS (Small Cubicle) Concrete Roof Slab Plan

SCP-705	Sewage Pumping Stations DN 3800 Duplex SPS (Small Cubicle) Concrete Roof Slab Sections
SCP-708	Sewage Pumping Stations DN 3800 Duplex SPS (Large Cubicle) Concrete Roof Slab Plan
SCP-709	Sewage Pumping Stations DN 3800 Duplex SPS (Large Cubicle) Concrete Roof Slab Sections
SCP-710	Sewage Pumping Stations DN 4600 Duplex SPS Concrete Roof Slab Plan
SCP-711	Sewage Pumping Stations DN 4600 Duplex SPS Concrete Roof Slab Sections
SCP-800	Sewage Pumping Stations Single Sliding Hatch Covers Marking Plan and Details
SCP-801	Sewage Pumping Stations Single Sliding Hatch Covers Hatch Cover Details
SCP-802	Sewage Pumping Stations Single Sliding Hatch Covers Door Stop and Screen Support Details
SCP-803	Sewage Pumping Stations Double Sliding Hatch Covers Marking Plan and Details
SCP-804	Sewage Pumping Stations Double Sliding Hatch Covers Hatch Cover Details
SCP-805	Sewage Pumping Stations Double Sliding Hatch Covers Door Stop and Screen Support Details
SCP-900	Sewage Pumping Stations DN 1800 to 3000 Precast Type Pump Well Details
SCP-901	Sewage Pumping Stations Blockout and Puddle Flange Detail
SCP-902	Sewage Pumping Stations Drop Tubes and Pipe Clips
SCP-903	Sewage Pumping Stations Benching Details Without Baffle Wall
SCP-904	Sewage Pumping Stations Benching Details With Baffle Wall
SCP-905	Sewage Pumping Stations Induct Vent Pipe Clip
SCP-906	Sewage Pumping Stations Cable Holder and Chain Hook Details
SCP-907	Sewage Pumping Stations Cable Trench Covers
SCP-908	Sewage Pumping Stations Concrete Supports for Stop Valves and Reflux Valves
SCP-909	Sewage Pumping Stations Valve Pits Monorail Ladder Details
SCP-910	Sewage Pumping Stations N55 Cast Iron Induct Vent
SCP-911	Sewage Pumping Stations Water Service Details
SCP-912	Sewage Pumping Stations Typical Pipework Arrangement and Details
SCP-923	Typical Electrical Installation Details
SCP-1000	Pipe Support and Trench Fill for Sewer Rising Mains up to DN 600
SCP-1001	Pipe Support and Trench Fill in Bad Ground for Sewer Rising Mains up to DN 600
SCP-1002	Discharge Access Chambers for Sewer Rising Mains up to DN 500
SCP-1003	Educt Vent Stack and Holding Down Bolt Details

- SCP-1004 Air Release Valve for DN 100 to 600 Sewer Rising Mains
- SCP-1005 Pump Out Scour for DN 100 to 600 Sewer Rising Mains
- SCP-1006 Gravity Scour for DN 100 to 600 Sewer Rising Mains
- SCP-1007 Driveway / Roadway Crossings for Sewer Rising Mains up to DN 600

3. ORDER OF CONSTRUCTION

Undertake and complete all work including fittings before connection is made to the existing sewerage system.

4. MATERIALS

4.1 General

Obtain all materials necessary for construction of the Works from approved sources. Comply with all recommendations of the manufacturers regarding the storage and handling of the materials. Undertake all handling, transport and storage such that no damage occurs to the materials including coatings and linings.

Select materials from Hunter Water's lists of Approved Products and Manufacturers which can be accessed on the internet at:

<http://www.hunterwater.com.au/Building-and-Development/>

Where suitable materials are not listed, submit full technical details of proposed items and obtain written approval prior to use.

WSAA Product Specifications Hunter Water Version (WSA PS) can be accessed on the internet at:

<http://www.hunterwater.com.au/Building-and-Development/>

4.2 On-site Stockpiles

Only store sufficient materials on site as are necessary to allow timely and efficient progress of the work. Locate stockpiles of excavated or imported material where they cause no interference to the public, drainage routes or vehicular or pedestrian traffic. Clear lines of sight for drivers must not be obstructed. Do not stack materials against structures, fences, trees or other property improvements. Leave a clear path at least 600 mm wide between the edge of any excavation and the inner toe of any stockpile or spoil banks.

Immediately remove all contaminated spoil to an approved waste facility. Any temporary stockpiles must be separated from backfill stockpiles and in accordance with NSW regulatory requirements.

4.3 Bedding Sand

Supply bedding sand embedment material in accordance with Standard Technical Specification STS101.

4.4 High Grade Compaction Sand

Supply high grade compaction sand embedment material in accordance with Standard Technical Specification STS101.

4.5 Select Fill

For select fill use excavated material, free from organic matter and having a particle size no larger than 20 mm. The material shall be suitable to allow compaction as specified without causing damage to the pipeline. If material excavated during excavation does not comply, import non-cohesive material.

4.6 Trench Fill

Where the trench is not subject to traffic loading use excavated material for fill in the trench fill zone provided it has a particle size no greater than 75 mm across the largest dimension, is free from organic matter and can be placed into a dense mass free of voids and cavities.

For trafficable areas use:

- cement stabilised trench fill for all existing roads; or
- crushed rock dust in accordance with Standard Technical Specification STS101; or
- crushed rock in accordance with Standard Technical Specification STS102; or
- as directed by the authority responsible for the trafficable area.

4.7 Cement Stabilised Trench Fill

Cement stabilised trench fill shall comprise a 14:1 sand : cement mix.

4.8 Pipes and Fittings

Supply pipes and fittings in compliance WSA Product Specifications Hunter Water Version.

Do not use UPVC pressure pipes exceeding 6 months of age from the date of manufacture. All fittings for UPVC pressure pipelines DN 100 and greater are to be ductile iron to clause 4.9 and internally and externally coated with a thermal bonded coating in accordance with Section SP30 of WS-Spec.

4.9 Polyethylene Sleeving

For all ductile iron mains use polyethylene sleeving, adhesive tape, strap and buckle in accordance with WSA PS 320.

4.10 Geotextile Filter Fabric

Geotextile filter fabric shall be approved inert material, BIDIM A14, manufactured by Geofabric Australia Pty Limited or approved equivalent.

4.11 Timber Piles

All piles are to be treated hardwood, strength group F14, and in accordance with "Koppers - Standard Specification, Hardwood Foundation Piling". The CCA treatment shall be to the requirements of AS 1604 Hazard Level 5 protection and the further requirements of the NSW Timber Market Act.

4.12 Fasteners

Supply all nuts, bolts and washers in accordance with AS 2528. All exposed boltheads and nuts shall be hexagonal and the length of all bolts shall be such that tightened bolted connections shall have a minimum of 2.5 threads and a maximum of 5 threads protruding from the nut.

All anchors, bolts, nuts and washers either embedded in concrete, installed within the wet well and/or used in the fabrication and/or installation of stainless steel items shall be of Grade 316 stainless steel to AS 2837. All other steel anchors, bolts, washers and nuts shall be hot dip galvanised in accordance with AS 1650. Grade 316 stainless steel to AS 2837 is an acceptable alternative to hot dip galvanised steel. Passivate all stainless steel components in accordance with STS100.

4.13 Cement

Use only one of the following cements:

- Fly Ash Blended Cement conforming to the requirements of Type SR to AS 3972 and containing 20-30% fly ash to AS 3582 Part 1, "fine grade" only, or

- Blended Cement, other than fly ash, conforming to the requirements of Type SR to AS 3972.

4.14 Concrete

Supply normal class concrete in accordance with WSA PS 358.

Supply special class concrete in accordance with WSA PS 358.

Supply concrete from plant(s) with third party certified Quality Systems for the manufacture and supply of concrete. Do not use any admixtures in the concrete.

4.15 Reinforcement

Supply reinforcement which complies with AS 1302 Steel reinforcing bars for concrete, AS 1303 Steel reinforcing wire for concrete, and/or AS 1304 Welded wire reinforcing fabric for concrete.

4.16 Appurtenances

Supply all appurtenances in accordance with WSAA Product Specifications Hunter Water Version.

4.17 Knife Gate Valves

Supply knife gate valves manufactured to WSA PS 266 and the following additional requirements:-

- (a) Enclosed bonnet not required
- (b) The knife gate valves are to be suitable for installation in applications where they shall be subject to submergence in or splashing by sewage or sludge.
- (c) The valve body shall be of wafer design for bolting between flanges with 316 stainless steel bolts, nuts and washers.
- (d) The stem of the valve is to be driven through a fixed bronze drive bush driven by a stainless steel drive tube fitted with a Hunter Water Corporation standard square drive. The valve stem will rise within the drive tube such that when in the fully open position the valve stem is to be isolated from sewage contamination by being enclosed in the drive tube. The valve stem is to be attached centrally to the gate and not offset. (DeZurik non rising adaptor or similar.)
- (e) Extension stems are to be hot dip galvanised mild steel with female square drive fitted to valve drive and with Hunter Water Corporation standard square top drive. Extension stems over 3 metres shall be supported with spindle support brackets.

4.18 Equipment Number Labels

Manufacture Equipment Number Labels from:

- (a) Pumping Station Equipment Number Label - Zinc anneal steel sheet 80 mm high with 50 mm high black uppercase embossed lettering on a white reflective background.
- (b) Pump Equipment Number Labels
 - (i) on hatch cover - 1.2 mm thick silver anodised aluminium sheet by 30 mm high engraved with 15 mm high uppercase lettering.
 - (ii) adjacent to circuit breaker - Laminated plastic engraved with 5 mm high black uppercase lettering on a white background.

The equipment number is listed in Appendix C.

4.19 Metering Equipment

Obtain Metering Equipment for the electrical switchboard from the Supply Authority.

4.20 Lock Barrels

Obtain lock barrels for the pumping station switchboard from the Hunter Water Corporation. Contact the Superintendent regarding supply of lock barrels.

5. EXISTING SERVICES

5.1 Location of Services

Any details of services shown on the Drawings are not to be taken as indicating all existing services or exact locations. Irrespective of any information on the Drawings, verify the exact location of all services which may be affected by construction activities. If services are located which are not shown on the Drawings or are not in the location shown on the Drawings, give notice at least five (5) working days prior to commencement of any construction activity that may affect the service.

5.2 Protection and Maintenance of Services

Take all actions and provide all things necessary to protect and maintain existing services to the satisfaction of the relevant authority or owner. This may include arranging or performing relocation, temporary diversion or support of the service.

5.3 Repair of Services

If a service is damaged during construction, arrange or perform repair to the satisfaction of the controlling authority or owner. Obtain from the authority or owner, a certificate stating that the repair has been carried out to their satisfaction.

If the service is not under the control of an authority and the owner cannot be located within a reasonable time, report the damage, and arrange or perform repair to an approved standard. Do not backfill, cover up or make the repair inaccessible prior to obtaining approval from Hunter Water.

6. CLEARING

Do not destroy, remove or clear vegetation or surface improvements to an extent greater than necessary for the execution of works.

Obtain the approval of the Council for the removal of any trees. Take all steps necessary to prevent damage to trees that are not to be removed.

Dispose of all rubbish and surplus material within 24 hours of clearing to an approved waste facility.

Stockpile topsoil separate from other excavated material and use it to make good the surface after backfilling.

7. EXCAVATION

7.1 Limits of Excavation

Keep the extent of excavation to the minimum possible to allow efficient construction of the Works while meeting the minimum requirements shown on the Drawings and the relevant Standard Drawings. Keep pipe trench widths within the maximum widths recommended by the pipe manufacturer.

Keep the sides of excavations for pipework vertical to at least 150 mm above the pipe.

Ensure that the minimum cover requirements will be satisfied following any earthworks which may occur in the area of the pipelines and services to the pumping station. This is particularly relevant in new subdivisions or developments where earthworks are to be expected to form roads, driveways, footpaths and for general shaping of the surfaces. Preferably lay services after formation of surfaces to finished levels. If minimum cover requirements cannot be achieved submit a proposal to overcome the problem.

7.2 Improved Surfaces

Where excavation is required under improved surfaces such as pavements, driveways and kerb and gutter, use tunnelling or boring where the surfaces cannot be satisfactorily reproduced and under existing concrete footway areas and concrete driveways. Ensure backfilling is to a standard to fully support the surface and any likely applied load.

If open excavations are used in improved surfaces, keep the excavation width to the minimum allowed. Saw cut neat straight lines at the outer limits of the excavation through bitumen, asphalt and concrete. Remove pavers, blocks or brick pavements by hand, clean them and set them aside for later replacement.

7.3 Drainage and Dewatering

Keep all excavations free of water. Provide, maintain and operate intercepting works to prevent surface water from entering the excavations; and all equipment necessary for dewatering the excavations and keeping the Works free from water.

Dewatering permits must be obtained from the relevant authority prior to undertaking any dewatering activities.

Lowering of the water table by well points or other external dewatering methods may only be used if no damage is likely to be caused to adjacent structures and services.

Ensure that all downstream works that are under construction, completed or in use are protected at all times against the effects of any drainage which is discharged or likely to be discharged from the work.

7.4 Foundations and Foundation Stabilisation

Where the bottom of an excavation is soft or considered to provide an unacceptable foundation produce a stable foundation by one of the following:

- (a) Use of geotextile surround as shown on Standard Drawing SCP-1001 for pipework. For other structures place geotextile fabric across the full excavation width and extending up the sides to minimum level of 600 above the base of the excavation.
- (b) Extra depth excavation in accordance with clause 1.1.
- (c) Ram ballast into the soft ground until an approved firm foundation is obtained at the design depth. Use ballast comprising clean hard rock of 100 mm nominal size having no less than 85% retained by a 100 mm sieve and no less than 95% retained by a 80 mm sieve, Remove and dispose of any excess material.

Give notice prior to commencing any foundation stabilisation.

7.5 Extra Depth Excavation

If extra excavation is required to reach a firm foundation or if excavation has extended deeper than necessary to meet the requirements of this Standard Technical Specification, refill to the required level with an approved non-cohesive material complying with STS101. Place and compact the material in accordance with clause 9.1.

Where material has been disturbed to a level deeper than necessary under this Standard Technical Specification, compact the disturbed material to density index not less than 70% for granular (non-cohesive) material or to dry density ratio not less than 95% for non-granular (cohesive) material. If satisfactory compaction of the disturbed material cannot be achieved,

remove the material and refill to the required level with an approved non-cohesive material complying with STS101. Place and compact the material in accordance with clause 9.1.

7.6 Surplus Excavated Material

Promptly remove and dispose of excavated material which is not required for reuse. Do not dispose of the surplus material without the prior written consent of the dump site's owner, owner's agent, lessee or controlling authority.

