

**WSAA Sewage Pumping Station Code of
Australia**

WSA 04-2022 Version 3.1

South East Water Supplement

AM2961

AM2961 – Supplement to WSA04


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1. INTRODUCTION

1.1 Purpose of SEW Supplementary Standard Manual

This South East Water Supplementary Standard Manual (the “Supplement” or “WSA04 Supplement”) must be read in conjunction with the Sewage Pumping Station Code of Australia WSA 04 –2022 (Code), which South East Water (SEW) acknowledges as the source document in the preparation of this standard..

WSA04-2022 is an Australian national code that represents the consensus of a working group of water agencies from across the country; hence it embodies a range of communities, terrains, climates as well as design, construction operation and maintenance practices. This consensus may be expressed in the Code as a range of options, and it may exclude practices that are particular to only a few water agencies.

This South East Water Supplementary has been written as an addendum to WSA04-2022 to more specifically define requirements that are particular to our local area and practices. It needs to be read alongside WSA04-2022 as it cross references, rather than repeats the content of WSA04-2022. It connects other SEW standards and guidelines plus material from other sources.

1.2 Further Information

To advise of possible errors, omissions and changes required for future revisions, please contact standardsissues@sew.com.au.

1.3 Terminology

Where the word Developer is used this can be substituted with Designer or Consultant.

This document uses the term “pressure main” to be consistent with WSA04-2022, whereas it is often referred to as a (sewage) “rising main” at South East Water with abbreviation SRM.

1.4 Scope

This document applies to Sewage Pump Stations with a pumping capacity of up to 200L/s and Pressure Mains up to and including DN 375 (DN 450 for PE). For larger assets, macerated sewage transfer pump stations, twin pressure mains and other bespoke assets South East Water may define additional project specific requirements, which shall be sought from SEW.

South East Water’s previous WSA04 supplementary pertained to WSA04-2001 revision 1.0, noting that WSA04-2005 revision 2 was never formally adopted by SEW. As WSA04-2022 is a clearer more comprehensive document than WSA04-2001 SEW have chosen to adopt it prior to writing a comprehensive Supplementary, hence this interim Supplementary has been published specifically so that this can now occur. This interim Supplementary is considered an incomplete revision as it adapts the previous revision of the Supplementary to suit the different section numbering in WSA04-2022 but does not fully customise the additional material in WSA04-2022 to SEW’s requirements. The drawings in WSA04-2022 have not been

reviewed, and are to be considered as information rather than as SEW requirements. Before relying on content in WSA04-2002, confirm its suitability with the SEW project representative.

1.5 Approved products

All materials and equipment shall comply with South East Water's Approved Products listing located in the MRWA Products Portal at www.mrwa.com.au

1.6 Order of precedence

The order of precedence shall be:

- 1) Contract / Deed of Agreement
- 2) South East Water Bulletins
- 3) South East Water Sewage Pump Station Supplement (excluding appendices)
- 4) South East Water standards
- 5) South East Water Sewage Pump Station Supplement appendices and standard drawings
- 6) MRWA Bulletins (www.mrwa.com.au)
- 7) MRWA Standards
- 8) WSAA Code (excluding drawings)
- 9) WSAA standard drawings
- 10) Australian Standards (including Building Code of Australia and Australian Industry Association standards)
- 11) International Standards (ISO)
- 12) British Standards (BS)
- 13) European Standards (EN)
- 14) DIN Standards
- 15) American Standards

Unless otherwise stated, the current revision of all standards shall apply.

1.7 Professional Engineers Registration Act

This document is not intended to be used as a "prescriptive standard" as defined by the Professional Engineers Registration Act 2019(Vic)

2. SEWAGE PUMPING STATION STANDARDS

Unless otherwise noted, new and upgraded assets shall comply with the technical standards published on SEW's public website (www.southeastwater.com.au/building-and-development/developers/technical-standards). At the time of publication of this document, the potentially relevant standards include:

- MRWA WSAW Sewerage Code
- MRWA Sewerage Standards
- AM2488 Drafting Specification
- AM2522 O&M Manuals Specification
- AM2714 Electrical Standard
- AM2717 Generator Specification
- AM2739 Corrosion Mitigation
- AM2755 Testing, Commissioning and Handover Template
- AM2757 Covers for Underground Structures
- AM2759 Facility Resilience and Security Technical Standard
- AM2760 Stainless Steel Specification
- AM2761 Facility Vehicle Access Standard
- AM2775 Maximo Template
- AM2776.3 Air Treatment Unit Specification
- AM2776.4 Sewerage Chemical Dosing Unit Standard
- AM2780 Sewage Pump Station PLC, RTU & SCADA Specification
- AM2832 Instrumentation and Control Standard
- AM2847 Communications Standard
- AM2848 Approved EIC Equipment List
- AM2851 EICC Inspection, Testing, Completion and Decommissioning
- AM2883 Sewage Air Valve Standard
- AM2884 Pit Standard
- AM2922 Fixed Ladder and Stairway Standard
- Protection of South East Water Sewerage Assets
- Sewage Pumping Station Electrical Standard Drawings:
 - Generator Electrical Standard Drawings
 - Sewage Pump Station General Electrical Standard Drawings
 - Sewage Pump Station Soft Starter Standard Drawings
 - Sewage Pump Station V.S.D Standard Drawings
- Sewage Pumping Station Civil & Mechanical Standard Drawings:
 - SEWL_STD_000 Inlet Valve Mounting Flange
 - SEWL_STD_001 Pump Guide Rail Intermediate Support Details
 - SEWL_STD_002 Lateral Support Brackets
 - SEWL_STD_003 Valve Spindle Extension

- SEWL_STD_004 Spindle Guide Assembly
- SEWL_STD_006 Gas Tight Winding Box
- SEWL_STD_008 Pump Pedestal and Chain Bracket Details
- SEWL_STD_090 Plan View
- SEWL-STD-091 Elevations
- SEWL-STD-100 Site Plan
- Appendix A: Pump Specification
- Appendix B - Design Checklist
- Appendix C - Submission of Pre-Commissioning Documentation
- Appendix D: Procedure for Performance Testing Of Pumps
- Appendix E - EPA Protocol
- Appendix F - Telemetry Data Sheet
- Appendix G - Schedule Of Documents To Submit

3. WSAA CODE CLAUSE AMENDMENTS

The following headings and heading numbering are as per the headings and numbering in WSA04-2022.

Preface - scope

This Code does not apply to low pressure pumping pods and reticulation systems but SEW may utilise parts of it for transfer pump station stations and pressure mains associated with such systems.

Part 0 Abbreviations

Additional Abbreviations

MRWA	Melbourne Retail Water Agencies
SEW	South East Water Corporation
SS316	Grade 316 stainless steel

1.5.3 Design responsibilities

The Designer shall be responsible for all aspects of the pumping station, pressure main and odour control design.

Figure 2.1 SPS Overflow Risk Reduction Decision Diagram

In the Operational Section Additional Note:

In the case of a re-lift pumping station the pressure main shall be kept to a minimum length to allow the station to overflow into the receiving sewer system, thereby minimising the risk of a spill.

2.3 Maintainability

SEW only requires double isolation on larger inflow pipes and penstocks.

2.5 Due Diligence Requirements

If not specified by SEW for a particular project, request direction from SEW as to the inclusion of a permanent generator.

2.12 Access

SEW requirements are described in AM2761 Vehicle Access Standard.

2.14 Site Infrastructure - Signage

If the pump station is within a fenced site, South East Water will provide a station identification sign to be installed on the fence near the gate. If the site is unfenced and the pump station is within a building that sign shall be installed on the main door.

A second sign requiring confined space permits shall also be fixed to the fence

- Made from 0.6mm thick steel or 1.4mm thick polypropylene (when not exposed to direct sunlight) 225mm X 300mm, holes in 4 corners for attachment.
- Not contain company names or contact details
- Sample shown below:



3.11.7 Location Markers

Pressure main location is to be identified with relevant posted signs. Signs are to be erected at

- Change of direction.
- At fittings along the pipeline.
- Minimum 500m apart.
- Posts are to be coloured green and comply with standard drawing **SEW_STD_060**.
- South East Water will provide the signage to be installed at the developer's / contractor's cost. The sign to be provided is detailed in Figure 1 below



Fig 1: Sign for attachment to posts

The sign is to be connected to the post using self-tapping stainless steel screws.

3.14.1 Commissioning Plan

South East Water commissioning requirements are detailed in clause 3.14.3 , this document's appendices, AM2755 Testing, Commissioning and Handover Plan and AM2581 EICC Inspection, Testing Completion and Decommissioning.

3.14.3 Commissioning

Prior to commissioning, all documentation outlined in preceding paragraph must be forwarded to South East Water's officer. In addition, the pre-commissioning checklist **Appendix C** shall be completed and lodged 5 working days prior to the planned commissioning date. Notification of the upcoming commissioning must be made to the Automation and Commissioning Team and Asset Integration Team at least 30 days in advance, to ensure that telemetry points are set up, and, the telemetry must be pre-commissioned in consultation with them to ensure that

all alarms are being received at South East Water's Network Operations Control Centre (NOCC). The pump station will not be commissioned / deemed operational until all documentation has been provided together with all the documentation listed in **Appendix G** and AM2755 Testing, Commissioning and Handover Plan

NOTE: South East Water