8. PIPE BEDDING, LAYING, JOINTING AND BACKFILLING

8.1 General

Bed, lay, joint and backfill the inlet and discharge pipework in accordance with Standard Technical Specification STS403.

8.2 Pipework Surface Coating

Coat all pipework and fittings within the pumping station wet well, except where thermal bonded coated, stainless steel, PVC, PE or ABS materials, with a two pack ultra high build solvent-free epoxy approved under the APAS Specification 2975 or 0213. Apply the coating in accordance with manufactures requirements.

<http://www.apas.gov.au/index.asp>

9. BACKFILLING OF STRUCTURES

9.1 General

Place and compact backfill in even layers on either side of structures to avoid differential loading.

Backfill containing boulders, large rocks, logs, stumps, tree loppings, builders refuse, broken concrete and other like material is expressly forbidden.

Keep all dewatering systems operating during backfilling so that no fill material is placed or compacted under water. At all times ensure that the pipelines and structures are not damaged or moved during placement and compaction of fill.

Place and compact backfill in layers not greater than 300 mm thick except in roadways use layers not greater than 150 mm thick. Compact cohesive (non-granular) backfill to a dry density ratio of 98% standard and cohesionless (granular) backfill to a density index of 70%.

Measure the degree of compaction in accordance with;

- for cohesionless (granular) fill - the density index determined in accordance with AS 1289.E6.1 based on the field dry density determined in accordance with AS 1289.5.3.1 or AS 1289.E3.5 and the maximum and minimum dry densities in accordance with AS 1289.E5.1
- for cohesive (non-granular) fill - the dry density ratio determined in accordance with AS 1289.5.4.1 based on the field dry density in accordance with AS 1289.5.3.1 and the maximum dry density in accordance with AS 1289.5.1.1.

Compact fill material by manual or mechanical tampers. Compact non-granular fill at a moisture content within plus or minus 2% of optimum and granular fill at a moisture content within plus or minus 3% of optimum. Flooding of the fill is not permitted.

9.2 Compaction and Density Testing

Undertake testing of fill compaction and/or density in accordance with AS 1289 Part E. Engage an approved body registered by NATA for the particular tests to be undertaken. Submit test results.

The minimum number of tests shall be:

AREA	ZONE	NUMBER OF TESTS
Hardstand	Pavement	Two
	Backfill and subgrade	Two for each 900mm layer
Access Road	Pavement	Two tests for every 50 m length of access road but not less than two.
	Backfill and subgrade	Two tests for each 900 mm layer for every 50m length of access road but not less than two tests per 900 mm layer.

Tests shall be considered to apply to a section of work being either the hardstand area or fifty (50) lineal metres of the access road. If a test fails, the relevant section of work shall be considered to be defective. Elect to either rectify the work or undertake two further tests in the section deemed to have failed within one week of the failed test. The locations of the additional tests shall be where directed. If both additional tests pass, the section shall be accepted. If one or both of the additional tests fail, rectify the work.

Within two weeks of the completion of any rectification work, perform two more tests where directed. If one or both of the tests fail, rectify the work and continue to retest and rework until all test results are satisfactory.

10. CONCRETE

10.1 General

Construct concrete civil engineering works to the requirements of Section TR10 - Concrete (Civil Works) of WS-Spec.

Unless noted otherwise on the Drawings use concrete strengths nominated below:

Item of Work	Minimum Crushing Strength At 28 Days (Mpa)
Reinforced sewage structures eg. pumping stations and other structures in contact with sewage	40
Unreinforced structures in contact with sewage eg. maintenance structures	32
Water structures eg. valve and pump pits, tanks, reservoirs, etc.	32
Stormwater structures eg. pits, headwalls channels, etc.	25
Accessway, dish crossing,	25
Reinforced concrete pipe bedding and surround	25
Thrust blocks	25
Pathways, footpaving, kerb and gutter	20
Unreinforced concrete pipe bedding, surround, bulkheads and other mass concrete	20

10.2 Identification Certificate

The Identification Certificate accompanying each load delivered to site shall include the following further details:-

- (a) time at which the concrete was batched
- (b) size of the load in cubic metres.
- (c) type of concrete eg. Grade 20.
- (d) total cement content of the load in kilograms (kg).
- (e) amount of free water batched in litres (L).
- (f) slump at time of batching in millimetres (mm).
- (g) type of cement used.

Do not use concrete supplied without a completed Identification Certificate.

10.3 Expansion and Contraction Joints

10.3.1 Kerbing

Weakened plane (contraction) joints shall be 3 mm wide, clean cut and made vertically through the concrete at right-angles to the direction of the work. Normally they shall be spaced at 3 m intervals with minor adjustments to avoid short closing lengths.

Form expansion joints adjacent to other structures. Expansion joints shall be sealed with 15 mm wide preformed, self-expanding cork joint sealer cut to the full profile of the kerb section. Remove tape from top of sealer at about the time of final set of the concrete.

Joint arrises abutting cork joint sealer shall not be tooled off.

10.3.2 Footpaths and Minor Paving

Joints shall be straight, continuous and normal to the surface of the pavement.

Weakened plane joints shall be formed by making a cut 3 mm wide for at least one quarter of the depth of the paving. Arrises shall be tooled to a suitable radius. Space weakened plane joints at 2 metre intervals with minor adjustments to avoid short closing lengths.

Expansion joints shall be constructed for the full depth of the paving using 15 mm wide preformed self-expanding cork joint sealer. They shall be provided where ever the paving abuts fixed structures, such as buildings and pits, transversely at maximum intervals of 15 m along path and at path intersections. Joint sealer shall be bonded to the first placed concrete using a suitable contact adhesive. Remove tape from top of sealer at about the time of final set of the concrete. Joint arrises abutting cork joint sealer shall not be tooled off.

10.3.3 Accessways and other structures

All joints to the details shown on the Drawings.

10.4 Blockouts and Cored Holes

- (a) Unless blockouts or cored holes are shown on the Drawings all pipes and fittings shall be cast into the structure when the structure itself is poured. Where this is not possible submit details of blockouts or alternative methods for approval. Details should conform to details shown on Drawing SCP-901;
- (b) All pipes which are cast into the concrete shall be thoroughly cleaned to remove all traces of dust, grease, rust and paint prior to the placement of concrete to secure a tight bond with the concrete;
- (c) Where cored holes or blockouts are to be grouted to hold pipework, bolts and other fittings, the cored holes or blockout shall be scabbled and treated with an epoxy

compound, such as Hilti CA80 ,Epirez 133 or Epirez 633, strictly in accordance with the Manufacturer's instructions;

- (d) Openings shall be constructed so as to leave a minimum clearance of 100 mm between finished concrete and the location of the item to be cast-in. Reinforcement shall be constructed continuously through openings as detailed on the reinforcement Drawings and shall be trimmed around the item to be cast-in at a maximum distance of 50 mm from the item;
- (e) After placing the pipe and fitting, the remaining void shall be carefully filled with epoxy mortar, such as Hilti CA80 or Epirez 633 mixed , using appropriate sand (either Epirez No 2 Quartzite Aggregate or Hilti CTS 99 Graded Sand), to the Manufacturer’s written instructions, to produce a watertight joint. The epoxy mortar shall be retained by a form which shall be built up as filling proceeds;
- (f) Where fixing bolts to be cast-in are positioned by means of a template they shall be supplied with a backing nut and a face nut for secure fixing of the bolt. The backing nut shall be cast into the concrete;
- (g) Aluminium or ferrous structural members built into brick or concrete shall have their contact surfaces first painted with two (2) coats of bituminous paint.

10.5 Cast In Items

All anchor bolts and fastenings cast in concrete shall be Stainless Steel Grade 316 to AS 2837 unless otherwise shown on the Drawings.

10.6 Specific Requirements

Unless specified otherwise, the following requirements shall apply. See Clause 9.2 of Section TR10 of WS-Spec.

		CLAUSE (TR10)	CLASS AND GRADE			
			S40	S32	S25	N20
OTHER	Curing Compound Accepted Yes/No	6.9	No	No	No	No
	Minimum Period Between Adjacent Pours (Days)	6.1	2	2	2	2
SURFACE FINISH - FORMED	Surfaces exposed to sewage, effluent, or sewage gases.	6.7	F3	F3	F3	
	Surfaces of water retaining structures exposed to water.		F3	F3	F3	
	Internal surfaces and all exposed surfaces, except trafficable surfaces.		F2	F2	F2	F2
	Internal trafficable surfaces.		F2	F2	F2	F2
	External trafficable surfaces.		F2	F2	F2	F2
	Concealed surfaces.		F1	F1	F1	F1
SURFACE FINISH - UNFORMED	Surfaces exposed to sewage, effluent, or sewage gases.	6.8	U3	U3	U3	
	Surfaces of water retaining structures exposed to water.		U3	U3	U3	
	Internal surfaces and all exposed surfaces, except trafficable surfaces.		U2	U2	U2	U2
	Internal trafficable surfaces.		U5*	U5*	U5*	U5*

	External trafficable surfaces.	U4*	U4*	U4*	U4*
	Concealed surfaces	U1	U1	U1	U1

Refer to clause 10.7 for requirements for Class U4 and Class U5.

10.7 Unformed Surfaces Finish

Requirement: Additional to finishes specified in Clause 6.8 of Section TR10 of WS-Spec, provide one of the following classes as specified:

Class U4 - (Broom finish)

Wood float finish Class U2 to be lightly broomed at right angles to the alignment of the pavement.

Acceptance criteria

- Abrupt irregularities less than 5 mm
- Gradual irregularities less than 5 mm

Class U5 - (Sponge Float - Trafficable)

Steel trowelled finish Class U3 to be sponge floated.

Acceptance criteria

- Abrupt irregularities less than 2 mm
- Gradual irregularities less than 5 mm

10.8 Topping and Benching

Benching shall have a minimum thickness of 25 mm. Cement content of the topping mix shall be the same as that of the structural concrete being topped or benched. Prior to placing the benching concrete and the grout beneath the pump pedestal, scabble the concrete surface and apply Hilti CA80 or Epirez 133 epoxy.

Place benching concrete to the dimensions as shown on the Drawings in the wet well following the installation of the pump pedestals and the discharge pipework. Ensure the topping or benching is dense, uniform and the surface free from blemishes. Remove any splatter or solids lodged in or upon the pedestal or pipework.

10.9 Concrete Repairs

Repair air voids, bolt holes and honeycombing using an epoxy paste such as Hilti CA273. Repairs by bagging and cement mortar are not permitted.

For thin bed bonding use Hilti CA80 or Epirez 133.

10.10 Testing

The Contractor shall arrange for concrete sampling and testing, including transportation of cylinders. A minimum of 2 cylinders shall be taken for all concrete supplies over one cubic metre. A Slump Test shall also be carried out at the time that the cylinders are taken. Sampling and Testing shall be in accordance with relevant Australian Standards, using NATA certified tests. The cost for all these works shall be borne by the Contractor.

Minimum crushing strength and slump when tested in accordance with SP45 of WS-Spec, cement content and water / cement ratio shall be in accordance with clause 10.1 and 4.14.

11. PUMPING STATION WET WELL

11.1 Flotation

Ensure that any partly or fully completed structures do not move due to hydrostatic pressures.

11.2 Corrosion Protection

11.2.1 Roof Structures

Protect the underside of the concrete roof slabs by impregnating a PVC or PE sheet, Plastiline or HWC approved equivalent, into the roof. Ensure the complete adhesion of the sheet to the underside of the roof, particularly around roof openings. All sheet joints are to be joined in accordance with manufacturer requirements. Submit details of sheet joining technique to the Superintendent for approval prior to undertaking the works. Ensure complete coverage to the extents shown on the Design Drawings.

11.2.2 Cast In-Situ Concrete

Apply a 100% solids, solventless, elastomeric polyurethane coating, Polybrid 705e or HWC approved equivalent, to the internal concrete surfaces as indicated on the Drawings. Prepare the concrete surface and apply the coating in strict accordance with the coating manufacturer's written instructions. Contractor, application method, repair procedures and all works associated with the application of the coating to be approved by the manufacturer.

11.3 Precast Concrete Units

Manufacture pipe units to include blockouts or cored holes shown on the Drawings.

Supply all precast units with an approved method for lifting.

Handle, store and transport to avoid damage.

11.4 Tolerances

The following tolerances shall apply to the wet well:-

- (a) In the final position, the centreline of the wet well shall not vary from plumb by more than 1 (horizontal) to 100 (vertical).
- (b) In the final position, the trace of the centreline of the wet well at the surface must be contained within a circle centred in the design position and of radius 150 mm.

11.5 Blockouts

On completion of pipework installation, epoxy mortar fill all blockouts in concrete structures in accordance with clause 10.4. Finish surfaces flush with the internal surface of all structures.

11.6 Cast Insitu Plug

Scabble the internal surface of the wall of the wet well in the area of the plug before casting the plug.

12. WATER SUPPLY TO PUMPING STATION

12.1 General

Provide the water service to the pumping station site from Hunter Water Corporation mains as indicated on the Drawings and in accordance with standard drawing SCP-911.

Comply with the requirements of the AS 3500.1 and the further requirements of Hunter Water Corporation and this Specification. All work shall be carried out by a plumber licensed by the Department of Fair Training and a permit submitted to the Hunter Water Corporation 48 hours prior to the commencement of any work.

Supply and install including excavation, backfill, compaction and restoration, the following:

- a main tap into the Corporation's watermain;
- water service from the main tap to the water meter;
- water meter and approved testable reduced pressure zone device (RPZD) complying with AS 2845.1 and with replaceable seats and check modules;
- a pressure pipe from the water meter to the hose tap at the pumping station;
- a 25 mm nominal size copper standpipe fitted with a 20 mm nominal size vandal proof DR brass hose tap.

The pipe diameters shall be as nominated on the Drawings.

12.2 Materials

From the main tap to the meter stand and from the meter stand to the standpipe at the pumping station the water service shall be either :

- (a) Copper pipe to WSA PS 214.
- (b) Polyethylene pipe to WSA PS 215

Vertical risers, the meter stand and the standpipe shall be Copper pipe Type A to AS 1432.

12.3 Installation

The water service shall be laid in accordance WSA03 Water Supply Code HWC Drawings WAT-1106V, WAT-1108V and WAT-1109V. Lay service at the Hunter Water Preferred minimum cover as indicated on drawing WAT-1201V.

12.4 Support Posts

The hose tap standpipe and each vertical leg of the meter stand shall be secured to a 100 x 100 x 1500 mm hardwood backing post by copper saddles fixed with brass screws. Below ground, the posts shall have two coats of bituminous paint. Above ground, the posts shall be primed and then painted with two (2) coats of white exterior enamel. The posts shall be driven 600 mm into the ground. In rock the posts shall be set in Grade 20 concrete to a minimum depth of 300 mm.

12.5 Path Box

Install a cast iron path box over the main tap in the watermain in accordance with Drawing SCP-911, where either of the following occur :-

- (a) The meter stand is located more than 30 metres from the maintap.
- (b) The service pipe from the main tap to the meter stand is not laid at right angles to the watermain.

13. INSTALLATION OF ELECTRICAL CONDUITS

13.1 General

Install electrical conduits in accordance with STS500.

Install a continuous 2 mm diameter galvanised mild steel draw wire inside each conduit run. The draw wire shall be of sufficient length to allow one (1) metre to be folded back into each end of the conduit run.

13.2 Vent Stack Draw Wire

The draw wire in the conduit to the base of the vent stack shall be left long enough to protrude at least one (1) metre above the vent stack. After the vent stack is installed this draw wire is to be left coiled around the top of the outside of the vent stack.

13.3 Switchboard - Location Remote from Pumping Station Wet Well

Where the switchboard cabinet is located remote from the pumping station roof slab provide a series of UPVC conduits, as shown on the respective Drawings..

Provide a 2 mm diameter stainless steel draw wire in each UPVC conduit between the concrete upstand and the wet well. Fit a suitable shackle or pulling eye to each end of each stainless steel draw wire to facilitate the pulling of cables in/out of the conduit. Permanently fix each draw wire to the base of the concrete upstand adjacent to each conduit.

14. MECHANICAL INSTALLATION OF PUMPS, VALVES AND FITTINGS

14.1 General

Lengths are to be determined accurately and items installed in such a manner as to ensure no undue loading on pumping units or pipework.

Prevent damage to or deterioration of pumps, electrical cables and ancillary equipment prior to putting into service and comply with manufacturer's recommendations for storage. Power cables shall be coiled and supported with cable sleeves on the hooks provided and with free ends protected and above any possible accumulation of water.

14.2 Flanged Joints

Select bolting in accordance with AS 4087 Appendix B.

Assemble flanged joints in accordance with AS 4087 Appendix C and the following requirements.

Use washers under all nuts. In addition, use washers under bolt heads for connection to items with protective coatings.

Where stainless steel fasteners are used to fasten galvanised items, install high strength fibre or phenolic insulating washers and sleeves between the stainless steel washers / bolts and the galvanised item being fixed or jointed.

All bolts, nuts, washers and locking devices in the flanges of the pumps and pipework and accessories in the pump wells shall be stainless steel to AS 2837 Grade 316. Apply "Loctite" nickel anti seize thread lubricant to all stainless steel fasteners prior to fitting nuts.

Where use of dismantling joints is indicated on Drawings they shall be of the type specified on the design drawings. Connect puddle and thrust flanges with a metal to metal epoxy. Prior to connection of puddle or thrust flanges, remove surface coatings on flanges and the pipe at the location of connection.

14.3 Installation of Pump Units

Install pumping units and associated items including guide rails, upper guide brackets, discharge bend pedestals, lifting chains and holding down bolts in accordance with written instructions and approved Drawings supplied by the pump manufacturer. Set the pumping unit discharge connections true and square by means of steel levelling wedges and with clearance to pumping station floor as set out on the Drawings. Check alignment with discharge pipework (including eccentric tapers where fitted) and with guide rails before final positioning.

Ensure correct seating into the discharge connections and free movement of the pumps along the guide rails. The pumping units and associated equipment shall be installed free of any undue stresses, strains or vibrations and be accessible for maintenance.

Set all foundation bolts to their maximum depth using an epoxy grout Epirez 133 with Epirez No 2 Quartzite Aggregate to a maximum ratio of 1:2 by volume or Hilti CA80 with Hilti CTS 99 Graded Sand to a maximum ratio of 1:2 by volume.

Fix the upper guide rails brackets to the vertical face of the access opening using grade 316 stainless steel chemical anchors to manufacturer's specifications. All anchors to have a minimum anchor depth of 70 mm.

14.4 Pump Numbers

Supply 100 mm high pump numbers cut from 2.5 mm thick marine grade C5251-H34 aluminium or grade 316 stainless steel. The numbers shall be the pump and starter number ie. "1", "2", "3".

Install the pump numbers adjacent to the top of each pump guide rail and so as to be easily seen from the pumping station roof using grade 316 stainless steel expanding metal sleeve masonry anchors.

The pump with the lowest serial number shall be the No 1 pump and shall be installed closest to the electrical switchboard.

14.5 Test Tapping Points

Provide three DN 10 mm (3/8") BSP tapings and supply and install, at each tapping, a 1/2" BSP Ball Valve (or metric equivalent) and fittings as required to complete installation. Valves and fittings to be bronze or stainless steel. Fit removable caps to all valves.

14.6 Pump Equipment Number Labels - Hatch Cover

Fix each label, using four (4) aluminium pop rivets, to the top of the sliding hatch cover such that the label shall be adjacent to the respective pump guide rail when the hatch cover is open. The equipment number is listed in Appendix C. Do not paint.

15. METALWORK

15.1 Steelwork

Use Grade 250 steel in accordance with AS/NZS 3678, and AS/NZS 3679. Fabricate in accordance with AS 4100. Round all cut edges to 2 mm radius.

Except where otherwise noted on the Drawings, hot dip galvanise all steelwork including vent stack after fabrication, all in accordance with AS 1650. Do not weld galvanised components after galvanising.

Prior to galvanising, clean the steelwork surface of all dirt, weld spatter, grease, slag, oil, paint or other deleterious matter and chemically descale in accordance with AS 1627 Part 5, or abrasive blast clean in accordance with AS 1627 Part 4 to Class 3 standard.

The zinc coating shall consist of a uniform layer of commercially pure zinc free from abrasion, cracks, blisters, chemical spots or other imperfections and shall adhere firmly to the surface of the steel. The thickness of zinc coating shall not be less than 100 microns at any point.

Any surface damage to the galvanising shall be shot or grit blasted clean and given two coats of Amercoat No 62 primer. Apply the second coat after the first coat is touch dry and within twenty-four hours of application of the first coat.

Where site welding of galvanised steelwork has been approved, the resulting weldment is to be chipped and cleaned to bare metal and painted with Galment zinc enriched paint.

15.2 Aluminium Components

Aluminium components shall be grade 6061, 6063, 6351, 5083 or 5251. Fabricate in accordance with AS 1664 and AS 1665. Apply two coats of bituminous paint to surfaces of aluminium components in contact with concrete.

15.3 Stainless Steel Components

Stainless steel shall conform to AS 2837 type 302, 304, 304L, 316, 321 or SAF2304. The free machining type 303 is not acceptable.

Passivate all stainless steel components in accordance with Standard Technical Specification STS100.

15.4 Fasteners

All nuts, bolts and washers shall be in accordance with AS/NZS 1111 and AS/NZS 1112 or AS/NZS 1252. All exposed boltheads and nuts shall be hexagonal and the length of all bolts shall be such that bolted connections shall have a minimum of 2.5 threads and a maximum of 5 threads protruding from the nut.

Use washers under all nuts. In addition, use washers under bolt heads for connection to items with protective coatings.

Where stainless steel fasteners are used to fasten galvanised items, install high strength fibre or phenolic insulating washers and sleeves between the stainless steel washers / bolts and the galvanised item being fixed or jointed.

All anchors, bolts, nuts and washers either embedded in concrete or within the pumping station wet well (including above the nominated top water level) shall be of Grade 316 stainless steel to AS 2837.

All bolts, nuts and washers used in the fabrication and/or installation of stainless steel items shall be of stainless steel and of similar grades to the items being fixed or jointed. All other steel anchors, bolts, washers and nuts shall be hot dip galvanised in accordance with AS 1650. In addition, coat all nuts and bolts which are to be installed in ground, except Grade 316 stainless steel, with Denso 300 Primer and 400 Mastic/440 Cord, then wrap the entire joint in Denso 600 Tape (double thickness) and over wrap with Denso 931 Overwrap (minimum 55% overlap), all in accordance with the Manufacturer's recommendations. Grade 316 stainless steel to AS 2837 is an acceptable alternative to hot dip galvanised steel.

Apply loctite nickel anti-seize thread lubricant to the threads of all stainless steel nuts and bolts prior to assembly.

15.5 Educt Vent Stack

Subsequent to galvanising, powder coat the educt vent stack to the following specification:-

- (a) (a) Apply a conversion coating of iron phosphate, through a three stage pretreatment, as follows:-
 - (i) Combined iron phosphate/cleaner.
 - (ii) Fresh water rinse.
 - (iii) Acidulated rinse.
- (b) Ensure the removal of all moisture prior to powder coating, by passing the conveyorised metal through a drying oven.
- (c) Apply, in accordance with the manufacturers recommendations, a cured oxysalt PR23 Polyester powder of Hawthorne Green colour by electrostatic spray to a minimum thickness of 50 microns, and cured at temperatures recommended by the powder manufacturer.

Supply and install a bird proof cowling manufactured of powder coated (Hawthorn Green) galvanised steel mesh to each vent stack.

16. ACCESS ROAD AND HARDSTAND AREA

16.1 General

Provide a minimum 200 mm compacted pavement constructed to grade and levels as shown on the Drawings.

If shown on the Drawings provide a bituminous seal or asphaltic concrete seal in accordance with clause 16.4 or 16.5.

16.2 Subgrade

The subgrade is defined as the top 300 mm of the earth formation immediately below the paved area and extending 150 mm beyond the defined access road or hardstand dimensions.

Consolidate the subgrade, at optimum moisture content, to give a dry density ratio according to AS 1289.5.4.1 of not less than 98% standard based on the field dry density determined in accordance with AS 1289.5.3.1 and the compaction test in accordance with AS 1289.5.1.1 (Standard).

16.3 Basecourse

Construct the basecourse layer for the access road and hardstand area in accordance with Roads and Traffic Authority NSW Specifications for The Construction of Natural Gravel or Crushed Rock Road Pavement (Bitumen Surfaced) (MR Form No 743) or The Construction or Resheeting of Natural Gravel or Crushed Rock Road Pavement (Not Bitumen Surfaced) (MR Form No 800).

For bitumen surfaced pavements the material shall meet the requirements of MR Form No 743 Table 2 Class A nominal size 20 mm. For unsealed pavements the material shall meet the requirements of MR Form No 800 Appendix 1.

Supply a test certificate from a NATA registered laboratory certifying the proposed material complies with the requirements of this clause.

The basecourse shall be compacted at a moisture content within plus or minus 2 % of optimum in layers not exceeding 150 mm loose thickness to obtain a dry density ratio according to AS 1289.5.4.1 of not less than 100% standard based on the field dry density determined in accordance with AS 1289.5.3.1 and the compaction test in accordance with AS 1289.5.1.1 (Standard) to a finished pavement thickness of 200 mm minimum.

16.4 Sprayed Bituminous Sealing

If required apply a two coat hot bitumen and aggregate seal to the prepared surface of the pavement after the application of a prime coat. The work shall be carried out in accordance with the Roads and Traffic Authority of NSW Specification for Sprayed Bituminous Surfacing (MR Form No 93) and as specified below.

The work shall consist of

- Spraying of primer at 1.00 Litres per square metre of pavement surface.
- Precoating of aggregate at 8.5 litres per cubic metre.
- The spraying of hot bitumen at a uniform rate of 1.36 litres per square metre of pavement surface followed by the application of 14 mm precoated aggregate at a uniform rate of 1 cubic metre to 75 square metres of pavement surface.
- The spraying of hot bitumen at a uniform rate of 1.1 litres per square metre of pavement surface followed by the application of 10 mm precoated aggregate at a uniform rate of 1 cubic metre to 110 square metres of pavement surface.
- The rolling and incorporation of the aggregate.

The application of the second coat of bitumen and the subsequent placement of 10 mm precast metal shall take place immediately after incorporation of the first coat of aggregate.

Materials shall comply with the following :

- Bitumen shall conform to the Roads and Traffic Authority of NSW Specification for Residual Bitumen (MR Form No 337) for Class 170 Bitumen and AS 2008.
- Cover aggregate shall conform to the Roads and Traffic Authority NSW Specification for Supply and Delivery of Cover Aggregate (MR Form No 351).

16.5 Asphaltic Concrete

If required, or as an alternative to sprayed bituminous seal, apply an asphaltic concrete seal to the prepared surface of the pavement in accordance with Roads and Traffic Authority NSW Specification for Supplying and Laying Asphaltic Concrete (MR Form No 612) with the following requirements :

(a) Class of Bitumen	170
(b) Nominal size mix	10 mm
(c) Minimum Compacted thickness	25 mm
(d) Pavement Category	A

16.6 Timber Guardrail

Construct timber guardrails from Koppers Tanalith logs to AS 1604 with post spacing, post diameter, post embedment and rail diameter as shown on the drawings. Use Brand No. H5 logs to the requirements of AS 1604 Hazard Level 5 protection. The rails shall be suitably scarfed and fixed by a 16 mm galvanised bolt at each post.

Where details are not shown on the Drawings dimensions shall be in accordance with the following table.

Post Diameter (mm)	Post Spacing (mm)	Post Hole Diameter (mm)	Post Embedment (mm)	Top of Rail above Finished Ground Level (mm)	Rail Diameter (mm)
150	1800	400	900	700	125

Backfill the post hole with concrete of Grade N20.

Protect all treated timber surfaces which have been cut or machined including scarfed and drilled surfaces by applying, in accordance with Manufacturer's instructions:

- (a) above ground - Koppers Reseal
- (b) below ground - Koppers CN Emulsion

17. RETAINING WALLS

17.1 Retaining Walls - Timber Cantilever

17.1.1 General

Construct timber walls from Koppers Tanalith logs to AS 1604 with post spacing, post diameter, post embedment and waling size as shown on the drawings. Use Brand No. H5 logs to the requirements of AS 1604 Hazard Level 5 protection.

Where details are not shown on the Drawings dimensions shall be in accordance with the following table:

Retained Height (m)	Post Diameter (mm)	Post Spacing (m)	Post Hole Diameter (mm)	Post Embedment (m)	Waling Slabs (mm)
0.3	75	1.8	200	0.7	100
0.6	125	1.8	400	1.0	100
0.9	175	1.8	400	1.4	100
1.2	225	1.5	400	1.8	100
1.5	250	1.2	450	2.0	100

Rake the posts back towards the retained material at an angle of 5 degrees from vertical.

Backfill the post hole with concrete of Grade N20. Where posts are embedded in sound unfractured rock the minimum embedment may be reduced to 500 mm.

Use 100 mm high slab walings. Scarf walings at either end to ensure even bearing on the posts. Fix the top row of walings with 100 mm long galvanised bridge spikes.

Backfill the post hole with concrete of Grade N20.

Protect all treated timber surfaces which have been cut or machined including scarfed and drilled surfaces by applying, in accordance with Manufacturer's instructions:

- (a) above ground - Koppers Reseal
- (b) below ground - Koppers CN Emulsion

Line the internal or loaded face of the retaining wall with a geotextile membrane, Terra Firma Grade 1000, from the top waling to a minimum depth of 150 mm below the bottom waling.

17.1.2 Handrails

Provide a handrail 900 mm above ground level along the full length of all retaining walls higher than 600 mm. Use a 125 mm diameter log, suitably scarfed and fixed by a 16 mm galvanised bolt at each post.

17.2 Retaining Walls - Concrete - Crib Wall

17.2.1 General

Construct from Humes Crib Wall components (or approved equivalent) in accordance with the Manufacturer's guidelines.

Course height shall be 250 mm, header spacing shall be 1000 mm, header length shall be 900 mm unless detailed otherwise on the Drawings and batter shall be 1 in 4.

17.2.2 Foundations

Where the wall is to be founded on bedrock remove all vegetation, loose rock, soil, clay and friable weathered rock. Fill any irregularities with mass concrete.. Ensure that the wall is founded on intact bedrock and not on a foundation of floaters. Do not support a wall on undercut material.

Where the wall will be founded on soil, any material containing a high proportion of organic material shall be stripped, the exposed foundation shall be scarified to a minimum depth of 200 mm, brought to near the Standard Optimum Moisture Content (AS 1289.5.1.1) and compacted to a minimum dry density ratio (AS 1289.5.4.1) of 95% Standard (AS 1289.5.1.1). All fill should be placed in layers with a maximum loose thickness of 250 mm and compacted in the manner described above.

Slope the foundation surface to ensure the required batter.

Approval of the foundation shall be required prior to placement of the wall materials.

Where the wall is to be founded on bedrock, the base of the wall shall be at a level which is a minimum depth of 250 mm below the finished surface level at the toe of the wall.

Where a wall, is to be founded on soil, the base of the wall shall be at a level which is a minimum depth of 450 mm below the finished surface level at the toe of the wall.

Provide a continuous base of 250 mm thick S32 concrete reinforced with 2 layers of F81 fabric. Step the base where required in increments of 250 mm.

Where pipes are to pass beneath the wall they shall be encased in concrete.

17.2.3 Cribfill and Backfill

Use crushed rock with maximum particle size 75 mm for fill material in the wall (Cribfill).

Use granular material consisting of sand, crushed rock, slag, skulls, ripped sandstone for backfilling behind the wall.

Do not use clay material as fill material in the wall or backfill material within 500 mm of the rear of the wall.

Compaction of fill placed behind the wall shall be carefully carried out to minimise the induced lateral stress against the wall.

Place fill in layers with a maximum loose thickness of 250 mm and compact to a dry density ratio (AS 1289.5.4.1) of not less than 95% Standard Compaction (AS 1289.5.1.1).

Where pavement construction is to take place using the backfill as subgrade material, compact in accordance with the requirements of clause 16.2.

17.2.4 Drainage

Install a 160 mm diameter subsoil drain with filter sock at the rear of the wall foundation.

Direct all surface runoff away from the back of the wall so as to prevent infiltration of such surface runoff into the granular backfill. Direct the surface runoff so as to prevent erosion and possible undercutting along the toe of the wall. Ensure that water does not pond at the toe of the finished wall.

17.2.5 Handrail

Provide a handrail 900 mm above ground level along the full length of all retaining walls higher than 600 mm. Construct the handrail from Koppers Tanalith logs to AS 1604 with post spacing, post diameter, post embedment and rail diameter as shown on the Drawings. Use Brand No. H5 logs to the requirements of AS 1604 Hazard Level 5 protection. Suitably scarf the rails and fix at each post with a 16 mm galvanised bolt.

Where details are not shown on the Drawings dimensions shall be in accordance with the following table.

Post Diameter (mm)	Post Spacing (mm)	Post Hole Diameter (mm)	Post Embedment (mm)	Rail Diameter (mm)
125	1800	400	1000	125

Backfill the post hole with concrete of Grade N20.

Protect all treated timber surfaces which have been cut or machined including scarfed and drilled surfaces by applying, in accordance with Manufacturer's instructions:

- (a) above ground - Koppers Reseal
- (b) below ground - Koppers CN Emulsion

18. RESTORATION

18.1 General

Restore as near as practicable to their pre-existing condition, all surfaces, services and/or improvements disturbed, destroyed, removed or damaged during construction of the Works and during installation of temporary works such as access roads. Improvements shall be deemed to include trees and shrubs, mulched areas, gardens, paving, flagging, proprietary finished areas such as 'pebble crete' and the like, retaining walls, fences and all other structures.

When necessary for the restoration of surfaces, stockpile existing topsoil separately and replace it over the areas where it was previously located when completing backfilling operations. Where there is a shortfall of existing topsoil use approved imported topsoil.

18.2 Timing of Restoration

Undertake restoration to surfaces, services and improvements progressively as the work proceeds. At all times ensure that services are maintained. Complete restoration and repair work within five calendar days after completion of backfilling of each section of the Works unless specifically stated otherwise elsewhere.

Undertake any maintenance of the restoration within two calendar days of the need for such maintenance becoming apparent.

18.3 Pavements

Immediately after backfilling of a trench excavated through a pavement, temporarily restore the surface and maintain it in a trafficable condition until final restoration is completed. Where the original pavement was bitumen or asphalt use a pre-mixed asphaltic material for the temporary restoration. Otherwise use crushed metal or gravel. Complete final restoration of pavements within one month of temporary restoration.

18.4 Turf

Restore areas of established well maintained lawns to the full limits of the disturbed area with approved imported turf. Restoration using sods removed prior to construction will only be approved if the sods are of equivalent standard to imported turf. Also use turf to restore areas where there is significant risk of erosion such as on steep or long slopes.

Following backfilling and initial settlement spread and grade topsoil to achieve a smooth surface free from lumps, stones or other debris and blending into the levels and shapes of the adjoining undisturbed ground allowing for the turf. Mix an approved fertiliser of N:P:K ratio of 10:4:6 (equivalent to "Mulitgro") into the topsoil at a rate of 40g/m².

Lay the turf without gaps on the prepared topsoil surface and lightly top dress and compact. Water regularly until regrowth is established.

18.5 Grassed Areas

For grassed areas not requiring restoration with turf, restore by replacing the pre-existing topsoil or approved imported topsoil, to a minimum thickness of 50 mm. Seed the affected area with grass seeds of the varieties prevalent in the immediate area. Water and maintain the disturbed area until regrowth is established.

If regrowth fails to occur within six weeks of restoration, reseed and maintain until regrowth is established.

18.6 Trees

Where Council or private landowners require replacement trees to be planted, provide suitable trees. Where such replacement trees will be adjacent to a sewer, provide trees suitable for planting adjacent to the sewer as detailed in Hunter Water Corporation's publication entitled "Tree Roots".

18.7 Provision for Settlement

Make good any settlement of the trench during the Defects Liability Period by placing additional approved fill such that the finished surface level conforms with the adjacent surface.

For trenches through other than pavements, turf areas, grassed areas or other improved surfaces, backfill may be placed sufficiently high to compensate for expected settlement unless it would create a hazard or inconvenience to the public. At the end of the Defects Liability Period, trim back such excess material to conform with the adjacent surface and dispose of the surplus.

18.8 Tunnelling

Where tunnelling has been used in lieu of trenching to avoid improved surfaces, backfill such as to restore full support to the surface. Repair any damage to the improved surface which occurs at anytime due to subsidence of the backfill.

18.9 Maintenance of Restored Surfaces

Maintain all restored surfaces and improvements in a satisfactory condition until expiry of the Defects Liability period notwithstanding that any deterioration, and the need for their maintenance, may or may not be due to defects which become apparent or arise from events which occur during that period.

18.10 Certification

Submit certificates issued by the relevant public authorities certifying that all roads, footpaths and surfaces in public places under their control have been satisfactorily restored. Notwithstanding any other provision, the Defects Liability Period shall not be completed until such certification is submitted unless it is agreed that the public authority has unreasonably withheld issue of the certificate. The issue of such certificates shall not relieve any responsibility for any defect.

19. CONNECTION TO EXISTING SEWERAGE SYSTEM

Only undertake connection to existing live sewerage system on completion of all other Works. Give written notice, including full details of the proposed connection procedures, 10 working days prior to making the connection and comply with any directions regarding the method and timing of the connection which are necessary to meet operational needs of the existing sewer system.

Perform the connection on the approved date and at the approved time. Do not commence the connection work unless all necessary materials and equipment are available on site. Undertake all work so as to minimise interruption to the operation of the existing sewer system and to prevent overflow of sewage. Escape of sewage from the live system shall not be tolerated. If necessary pump sewage around the point of connection.

20. ACCEPTANCE TESTING

20.1 General

Undertake acceptance testing of the pumping station wet well, valve pit, overflow structures and all pipelines constructed. Acceptance testing may be done progressively, but must be no earlier than 7 days after completion of the structure or pipeline section to be tested. Give 48 hours notice before commencement of acceptance testing. Ensure that structures and pipes are clean before any test is performed. Do not pressure test during wet weather.

If any of the tests prove to be unsatisfactory, detect and repair the fault and then re-test. Continue to repair and re-test until a satisfactory test is obtained. Even if testing produces satisfactory test results, repair any structure, pipeline or conduit in which there is a visible or detectable leak or blockage.

20.2 Acceptance Testing of Gravity Pipelines

Test all gravity pipelines including all overflow pipework and the inlet pipework from the collecting access chamber to the wet well in accordance with clause 22 of WSA02 Part 3 Hunter Water Edition.

20.3 Acceptance Testing of Pressure Pipelines

Test all pressure pipelines including the discharge pipework from the pump discharge bend to the connection point to the rising main in accordance with clause 19 of WSA03 Part 3 Hunter Water Edition.

20.4 Testing of Pumping Station Wet Well

20.4.1 General

Test the pumping station wet well for leakage as soon as practicable after it has been constructed. Plug all pipe openings in the walls with the plugs placed in the pipes as near as practicable to the internal face of the well.

Use an exfiltration test unless it can be demonstrated that ground water is at a sufficiently high level to ensure that all construction joints and pipe penetrations can be adequately tested by an infiltration test.

20.4.2 Exfiltration Test

Fill the well totally with water and after allowing an interval for absorption of 4 hours refill the well and measure the loss of water during a period of 30 minutes.

The test will be considered satisfactory provided that water loss is less than 2 mm depth for each 1 m depth of well. The depth of well is measured from the underside of the roof slab to the well floor.

20.4.3 Infiltration Test

Where the pumping station wet well is subjected to a significant head of ground water, the Superintendent may order that the hydrostatic test on the wet well be by visual inspection and measurement of infiltration.

If the Superintendent requires a visual inspection and infiltration test the Superintendent shall determine the duration over which infiltration is to be measured, and the amount of infiltration allowable for a satisfactory test.

21. COMMISSIONING OF PUMPING STATION

21.1 Requirements

All materials, equipment, installation and workmanship included in the Works covered by this Specification shall be tested and/or inspected to prove compliance with the Specification requirements.

Tests and inspections shall comply with current relevant Australian Standards.

Testing shall include pre-commissioning, field testing and performance testing of each part of the whole installation.

21.2 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.

Pre-commissioning shall be conducted in a logical sequence in accordance with Appendix A - Pre-Commissioning Checklist.

Pre-commissioning tests shall be carried out under the Supervision and to the satisfaction of the Hunter Water Corporation and shall be recorded on the appropriate Pre-commissioning Checklist.

Prior to Commissioning submit one signed copy of each completed Pre-commissioning Checklist countersigned by the Hunter Water Corporation's Representative who witnessed the test.

21.3 Commissioning

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.

Representatives of the Hunter Water Corporation will participate in the tests and may elect to record an independent set of test results for evaluation. The Hunter Water Corporation shall require a period of ten (10) working days notice to undertake testing.

Commissioning shall be conducted in a logical sequence in accordance with Appendix B - Commissioning Checklist.

Throughout commissioning the Contractor shall be responsible for the test program.

Provide continuous supervision by personnel experienced in the operation of the equipment and have qualified personnel in attendance to carry out all necessary adjustments and/or remedial work during the commissioning tests.

Submit one signed copy of each completed Commissioning Checklist countersigned by the Hunter Water Corporation's Representative who witnessed the test. Provision of completed Commissioning Checklists is a prerequisite of Practical Completion.

22. WORK-AS-CONSTRUCTED DETAILS

Provide Work-As-Constructed details in accordance with STS903, STS904 and STS911 at least ten (10) working days prior to the date of commissioning.

23. OPERATION AND MAINTENANCE INFORMATION

23.1 Manuals

Clause 23.1 applies if no Operation and Information Package has been provided by Hunter Water Corporation.

Provide four (4) copies of Operations and Maintenance Manuals including lubrication charts and trouble-shooting instructions for the whole of the equipment including soft starters if used. Submit Operations and Maintenance Manuals to the Superintendent at least ten (10) working days prior to the date of commissioning.

The installation, operation and maintenance instructions must be relevant to the actual machinery supplied under this Contract. Identify all parts requiring maintenance and clearly state the type and frequency of recommended maintenance. Installation, operation and maintenance instructions that are of a general nature are not acceptable.

Each copy must be assembled between a set of durable hardcovers suitably labelled and securely fastened. The method of binding must provide a secure system of fastening pages and allow manuals to lay open whilst in use and permit pages to be easily replaced and / or added.

In addition to the requirements set out above the manuals shall include:-

(a) General

Contractors name, address and telephone number

Client contract number

Job name

Pumping station general arrangement drawing of pumps, motors and pipework.

Work as Constructed electrical installation drawings prepared in accordance with clause 26.7.

(b) Pumps

Manufacturer

Type and model number

Serial numbers

Typical performance curves

General arrangement drawing of pump and discharge bend assembly (dimensioned)

Section arrangement drawing with parts and material list.

(c) Motors

Manufacturer

Type and model number

Serial numbers

Dimensioned arrangement drawing

Sectional arrangement drawing with parts and material list

Gland sealing arrangement drawing for submersible motor power cables

(d) Test Curves (where applicable)

Pump certified test curves

Test result log sheet

Motor test curves

Motor torque/speed/efficiency characteristics curves

(e) A Description of Operation

(f) Installation Instructions

(g) Start Up/Shut Down Procedures

(h) Maintenance Information

Trouble shooting instructions for pump and motors.

Step by step procedures for dismantling and reassembly of pumps and motors using any special tools shall be detailed together with step by step procedures for replacement of wearing parts such as bearings, seals, wear rings, etc.

Drawings as scheduled and any other drawing necessary for complete understanding of installation, operation and maintenance.

Log sheets and maintenance inspection sheets for use by operations and maintenance staff detailing routine monitoring, inspection and maintenance requirements and frequency thereof.

(i) PLC Information

Copy of PLC program and Label File on 3 ½” Disk

Program Documentation

23.2 Information Package

Clause 23.2 applies if an Operation and Information Package has been provided by Hunter Water Corporation.

The electronic Operation and Information Package provided lists all of the information required to allow the ongoing operation and maintenance of the Works. Some of the required information has been prepared by the designers and is included in the package.

Prepare all of the information indicated in the package to be provided by the 'Installation Contractor', append it to the package in the form indicated, and submit the complete package at least ten (10) working days prior to the date of commissioning.

24. GENERAL ELECTRICAL WORKS

All telemetry and automation, electrical installation and switchboard manufacture work is to be performed by companies approved to do so by Hunter Water Corporation.

Comply with the Hunter Water Corporation's General Requirements for Electrical Installations STS500..

Arrange for each Authority having jurisdiction to inspect and check the works.

25. MANUFACTURE AND SUPPLY OF ELECTRICAL EQUIPMENT

25.1 Equipment Rating

Equipment ratings shown on schedules or drawings are estimates only. Confirm the actual equipment ratings to of the supplied equipment including motor starters and cabling. Where the rating exceed the drawing values the Contractor shall be responsible for determining the required ratings of equipment and cables.

25.2 Provision of Plinths

Construct the cabinet base 25 mm smaller than the concrete plinth on all sides.

25.3 Switchboards

25.3.1 Circuit Breakers

The service protection circuit breaker shall, as a minimum, be fitted with an electronic control unit, have adjustable thermal, magnetic and instantaneous pickups as well as adjustable time delays for thermal and magnetic pickups. It shall discriminate with the supply authority fuses.

The motor circuit breakers are to be selected to discriminate with the service protection device and provide sufficient current for the pumps to start at a minimum of 4 times full load current

25.4 Control Circuit Wiring

Bush all metal edges in contact with cables.

Cable primary insulation shall be coloured in accordance to STS500

Seek direction on colour coding for voltages other than those listed in STS500.

25.5 Equipment Mounting

Mount all items of equipment using metric, zinc plated metal thread set screws, screwed into tapped holes. Mount small items such as relays and miniature circuit breakers on DIN35 mounting rail.

Terminal mounting rail, DIN35 mounting rail and plastic wiring duct, may be secured by self drilling/threading screws.

Do not use self tapping screws.

Provide a minimum of 25 mm between the terminal side of all relays and equipment and the adjacent wiring duct or equipment, to facilitate wiring.

Do not mount any equipment in front of other equipment.

Do not locate terminals within 250 mm of the base of the cubicle or 300 mm of the top of the cubicle.

Locate mains and motor terminals such as to provide easy access to outgoing terminations, with cable holes clearly visible.

25.6 Terminations

Provide suitably rated power terminal blocks in the switchboard for the termination of the incoming field wiring. Provide control terminal blocks, minimum size 10 amps, in each cubicle for the termination of the incoming field wiring. Provide a separate terminal for every field cable core including spare cores. Terminate each core within a cable in consecutive terminals.

Terminate control wiring, at each end, with a pre-insulated crimp lug or cable crimp sleeve.

Where two control wires are to be terminated in a single tunnel terminal, twist both wires together and crimp in a common crimp sleeve designed for the purpose.

Crimp all crimp sleeves and crimp lugs to the wire ends with a tool having a ratchet device to ensure full crimping before tool will release. Do not use crimp tools without ratchet devices, pliers or similar blade tools to secure sleeves or lugs to wires.

The entire metal surface of any crimp sleeve or lug shall be contained within the terminal shrouding and shall not be visible.

Do not use pin or blade type crimp lugs in tunnel type terminals.

25.7 Equipment Requirements

25.7.1 Compliance

Select equipment from Hunter Water Corporation's lists of Approved Products and Manufacturers which can be accessed on the internet at:

<http://www.hunterwater.com.au/Building-and-Development/>

Where suitable equipment is not listed, submit full technical details of alternative items and obtain written approval prior to use.

Provide proof of compliance with the relevant Australian Standard if requested. Such proof shall comprise a complete Test Certificate from an accepted independent Testing Authority or a Certificate of Suitability issued by an Australian Electricity Authority.

25.7.2 Equipment Supplied by Others

Obtain the kWh Metering Equipment direct from the Supply Authority.

25.7.3 Equipment Supplied by Others at the Contractor's expense

Lock Barrel - obtain from Hunter Water Corporation Ltd.

Notify the Hunter Water Corporation a minimum of fifteen (15) working days prior to requiring the 81/3 lock barrels.

The installation of HWC locks is the responsibility of the contractor.

25.8 Labelling

25.8.1 General

For each starter attach the pump and motor nameplate to the starter inner door. These are to match the nameplates attached to the pump

Clearly and accurately label every item of equipment within or on the switchboard. Provide a label, mounted adjacent to each fuse base, engraved with the fuse element rating.

STS500 and the design drawings provide further specific details of labelling requirements.

External labels are to be manufactured from the same material as the switchboard, eg Aluminium sheet for Aluminium switchboards.

25.8.2 Asset and Equipment Number Labels

Supply and install Equipment Number Labels as listed in APPENDIX C and manufactured from materials as detailed in clause 4.23. Fix labels as follows:

- (a) Station Equipment Number Label - Fix, using four (4) aluminium pop rivets, to the front of the switchboard cabinet above main labels and positioned such that it can be easily seen from the access driveway.
- (b) Pump Equipment number Labels - Circuit Breaker - Fix permanently adjacent to the respective circuit breaker using double backed adhesive mounting tape.

25.9 Programming of Logic Controller

Program all Programmable Logic Controllers to suit the operation and control requirements of the installation.

Obtain the sample PLC software from the Hunter Water Corporation.

Develop, prepare, install and commission PLC software to suit the pump station.

Assign all rights of the software prepared for this Contract to the Hunter Water Corporation.

25.10 Final Inspection and Test

Before delivering each switchboard to site the switchboard must satisfy the tests required in STS500 including at least the following:

- (a) Insulation test of all power wiring with 1000 V insulation tester, tested phase to phase and neutral, phase to earth, neutral to earth.
- (b) For switchboards containing busbars, a 2.5 kV high potential test with minimum 5 mA leakage current followed by repeat of test (a) above. Report any leakage current or change in insulation resistance.
- (c) Test and record earth continuity of earth busbar and earthing conductors.
- (d) Test all protection equipment and motor protection relays by secondary injection of the current transformer circuits.
- (e) Test phase fail, phase reversal relays with correct and reversed phase sequence to ensure correct operation. Also test relay by removing one fuse.
- (f) Test operation of all Residual Current Device (RCD) circuit breakers and combined Residual Current Device/General Purpose Outlet (RCD/GPO) units. Units shall trip when leakage exceeds 30 mA.
- (g) Test voltmeter and voltmeter selector switch for correct voltage indication.

- (h) Test each motor starter for correct operation with all other drives and equipment turned off. Test shall include operation of thermal overload, phase failure, over temperature devices, etc, with starter selected for both manual and automatic operation. Test operation of all indicating lamps and control devices.
- (i) Test motor starter with load connected and observe ammeter movement. Check for high resistance connections.
- (j) Test each Programmable Logic Controller input from the connected device and ensure correct operation.
- (k) Test each Programmable Logic Controller output and ensure correct operation of connected devices.
- (l) Test operation of level control systems by simulation of changing level on primary device.
- (m) Test operation of instrument loops by simulation of primary device.
- (n) Configure starter parameters
- (o) Configure circuit breaker settings
- (p) Simulation testing of Programmable Logic Controller.
- (q) Check that the Duty and Standby pumps alternate their duty upon each operation.

Give at least five working days notice before the final inspection is performed prior to delivery to site.

Within three working days of the inspection submit a signed completed copy of the results of the inspection.

25.11 Delivery and Storage

Deliver the switchboards to site undamaged in any way.

25.12 Site Testing

After the switchboard has been installed, perform tests to verify the performance under site conditions and to ensure performance of all equipment is satisfactory.

26. INSTALLATION OF ELECTRICAL EQUIPMENT

26.1 Supply Authority Requirements

Make all necessary applications and submissions to the Supply Authority. Forward the Customer Copy of all forms to the Superintendent.

26.2 Installation of Submersible Pump Cables

26.2.1 Location of Pumps

Pump number 1 shall be closest to the switchboard. Pumps are numbered in sequence from number 1 including future pumps not currently installed ie. where centre pump of a three pumping station is not installed, pumps are connected to Pump 1 and Pump 3 starters.

26.2.2 Installation

Pump cables are to be supported at the top of well with individual stainless steel cable stockings for each cable. Each stocking shall support only one cable. Support the cable stocking from the cable support bracket opposite the respective pump.

Do not cut or shorten flexible cables attached to submersible pumps, level probes or level regulators more than necessary. Where able to fit and maintain cable rating, coil excess cable neatly in the space beneath the junction box.

Support pump cables so that no undue bending or stress is evident at motor cable glands.

26.3 Installation of Level Sensors

26.3.1 Level Probe

Support each level sensor probe and each high level float switch with stainless steel cable stockings attached to a grade 316 stainless steel hook. Supply one hook per instrument. The instrument hooks supplied shall be as shown on SCP-906 (referred to as B-906 chain hook).

Locate the probe is so that is no closer than 300 mm to any equipment in the well. Install the support hook with 6 mm diameter stainless steel masonry anchors fixed into the side of the roof opening. Mount the bracket such that the fixing holes are closest to the top of the bracket.

Mount the float switch at the alarm level as shown on the Drawings and capable of being adjusted 1 metre above or below this level.

26.4 Installation in Pump Well

26.4.1 General

All areas in the wet well and valve pit are classified as a wet situation and are subject to a high level of corrosion.

All supports and fasteners used and installed in pump well or valve pit shall be manufactured from grade 316 stainless steel or approved non-corrosive products.

Do not use brass, mild steel, electro-plated mild steel, within the wet well or valve pit.

Place Insulating washers between any dissimilar metals to reduce corrosion due to electrolysis.

26.4.2 Cables

Install cables away from pumps and in a location which allows raising and withdrawal of any pump without disturbing the cabling to other pumps or equipment in the well.

Do not install pump cables behind pump guide rails without prior written approval.

26.5 Testing

Carryout all tests and verification as required by AS3000, particularly Section 8. Provide a checklist confirming each test in Section 8 has been undertaken and completed successfully. The checklist is to be signed by the certifying officer on behalf of the contractor. Include these test documents in the Operation and Maintenance Manual. Submit the completed checklist to the Superintendent at least 5 days before Pre-commissioning.

Submit, within three days of completion of any site tests, reports of all tests and inspections.

Tests shall include but not be limited to

- (a) Insulation resistance of Consumer's Mains and motor cables. Resistance shall be greater than 30 M ohm, measured with a 1000 V insulation tester.
- (b) Phase rotation check on Consumer's Mains. Rotation shall be Red - White - Blue.
- (c) Check supply voltage phase to phase and phase to earth. Voltage variation between phases shall not exceed two percent (2%).
- (d) Test resistance of motor thermistors (if installed), with a high impedance multimeter. Thermistor resistance shall be between 150 and 600 ohms.
- (e) Test the Vega level sensor by immersing the sensor or simulate a water level between zero and full span value ensuring output current varies between 4 and 20 mA. Also ensure level display readings are correct for depth of immersion.

- (f) Test operation of high level float switch with a high impedance multimeter. Disconnect circuit from the Telemetry module prior to testing.
- (g) General inspection of the completed installation for compliance with the specification.

26.6 Notification of Electrical Work

Make all applications and submissions to Energy Australia necessary to allow construction and commissioning of the Works. Submit copies of all forms to the Superintendent.

26.7 Work As Constructed Drawings and Schedules

Prepare Work-as-Constructed (WAC) Information in accordance with Hunter Water's Standard Technical Specification STS903 and STS904 as applicable

Notwithstanding that part/s of the WAC have been previously submitted, such as with O&M Information prior to Commissioning, submit for review two hard copies and one electronic copy (CD) of the complete WAC Information for the entire contract at least four weeks prior to Practical Completion.

The Superintendent may provide comments within 3 weeks of the submission.

Make appropriate amendments and submit one hard copy and one electronic copy (CD) of the final WAC Information which complies with the Contract.

Submission of the complying WAC Information for the entire contract is a prerequisite for Practical Completion.

27. AUTOMATION AND TELEMETRY

Design, install and commission the PLC, SCADA and telemetry system for the control and monitoring of the stations. Hunter Water shall provide a template program as the basis for the PLC program. Modify this program to suit each particular station. The PLC program shall contain code to support all required functions of the control system as defined in the Functional Specification. Fully document the PLC program in accordance with AS 3876.

Configure Hunter Water's SCADA database to allow remote control and monitoring including the following work:

- configure the RTU;
- configure the database points associated with the RTU and consistent with those required for the particular station type;
- make necessary additions/alterations to the SCADA pages;
- add the necessary SCADA points; and
- update the SCADA system network diagrams.

Submit draft SCADA pages to the Superintendent for review and comment 3 weeks prior to pre-commissioning.

Program any switches or devices as necessary to complete the works.

28. SUBMERSIBLE MOTOR TYPE SEWAGE PUMPS

28.1 Selection of Pump Units

Obtain pumps from approved manufacturers/suppliers as indicated on Hunter Water Corporation's lists of Approved Products and Manufacturers which can be accessed on the internet at:

<http://www.hunterwater.com.au/217.aspx>

Unless the pump brand and model number has been specified elsewhere, select the most appropriate pump unit which meets all specified requirements at lowest life cycle cost.

28.2 Operating Requirements

28.2.1 Operating Range

The pumping units shall operate satisfactorily between maximum and minimum pipeline characteristics and down to flood minimum head without exceeding a current in any motor cable equivalent to 95% of the motor MCR current under the specified supply conditions.

The pumping units shall have steadily falling Head/Quantity curves from no-flow to flow rates 10% in excess of the flood head flow rates.

The pumps shall normally operate singly however shall be capable of operating in parallel unless otherwise specified.

28.2.2 Pipeline Characteristics

The pipeline characteristics are plotted as a graph - refer to "Graph of Pipeline Characteristics" included in Appendix D.

28.2.3 Pump Duty

Pump duties are shown in the Technical Schedule TSSS 3/81 - Extract Sheets.

The best efficiency point for each pump shall be as close as possible to the specified duty point unless otherwise specified.

The pump performance guarantee figures stated in Technical Schedules TSSS 3/81 Extract Sheets shall refer to system minimum head condition.

28.3 Pump Unit Requirements

28.3.1 General

The pumping units shall comply with the requirements set out in the Pumping Station General Arrangement Drawing.

The pumping units shall be current models which have been in successful operation under comparable conditions for at least two years.

Clearly and permanently mark the direction of pump rotation on the pump casing.

Impellers to have a minimum sphere clearance of 76 mm.

28.3.2 Mechanical Seals

The seals shall be suitable for sewage and fluids containing abrasives.

Double mechanical seals are required, preferably arranged in tandem. In tandem, the lower seal in the product field shall be shielded.

Use either single or multiple springs for shaft sizes of 100 mm or less. Use multiple springs for shaft sizes greater than 100 mm.

Secondary seals shall be O-ring or similar.

Seal materials shall be as follows:

(a) Lower or Product Seal

Rotating Seal Face:	Tungsten Carbide or Silicon Carbide
Stationary Seal:	Tungsten Carbide or Silicon Carbide
Springs:	Nickel Chrome Steel
Secondary Seal:	Fluoro Carbon or Nitrile Rubber

(b) Upper or Motor Seal

Rotating Seal Face:	Carbon or Tungsten Carbide
Stationary Seal:	Tungsten Carbide
Springs:	Nickel Chrome Steel
Secondary Seal:	Fluoro Carbon or Nitrile Rubber

Lap the seal interfaces. The depth of interface roughness shall be less than 0.3 mm and flatness shall be within two (2) light bands.

Provide pressure compensation for the oil in the seal chamber.

Fit a seal failure detection device to the seal housing with connections thereto from the motor housing. Externally connected devices are not acceptable.

28.3.3 Discharge Connection and Guide Bars

The discharge connection shall be arranged such that coupling and uncoupling of the pump shall be accomplished by raising and lowering the pump through a straight vertical lift.

The pump shall be automatically guided to the discharge connection by a system of guide bars which will ensure correct seating and sealing of the pump and discharge connection. Arrange the guide bars so as to prevent binding of the pump whilst it is being raised or lowered.

Secure the guide bars in such a manner as to allow removal of the pump from the station without dismantling any part of the pump or guide bar system.

Guide bars and brackets shall be constructed from Grade 316 stainless steel.

Provide Grade 316 stainless steel intermediate guide bar brackets if necessary to ensure rigidity and where unsupported length of bar exceeds 6 metres.

28.3.4 Lifting Chains

Supply lifting chains for installation and removal of the pumps.

The chain shall be a continuous length, sufficient to enable removal of the pump from the well, with a lifting eye attached to the top of the chain with a shackle (or forged into the top chain link) to enable the pump to be raised and large enough for a sling or crane hook. Attach a second lifting eye 1.5 metres below the top eye.

Shackle the other end of the chain to the pump lifting bridle.

Chain including lifting eye and shackles is to be load rated for lifting. Select the link size, lifting eye and shackle in accordance with the manufacturer's recommendations for the mass of the pump.

The lifting eyes shall have a minimum throat opening of 150 x 100 mm.

The lifting chains, lifting eyes and shackles shall be minimum 8 mm diameter Grade 316 stainless steel.

28.3.5 Holding Down Bolts

Secure the Discharge Bend, Guide Bars, Cable Support Hooks and Chain Support Hooks using holding down bolts, nuts and washers manufactured from stainless steel to AS 2837 Grade 316 and fastened into the concrete using chemical adhesive anchors. Fasteners subject to vibration

shall be provided with locking devices. For pump discharge bends use large series washers and holding down bolts of sufficient length for three full threads to protrude from the nut when installed.

28.3.6 Lifting Bridle

Fit a 316 stainless steel lifting bridle to each pump. The bridle shall be able to support the full working weight of the motor / pump set and be capable of accepting a crane hook 150 mm deep in section.

Ensure that when lifting either by chain or directly by crane hook, the weight distribution of the motor / pumpset will aid in seating and unseating of the pump from its pedestal.

28.3.7 Hatch Openings and Guide Brackets

The dimensions of the hatch opening and the pump spacings on the General Arrangement Drawings have been determined by Project requirements and the Contractor is to nominate pump locations and is to provide guide rail brackets to suit this opening. The brackets fixing the guide rail to the face of the hatch opening shall be designed to give a minimum clearance of 76 mm between the pump sliding bracket and the safety screen support angle to prevent interference on pump withdrawal. Fabricate any extension to the guide rail brackets using 10 mm minimum thick Grade 316 stainless steel plate. All bolted connections shall be by M12 minimum stainless steel screwed rod fastened into the concrete with chemical adhesive anchors.

28.3.8 Pumping station Arrangement

Tenderers are required to submit details of any necessary alterations to the wet well arrangements shown on the drawing(s) required to ensure satisfactory hydraulic performance of the Pumps tendered. Acceptance of the tendered pumps is conditional that they are suitable to the well arrangement as detailed unless alterations have been noted by the Contractor and accepted with the tenderer.

28.3.9 Pump Numbering

The pump with the lowest serial number shall be the No 1 pump and shall be installed closest to the electrical switchboard.

28.3.10 Pipes and Fittings

Where the outlet flange of the discharge bend is of a different size to the vertical riser pipework inside the well as shown on the drawing, supply flanged eccentric tapers.

28.3.11 Nameplate

Attach a stamped or embossed stainless steel nameplate to each pump using stainless steel drive screws. Do not paint.

Nameplate details shall include manufacturer's name, pump type, size, serial number, order/contract number, speed, year of manufacture and pump casing test head.

28.3.12 Protective Coatings

The pumps and discharge bends shall be supplied with painted finish to the pump manufacturer's standard coating or the following alternative:- grit blast to AS 1627 Part 4 Class 3 and paint in accordance with the paint manufacturer's instructions to a thickness of 500 microns with a high build solventless epoxy coating approved under the APAS scheme. Refer clause 8.2.

28.3.13 Galvanising

Where items are required to be galvanised, the process to be employed shall be hot dip galvanising and the provisions of AS 1650 shall apply subject to the additional requirements for heavy galvanising specified below. AS 1214 and the relevant requirements of AS 1650 shall apply to galvanising of fasteners such as bolts, nuts and washers.

Where applicable, galvanise after fabrication. Prior to pickling and galvanising, remove weld slag and weld spatter by mechanical means.

Provide enclosed hollow sections with vent and drainage holes at opposite sides of the member, prior to pickling and galvanising. The size and exact location shall be in accordance with the galvaniser's recommendations.

The average thickness of the zinc coating shall be not less than:

- (a) 84 um for steel 5 mm thick and over (the equivalent coating mass is 600g/m²).
- (b) 63 um for steel less than 5 mm thick (the equivalent coating mass is 450g/m²).
- (c) 52 um for fasteners (the equivalent coating mass is 375g/m²).

Where heavy galvanising is specified, the average thickness of the zinc coating shall be not less than 50% above the respective thickness specified above and may be achieved by using one, or a combination of, the following methods:

- (a) Abrasive blast cleaning of the surfaces which are to be galvanised, prior to pickling and galvanising. Abrasive blast cleaning shall be carried out in accordance with AS 1627 Part 4 provided that the minimum standard of surface preparation shall be Class 2 - "medium" blast cleaning and the surface profile height shall be not less than 50 um nor more than 75 um. Pickling and galvanising shall be carried out as soon as practicable after the abrasive blast cleaning.
- (b) Increasing the period of immersion in the galvanised bath.
- (c) Increasing the galvanising temperature.

28.3.14 Drawings, Documents and Manuals

- (a) Provide completed technical schedule TSSS 3/81 Extract Sheets 1 to 3 with the tender.
- (b) Supply pump and accessory installation drawings for each pumping station to the main Contractor with one (1) copy to the Superintendent for review.
- (c) Within 4 weeks of witness testing the pumps, provide four (4) copies of Installation, Operations and Maintenance information as described in clause 23 for inclusion in the Operations and Maintenance Manuals.
- (d) Provide one (1) copy of Work-as-Executed drawings.

28.4 **Electrical Requirements**

28.4.1 Motor Performance and Characteristics

The motor and driven unit torque/speed characteristics shall ensure smooth positive acceleration in conjunction with the scheduled starting method under all specified conditions of operation. The final speed during the first step of starting shall exceed the speed of breakdown torque.

All motors will be started by means of automatic starters designed to AS 1202.

All motors shall be suitable for Direct On Line starting, and motors 4.5 kW and above shall also be suitable for electronic soft starting and variable speed drives..

Motors shall satisfy the Electricity Supply Authority's requirements particularly in regard to interference to other consumers and frequency injection systems.

Motors shall be rated for type S1 duty in air, ie. maximum continuously rated (MCR) in air using a method of cooling consistent with continuous operation with a water level at the top of the volute. The motor power required over the entire operating range, ie. between maximum total head pipeline characteristic and flood head pipeline characteristic, shall be a maximum of 95% of the motor rating. Within the operating range the current in each phase shall be less than

the MCR current for a supply voltage within the specified range, and for a voltage variation between phases which is within the tolerance that the Electricity Supply Authority permits.

Motor starting, or continuous operation at MCR shall not cause a temperature rise in excess of that specified, and shall not cause nuisance operation of any protective device.

Starting characteristics shall be Design N to AS 1359.41-1986.

28.4.2 Motor Construction

Motor winding insulation shall be Class F, but the design of the motor shall ensure that the temperature of the windings does not exceed the limits for Class B insulation.

Terminate motor windings in the terminal box for delta connection with both ends of each phase winding terminated on a stud-type terminal.

Phase time sequence of the electricity supply will be red/white/blue (clockwise rotation) and the motor shall be suitable for connection of the motor cables directly to this supply sequence. Any interchanging of phases to achieve correct shaft rotation shall be within the motor terminal box.

Provide an earth terminal inside the motor terminal box.

The motor finish shall be in accordance with that indicated for the pump.

Attach a stamped or embossed stainless steel nameplate to each motor using stainless steel drive screws. Do not paint. The information on the motor nameplate shall include the motor details on Form E86 and shall remain legible for a life of 15 years in a sewage pumping station.

28.4.3 Method of Starting

The only acceptable methods of starting shall be electronic soft start or variable speed drive.

28.4.4 Motor Winding Impregnation

Vacuum pressure impregnation of the motor windings with epoxy or polyester varnish is required.

28.4.5 Motor Cables

Each pump shall be supplied with cables in single continuous lengths for power and control and of appropriate lengths to allow the cables to be supported in cable stockings (refer clause 28.5.7) on the cable hooks in the well without undue strain and in locations which will not obstruct access or removal of pumps and to allow for a minimum of 1.5 metres spare for each cable to be coiled at the switchboard.

Cable length is to be as shown in TSSS 3/81, Sheet 2 of 3, page S10, line 16.

(a) Single cables shall be used in preference to multiple cables.

(b) Minimum cable core size shall be:

i) Motor cores - 2.5 mm^2

ii) Control cores (if in a motor cable) - 0.75 mm^2

iii) Control cores (if in a separate cable) - 1.00 mm^2

(c) The cables are to be either Flygt Subcab or Olex EPR/CSP.

Power cores shall be continuously coloured, continuously numbered or fitted with wire numbers.

Terminate each cable at the motor using a cable gland, in such a way that there will be no undue mechanical stress on either the conductors or the motor terminals to which the cable is connected.

Further, the termination system shall be such that water cannot reach the motor windings from a cut cable under a pressure of fifteen (15) metres head of water.

Cables shall include control cores for each specified and other installed protection devices. Two control cores per device shall be provided.

Each motor shall have no more than three cables and the cables shall be tied together with black nylon cable ties at 300 mm centres. Control cores shall be in one cable or may be part of the power cables. Refer clause 28.5.7 for cable support.

When determining cable sizes, the three motor cores of motors for Direct-on-Line starting only shall be taken as each carrying a current equal to MCR current.

The rating of the motor power cores and earth cores shall be suitable for the motor supplied taking into account all derating factors of AS 3008.1. The cables are laid direct into a concrete trench between the pump well and motor junction box..

Cables shall also be sized to ensure that with the pump operating at MCR, the total voltage drop in the motor cores shall not exceed 2.5% of the supply voltage.

Ensure that signal noise of sufficient quantity to produce nuisance tripping is not induced in the thermistor, seal failure or any other control cores.

Permanently and indelibly mark control cores at the free end as S1 and S2 for seal failure cores, T1 and T2 for thermistor cores.

Fit the free end of each motor cable with a heat shrink seal giving a degree of protection of IPX8 to AS 1939 at 15 metres head of water.

28.4.6 Motor Protection

- (a) Supply motor overtemperature protection as recommended by pump manufacturer and shown on contract drawings.
- (b) Tenderers are to state in their tender those protective devices that must be operated as a condition of the warranty. When specifying these protection devices, tenderers are to fully describe any items that must be included in the switchgear for the satisfactory operation of the protective devices, together with the cost of the switchgear items.

28.4.7 Cable Support

Provide each cable to each motor with a support stocking. Supply one stocking of the appropriate size for each individual cable. Cables supported in groups by one stocking are not acceptable.

Cable support stocking are to be close loop weave stainless steel type with stainless steel ferrule as manufactured by Bullivants (Newcastle) or National Cable Grips, Moonbi, NSW, 2352.

28.4.8 Seal Failure Detectors

Provide seal failure detectors. Provide the primary sensing device installed in the pump and provide cable cores to connect to the sensing relay.

For Flygt Pumps use MiniCASII or MAS relays. If another brand of pump is supplied, install seal fail detectors to comply with pump manufacturers recommendations and in accordance with contract drawings. In all instances the seal fail relay is to be supplied from 24VDC.

28.4.9 Power Factor and Efficiency

Single speed motors, when operating at rated full load and rated speed, shall exhibit efficiencies and power factors equal to or greater than those indicated in the following table:

	2 POLE		4 POLE		6 POLE		8 POLE	
kW rating range	eff %	p.f.	eff %	p.f.	eff %	p.f.	eff %	p.f.

Less than 0.5 kW	64	0.62	60	0.62	54	0.62	54	0.56
0.5 kW to 1 kW	70	0.77	70	0.70	66	0.65	60	0.58
1 kW to 5 kW	75	0.80	75	0.74	70	0.70	70	0.65
5 kW to 30 kW	84	0.85	85	0.83	84	0.75	82	0.74
30 kW to 100 kW	90	0.85	90	0.85	90	0.80	90	0.75
Greater than 100 kW	92	0.88	93	0.85	93	0.81	93	0.77

28.5 Tests at Manufacturer's Works

Tests at the Manufacturer's works (for pumps with motors 15 kW and above) shall form the basis of acceptance of performance of equipment supplied under the Contract.

Certificates giving records of tests carried out and for such other items as the Hunter Water Corporation may direct shall be provided to the Hunter Water Corporation for approval prior to dispatch of pumping units from the Manufacturer's works.

28.6 Commissioning and Site Tests

After all equipment supplied under the Contract has been installed, the Subcontractor will be notified fourteen (14) days prior to the date of commissioning and site tests and may be present at the Subcontractor's expense.

The Subcontractor's absence from commissioning and site tests shall not relieve the Subcontractor's responsibility for the satisfactory performance and operation of all equipment supplied under the Contract.

Commissioning shall be the carrying out of inspections, adjustments and tests to ensure the Works are ready to commence operation and placing them into service in the manner specified for regular use.

Site tests during commissioning will be to ascertain that all equipment under the Contract has been properly installed and to verify their satisfactory performance under normal operational conditions.

28.7 Nature and Extent of Works Testing

28.7.1 Pumps

Pump tests at the Manufacturer's Works shall be carried out in accordance with Australian Standard AS 2417 Part 2 - Class C, subject to conditions as follows:

- (a) Each pump shall be tested with its own Contract motor over the range of operating conditions set out in clauses 28.2.4 to 28.2.6 inclusive. A minimum submergence test shall be carried out or a certified copy of an equivalent type test provided to confirm compliance with the requirements set out in the Schedule of Technical Data TSSS 3/81 Page S7 Line 25.
- (b) Test data shall be translated only in respect of voltage and frequency.
- (c) Tolerances as defined in AS 2417 Part 2 - Class C for non mass-produced pumps shall be allowed on guarantees over the specified working range.

28.7.2 Motors

Motors for which type test certificates are not available shall be performance tested at Manufacturer's Works in accordance with Australian Standard AS 1359 Part 60. Performance tests shall be carried out on the motor only and not as part of an integral motor/pump unit.

For the integral motor/pump tests (clause 28.8.1) the shaft output power of the motor will be calculated using the motor efficiency stated on the type test certificate or as performance tested as above.

Motors/pumps, 4.5 kW and above shall be started using the method of starting approved for the motor/pumps and the test shall demonstrate reliable starting in accordance with clause 28.5.1 for a supply voltage not exceeding 415 volts.

All motor/pumps shall be tested with seal failure device connected to a Tritonics type RTW relay. Motor/pumps 75 kW and above shall be tested with all thermistors and any other protective devices connected to compatible control relays. The tests shall demonstrate that nuisance tripping does not occur.

SCHEDULE OF PUMP AND MOTOR DETAILS - FORM E86

SUPPLY AND DELIVERY OF SUBMERSIBLE MOTOR TYPE PUMPS FOR

.....WWPS S.....

Manufacturer : Model Pump : Motor: kW

The Schedule is in addition to that submitted with the tender. One copy duly completed for each pumping station shall be submitted by the Contractor within 15 working days from the date of acceptance of the tender. This information will allow manufacturing of the switchboard.

Contractor to strike out pump alternative not applicable.

PUMP AND MOTOR DETAILS

Manufacturer Pump	Motor
Model Pump	Serial No.....
Serial No.	Serial No.....
Serial No.	Serial No.....
Serial No.	Speed rpm.....
Duty Head m Required Provided	Rating kW.....
Duty Flow L/s Required Provided	Full load Current A.....
Efficiency %	Locked Rotor Current A.....
Impeller Dia. mm	No Load Current A.....
Inlet Flange Size (AS 4087).....	Overload Setting A.....
Discharge Flange Size (AS 4087).....	Insulation Class A

SEAL FAILURE DETECTOR DETAILS

Type: Normal Switch State:

CABLE CONSTRUCTION PER MOTOR

Cable No. 1	No. & Size of Motor Cores..... x	mm ²
	Colours or Numbers of Motor Cores.....	
	Current Rating of Motor Cores.....	A
	No. & Size of Earth Cores x	mm ²
	No. & Size of Control Cores x	mm ²
	Overall Diameter	mm
Cable No. 2	No. & Size of Motor Cores..... x	mm ²
	Colours or Numbers of Motor Cores.....	
	Current Rating of Motor Cores..... x	A
	No. & Size of Earth Cores x	mm ²
	No. & Size of Control Cores x	mm ²
	Overall Diameter	mm
Cable No. 3 (If Required)	No. & Size of Motor Cores..... x	mm ²
	Overall Diameter	mm
Cable Length:	.....

Contractors Signature:

SCHEDULE OF TECHNICAL DATA (MANDATORY)

SUBMERSIBLE PUMP SETS SHEET 1 OF 3

..... WWPS S.....

<u>Description</u>	<u>Requirement</u>	<u>Offer</u>
		(X) Indicates Compliance
Pumps (..... off)	Wet Well	.....
Duty Point	..... L/s @ m	.....L/s @m
Estimated ML pumped per year	.....ML	
Performance Guarantees		
Flow rate L/s		..... L/s
Total Head (m)		..... m
Pump Efficiency %	 %
Power Input to Pump kW		..... kW
Motor Efficiency	 %
kWh/kL pumped		..... kWh/kL
NOL Power Input to Pump with Duty Impeller (not to exceed 95% of motor rating)		..... kW
Shut off head, duty impeller		..... m
Minimum submergence	To be stated	..... mm above pump C/L
Discharge Connection	To be Stated	..... mm x mm
Overall Dimensions	State min. well opening size.....	..... mm x mm
Mass of Pump and Motor	To be Stated	..... kg
Rotational Inertia	To be Stated	..... kg m ²
Manufacturer's Name	To be Stated	.....
Country of Manufacturer	To be Stated	.....
Pump Model and Size	To be Stated	.....
Discharge Opening	To be Stated	..... mm dia.
Impeller Type	To be Stated	.....
Impeller Number of Vanes	To be Stated	.....
Sphere Clearance	To be Stated	..... mm dia.
Impeller Diameter	To be Stated	..... mm dia.

Tenderer's Signature:

SCHEDULE OF TECHNICAL DATA (Mandatory)

SUBMERSIBLE PUMP SETS SHEET 2 OF 3

..... WWPS S.....		
<u>Description</u>	<u>Requirement</u>	<u>Offer</u>
Motor Manuf. Name	To be Stated	.....
Country of Manufacture	To be Stated	.....
Rating	To be Stated	..... kW at S1 duty
Winding temperature detectors: to AS1023 Pt.1 Class 1		Required / Not Required
Moisture detector () chamber		Motor chamber / oil seal
Motor Cable Length (min)	..... m	.....m
Total Voltage Drop in Cable(s) at MCR	To be Stated	.....
Cable form and size of motor conductors	To be Stated	..... cables with motor cores of.....mm ²
Cable Diameter	To be Stated	.....mm
Performance		
MCR in Air at 40oC	To be Stated	.....kW
Motor Speed	Max 1500 rpm	.....r/min
Starting Modes	DOL or Thyristor (electronic) Soft Start	.....
Min. motor voltage for adequate accelerating torque		..... V
Pull-up torque	To be Stated	..... Nm @.....r/min
Rated Current at MCR in Air at 40oC	To be Stated	..... A

Tenderer's Signature

SCHEDULE OF TECHNICAL DATA (Mandatory)

SUBMERSIBLE PUMP SETS SHEET 3 OF 3

..... WWPS S.....

<u>Description</u>	<u>Requirement</u>	<u>Offer</u>			
Locked Rotor Current	To be Stated	.....		
Loads for which data is required as a % of MCR in air at 40oC.		100% MCR	75% MCR	50% MCR	0% MCR
Efficiency To be Stated	.....	.....	.....	.....	.....
Power Factor	To be Stated	.....	.....	.....	.....
Current	To be Stated	.....	.....	.....	.....

Additional Information Required

Pump Set Performance Curves Drawn to AS 1686

Head v's flow	To be Supplied	()
Pump motor chart : (power input, current, power factor, efficiency)	To be Supplied	()

Tenderer's Signature:

SCHEDULE OF TECHNICAL DATA (MANDATORY)

SWITCHGEAR AND CONTROL GEAR ASSEMBLIES - EQUIPMENT SCHEDULE

FOR..... PUMPING STATION S.....

Drawing Nos

TYPE STARTERS - OUTDOOR

SCA

OFFER

(X) Indicates Compliance

Maker's Name:

Enclosure Material:

Degree of Enclosure: IP56

()

Switchboard manufacturer is required to furnish complete details for the following items of equipment :-

Component	Equipment Offered		
	Manufacturer	Cat No	Rating
Pump Main C/Breaker			
Pump By-Pass Contactor			
Pump Thermal Overload Relay			
Pump Soft Starter			
Main Switch			

Tenderer's Signature

APPENDIX A - PRE-COMMISSIONING CHECKLISTS

Incorporating

- Mechanical Pre-Commissioning Checklist
- Electrical Pre-Commissioning Checklist
- Control Pre-Commissioning Checklist

**MECHANICAL
PRE-COMMISSIONING CHECKLIST**

STATION: _____

Checked

- | | | |
|----|---|--------------------------|
| 1 | All valves operate from the closed to the fully open position | <input type="checkbox"/> |
| 2 | All valves seal when closed | <input type="checkbox"/> |
| 3 | All valves are right handed | <input type="checkbox"/> |
| 4 | All valves are easy to operate and have no sharp protrusions on hand wheels | <input type="checkbox"/> |
| 5 | All fasteners and mountings are tightened correctly | <input type="checkbox"/> |
| 6 | Pump with the lowest serial number (or number../1) installed as Pump 1 (ie nearest to switchboard) | <input type="checkbox"/> |
| 7 | Pressure gauge cocks provided on the pump side of each reflux valve and one on the rising main side | <input type="checkbox"/> |
| 8 | All pipework within the pump well complete, suitably anchored and guide rails in place | <input type="checkbox"/> |
| 9 | Gate valves fitted, on the rising main side of the reflux valves with spindles and handwheels. Knife gate valve on the incoming sewer fitted with extension spindle and stop valve surface box. | <input type="checkbox"/> |
| 10 | Specified pump number labels are correctly installed adjacent to the guide rails | <input type="checkbox"/> |
| 11 | Drop tube and or baffle wall installed (if required) | <input type="checkbox"/> |
| 12 | Pumps are clear of the batter and well bottom, as per Pump Contractor's Drawings | <input type="checkbox"/> |
| 13 | Pump discharge stand supported on grout pads and foundation bolts tight | <input type="checkbox"/> |
| 14 | No rubbish at the bottom of the well which is likely to damage the pump when it is started | <input type="checkbox"/> |
| 15 | With all gate valves shut fill the rising main with water | <input type="checkbox"/> |

OK

Rectification Required

Comments:

**CONTRACTOR'S
SIGNATURE:**

DATE:

**HWC REP'S
SIGNATURE:**

DATE:

<p><i>ELECTRICAL</i> <i>PRE-COMMISSIONING CHECKLIST</i></p>
--

STATION: _____

1.	Check that all defects from switchboard inspection have been addressed	
2.	Electricity supply has been connected and energized. And confirm that a Certificate of Compliance for Electrical Work (CCEW) and associated paperwork has been supplied	
3.	Gate valves fitted on the suction to the pumps and the delivery side of the reflux valves with spindles and hand-wheels	
4.	Pump with the lowest serial number is installed as Pump 1 (i.e. nearest to switchboard)	
5.	Pressure gauge and tapping cocks provided on the suction and delivery pipes	
6.	Specified pump number labels are correctly installed adjacent to the pumps	
7.	With delivery gate valves shut fill the pump casings with water (vent casing)	
8.	Ensure that all Hatches are fitted with security magnet limit switches as per the HWC standards document STS105	
9.	“DANGER ELECTRIC” marker bricks installed at ground level and painted yellow	
10	Earth electrode installed as specified in STS500	
11	Earth pit, main earth electrode and water service bond installed	
12	Meter panels are equipped and wired to Supply Authority requirements	
13	Cable supports within the pump well are correctly located and properly fixed	
14	No cable stocking has more than one cable installed in it	
15	Motor cables are supported so as to avoid damage when removing other pump / pumps	
16	Motor cables have minimal slack and do not present undue stress on motor cable glands	
17	Check that the cable duct cover is held firmly under the edge of the concrete plinth by the well sliding cover. Also check that it is held firmly under the edge at the switchboard end.	
18	Appropriate lugs fitted to all field cables, and cables correctly identified at terminations	
19	Confirm sufficient terminals installed to allow an individual terminal for every incoming field wire	
20	Confirm all field wiring holes are mechanically protected (bushes, sleeves, etc.)	
21	Motor terminations are in accordance with the connection diagram	
22	All power cable terminations tested for tightness	
23	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	
24	SCA rating plate complying with AS 3439 has been fixed	
25	Confirm motor and pump details displayed on all labels are identical to the manufacturer’s information. Take a copy of name plate information	
26	Correct orientation and fixing of the switchboard as per design	
27	Switchboard plinth and all gland plates sealed	
28	<u>Check continuity of Earthing system:</u>	

	Main Earth Water pipe bond Pump 1 connection box Pump 2 connection box Pump 1 Motor Pump 2 Motor		
29	With all delivery valves closed run pumps to test for leaks in pipe work and valves		
30	With the motor circuit breakers open and the control isolators off, turn the main switch on, and check that the supply monitoring relay picks up		
31	Check operation of phase failure/phase reversal function of the power meter by removing one phase of supply. Also check by reversing the supply rotation to ensure relay does not operate on reversed phase		
32	Measure the voltages both phase to phase and phase to neutral. Compare the actual voltages relative to typical no-load voltage of 400/230V, and the voltage variation between phases should be less than 2%		
33	Check settings of Starters(VSD or Soft starter)		
34	If fitted, check operation of by-pass contactor		
35	Check the motor and pump nameplates for all details and for compliance with the data shown on the pump rating plate. Take a copy of name plate information		
36	Check that the level switches have been adjusted to the required settings and are functional		
37	Check that level transmitters give an analogue output for the full level range of the device. Simulate a pressure/water level of zero to full (or part of) span and check the reading on the level display		
38	<u>For the following tests, test for pump 1 & pump 2:</u> E-Stop Overload Motor Thermal Protection Other: Check operation of all safety/protective devices for correct operation	P1	
39	With the main switch, pump circuit breakers and control isolating switches off, conduct an insulation test with a megometer (megger test) on all motors at 500V. This must give greater than 10 MΩ. Record Results: 415 Bus RW WB BW RE WE BE Pump 1 cables RW WB BW RE WE BE Pump 2 cables RW WB BW RE WE BE GPO RE =		
40	For each pump turn the circuit breaker on and with personnel clear of all pumps, momentarily turn the control switch to ON and check for correct. Switch pump circuit breaker off.		
41	Confirm that the Power Meter is configured for CT's and that the readings on the		

	local display are appropriate.	
42	Inspect telemetry and radio supply cable connections for correct polarity	
43	Measure telemetry supply voltage and back-up battery voltage (should be 13.6V). Ensure appropriate voltages are detected as per electrical drawings	
44	Check for mains voltage rated insulation on data cables where mixed with mains voltage cables	
45	Check configuration of the PLC I/O against electrical drawings	
46	Confirm that the telemetry unit has been configured	
47	Confirm that the RTU calibration certificate has been supplied	
48	Visual check of antenna installation, clearance from surroundings, mountings secure, and all cables connectors fitted and taped.	
49	Check antenna mounted with weep hole to bottom	
50	Check antenna bearing and polarization	
51	Check for secure earth on radio coax surge protection (if applicable) and coax continuity	
52	Check radio is marked with frequency in use as per electrical drawings	
53	Check radio signal strength against fade margin figures	
54	Check telemetry transmit-level to network device. Set as required by network device	
55	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)	
56	Monitor telemetry messages for errors	
57	Monitor radio audio clarity and set audio control off or to minimum volume	
58	Enable SCADA RTU and check telemetry unit is configured correctly	
59	Check that correct locks are fitted to all cubicles	
60	Monitor SCADA poll and error counters for satisfactory operation over a period of time (to be confirmed with contractor after 7 days, with error rate less than 3%) (SCADA).	

OK

Rectification Required

Comments:

CONTRACTOR'S SIGNATURE:

.....

DATE:

.....

HWC REP'S SIGNATURE:

.....

DATE:

.....

APPENDIX B - COMMISSIONING CHECKLISTS

Incorporating

- Pumping Station Data
- Mechanical Commissioning Checklist
- Electrical \Control Commissioning Checklist

PUMPING STATION DATA
TO BE SUPPLIED WITH COMPLETED COMMISSIONING CHECKLISTS

STATION _____

<u>Pump</u>	<u>Motor</u>
Manufacturer	Manufacturer
Model	Serial No
Serial No	Serial No
Serial No	Serial No
Serial No	Speed rpm
Flow L/s	Rating kW
Head (m)	Full Load Current A
Efficiency %	Locked Rotor Current A
Impeller Dia/Code	No Load Current A
Inlet Flange Size (AS 2129)	Overload Setting A
Discharge Flange Size (AS 2129)	Insulation Class A

<u>Seal Failure Detector Details</u>		
Type	Probe in Oil	Yes / No
Resistance of Probe	Normal Switch State	Open / Closed

<u>Thermistor / Thermostat Details</u>		
<u>To AS 1023.1</u>	Thermistors Fitted	Yes / No

<u>Switchboard</u>	<u>Incoming Circuit Breaker</u>
Voltage	Make
	Rating kW

<u>Starters</u>		
Name	Make	Type
Name	Make	Type
Name	Make	Type

<u>Main Breakers</u>	
Make	Rating kW
Make	Rating kW
Make	Rating kW

<u>Valves</u>			
Function	Type	Make	Size
Function	Type	Make	Size
Function	Type	Make	Size
Function	Type	Make	Size

<u>PLC</u>	Make	Model	Serial No
<u>Telemetry</u>	Make	Model	Serial No

**MECHANICAL
COMMISSIONING CHECKLIST**

STATION: _____

Checked

- | | | |
|---|---|--------------------------|
| 1 | Check that the pump cables are installed clear of guide rails and not such as to impede removal of the pumps | <input type="checkbox"/> |
| 2 | Lift the pumps on the top slab and check the oil level according to the manufacturer's instructions | <input type="checkbox"/> |
| 3 | Turn the impellers by hand to ensure they are free to rotate | <input type="checkbox"/> |
| 4 | Check motor and pump name plate for all details and for compliance with the data shown on the pump rating plate. Take a copy of name plate information | <input type="checkbox"/> |
| 5 | Turn the circuit breaker for one pump on and with personnel clear of all pumps, momentarily turn the control switch to "on" and check for correct rotation as indicated by the arrow on the pump casings and also that the correct pump starts. Switch pump circuit breaker off. Repeat for all the remaining pumps | <input type="checkbox"/> |
| 6 | Lower the pumps in the well, checking that they slide smoothly on the guides and sit properly onto the discharge stand | <input type="checkbox"/> |
| 7 | Fill the wet well with water to the invert level of the incoming sewer | <input type="checkbox"/> |
| 8 | With the relevant gate valve open, start one pump in manual mode and check for leaks, pump/motor vibrationer noise, and that the well level drops | <input type="checkbox"/> |
| 9 | Shut gate valve and restart pump and check for any leaks in pipework or at the discharge bend connection | <input type="checkbox"/> |

OK

Rectification Required

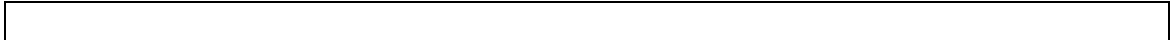
Comments:

**CONTRACTOR'S
SIGNATURE:**

DATE:

**HWC REP'S
SIGNATURE:**

DATE:



<i>ELECTRICAL /CONTROL</i>
<i>COMMISSIONING CHECKLIST</i>

STATION:

<i>Electrical / Control Commissioning Checklist</i>		<i>Checked</i>	
1.	Check that all defects from pre-commissioning have been amended		
2.	Close both pump delivery stop valves		
3.	Fill the wet well with water to above the high level float		
4.	Turn off main switch. On the overview page of the SCADA confirm that the <i>POWER</i> changes from <i>NORMAL</i> to <i>FAIL</i> . And back again when power restored.		
5.	In the following test each pump: Turn the pump from OFF to MANUAL. Check that on the SCADA that <i>PUMP MODE</i> changes from <i>OFF</i> to <i>TEST</i>	P1	P2
6.	Press the 'Manual Start' button. Check that on the SCADA that <i>PUMP STATUS</i> changes from <i>STOPPED</i> to <i>RUNNING</i> .		
7.	Turn pump from MANUAL to AUTO. Check that on the SCADA that <i>PUMP MODE</i> changes from <i>TEST</i> to <i>AUTO</i> . NB: Pump may stop if not called by the controller.		
8.	Turn pump from AUTO to OFF. Check that <i>PUMP MODE</i> change to <i>OFF</i> and <i>PUMP STATUS</i> changes (or already has changed) back to <i>STOPPED</i> .		
9.	From the SCADA terminal initiate <i>PUMP INHIBIT</i> on the pump. Ensure that the pump will not operate, and that the "PLC Inhibit" lamp is ON. Turn the <i>PUMP INHIBIT</i> off and check that both pumps operate and that the "PLC Inhibit" lamp is OFF.		
10.	Operate the "Emergency-Stop" push button. Ensure that the pump becomes unavailable on the SCADA & the "Drive Fault" lamp is ON. Then release the "Emergency-Stop" push button, switch the pump to OFF, then AUTO, and ensure the pump returns to available & the lamp is OFF.		
11.	Bridge out terminals for the seal fail probe on the pump until the seal fail relay is activated (may be referred to as "Pump Warning Healthy"). Check that on the SCADA <i>PUMP WARNING</i> changes from <i>NORMAL</i> to <i>ALARM (FAIL)</i> & the "Pump Warning" lamp is ON. Reset the relay and check that <i>PUMP WARNING</i> returns to <i>NORMAL</i> & the "Pump Warning" lamp is OFF. NB: This will not trip the pump.		
12.	Test operation of overload relay by winding down trip point. Check that on the SCADA that the pump becomes unavailable and the pump status is <i>FAILED</i> & the "Drive Fault" lamp is ON. Reset the relay. Reset the alarm condition reset by pump inhibit OR switch		

Electrical / Control Commissioning Checklist		Checked	
	pump to Off, then Auto. Check Alarm clears.		
13.	<p>If Power Factor Correction and a PFC contactor is installed, ensure the Bypass contactor is not energised. Bridge out terminals for the Power Factor Correction contact on the drive (for more than 2 seconds).</p> <p>Ensure that the pump becomes unavailable, and check that on the SCADA the PFC failed alarm is raised & the “Drive Fault” lamp is ON.</p> <p>Reset the relay. Reset the alarm condition reset by SCADA inhibit OR switch pump to Off, then Auto.</p>		
14.	<p>On the soft starter set the current limit down to minimum and start the drive.</p> <p>The Soft start fault input will then be detected and the drive will become unavailable.</p> <p>Check that on the SCADA the Soft Starter status changes from <i>NORMAL</i> to <i>ALARM</i> & the “Drive Fault” lamp is ON.</p> <p>Return limit setting to normal. Reset the alarm condition reset by pump inhibit OR switch pump to Off, then Auto. Check that Soft Starter status returns to <i>NORMAL</i> & the “Drive Fault” lamp is OFF.</p>		
15.	<p>Using a manual trip on the pump temperature sensor relay (may be referred to as “Pump Protection”).</p> <p>Ensure that the drive trips and becomes unavailable on the SCADA, and check that the “Pump Fault” lamp is ON.</p> <p>Remove the trip condition and reset by pump inhibit OR switch pump to Off, then Auto</p>		
16.	Removing the 24vdc control fuse for the drive and ensure that the drive cannot start in automatic or Test		
17.	Ensure Level Control Override push button calls Level 1.		
18.	<p>While pumps are running.</p> <p>Check that the correct pump current readings are recorded in the SCADA.</p>		
19.	Check on the SCADA that Pump Hours Run is calculated and displayed correctly. NB: Change clock on PLC to test as value resets at 8am.		
20.	Check on the SCADA that Pump Starts for the previous hour is calculated and displayed correctly.		
21.	<p>Ensure that an appropriate “Fail to Start” time has been entered. Remove the Pump Start feedback from PLC and call the pump to run in Auto.</p> <p>After the “Fail to Start” time, ensure that an Alarm is raised, and the pump is <i>FAILED</i> & the “Drive Fault” lamp is ON.</p> <p>Reset the relay. Reset the alarm condition reset by pump inhibit OR switch pump to Off, then Auto. Check that the pump is no longer <i>FAILED</i> & the “Drive Fault” lamp is OFF.</p>		
22.	After a pump has run for 20 seconds, check that the instantaneous power and power factor (red phase) is measured and displayed correctly in the SCADA.		
23.	<p>Simulate control levels by raising and lowering the hydrostatic level probe in the well.</p> <p>Check that the level shown is accurate.</p> <p>Also check on the SCADA that the <i>WELL DISPLAY</i> and <i>WELL</i></p>		

<i>Electrical / Control Commissioning Checklist</i>		<i>Checked</i>
	<i>PERCENTAGE</i> are filling to the appropriate level.	
24.	<p>Check that the pumps are cutting in and out at the correct levels.</p> <p>Also check on the SCADA that <i>LEVEL 1</i> and <i>LEVEL 2</i> are becoming <i>SELECTED</i> at the correct percentage full.</p> <p>NB: The PLC uses 30 seconds de-bounce timer on Cutin levels & 5 seconds for Cutouts.</p>	
25.	<p>Lift wet well high alarm float switch out of the well and hold upside down.</p> <p>Check on SCADA that <i>WET WELL</i> changes from <i>NORMAL</i> to <i>FLOODED</i>.</p> <p>After 30 seconds, ensure that Level 2 is called.</p> <p>Place the float switch back in the well (wait 5 seconds) and check that the <i>WET WELL</i> reverts back to <i>NORMAL</i>.</p> <p>Wait 90 seconds, and then ensure station operates as per the present analog level instrument level control.</p>	
26.	<p>From the SCADA terminal initiate a <i>STATION INHIBIT</i>.</p> <p>Check that no pumps can operate in auto whilst the <i>STATION INHIBIT</i> is operational and that the “PLC Inhibit” lamp is ON.</p> <p>Turn the <i>STATION INHIBIT</i> off.</p> <p>Check that both pumps operate and that the “PLC Inhibit” lamp is OFF.</p>	
27.	<p>By raising the level probe simulate a level below lead cut-in and above lead cut-out.</p> <p>From the SCADA terminal initiate a <i>STATION START</i> check that pumps start.</p>	
28.	Ensure the lead pump is changed over each time a pump runs (Lead Pump Changeover)	
29.	Test all PLC inputs from drive equipment. Test all PLC outputs to drive equipment Test each “press to test” indicating lamp	
30.	<p>Bridge out terminals for the Generator Selected contact.</p> <p>Ensure that only one pump is permitted to run.</p> <p>Check that on the SCADA the Generator Supply status changes from <i>OFF</i> to <i>SELECTED</i>. NB: There are no alarms.</p> <p>Return the Generator Selected contact to normal</p>	
31.	<p>Check that on the SCADA the Surge Diverter alarm changes from <i>NORMAL</i> to <i>ALARM</i>.</p> <p>Return the Surge Diverter Healthy contact to normal</p>	
32.	<p>Close all hatches and J/Box doors.</p> <p>Check on SCADA that the <i>SECURITY</i> changes from <i>ALARM</i> to <i>NORMAL</i>.</p> <p>Then operate each individual door and hatch to operate the station security alarm. (This can be monitored from the PLC input “Field Secure”)</p>	
33.	<p>Close all switchboard and cubicle doors.</p> <p>Check on SCADA that the <i>SECURITY</i> changes from <i>ALARM</i> to <i>NORMAL</i>.</p> <p>Then operate each individual door to operate the station security alarm. (This can be monitored from the PLC input “Switchboard Secure”)</p>	
34.	Test Duty Queue	
35.	Check on the SCADA that “Start Station” button will call level 1.	

Electrical / Control Commissioning Checklist		Checked
36.	Check on the SCADA that the following Setpoints can be adjusted (within acceptable ranges), and have the correct units: Level 1 Cut In (%) : Level 1 Cut Out (%) : Level 2 Cut In (%) : Level 2 Cut Out (%) :	
37.	Remove the serial Modbus communications cable between the PLC & RTU, and ensure that the "PLC Comms" Alarm changes from <i>NORMAL</i> to <i>FAILED</i> . Re-attach the cable, and ensure that the alarm returns to <i>NORMAL</i> .	
38.	Confirm that Power Meter figures returned to SCADA are appropriate	
39.	Check derived Flow values with a draw down test	
40.	Inspect the SCADA screens & popups, and ensure that they comply with the typical WWPS SCADA mimics.	

OK

Rectification Required

Comments:

CONTRACTOR'S SIGNATURE:

DATE:

HWC REP'S SIGNATURE:

DATE:

APPENDIX C - ASSET AND EQUIPMENT NUMBER LABELS LIST

.....SEWAGE PUMPING STATION S.....

Pumping Station Equipment Number SS.....

Switchboard Equipment Number SS.....SB

Pump Equipment Number - Pump No 1 SS.....SP1

Pump Equipment Number - Pump No 2 SS.....SP2

Pump Equipment Number - Pump No 3 SS.....SP3

APPENDIX D - PIPELINE CHARACTERISTIC CURVES

APPENDIX E - BORE LOGS

[END OF STS402]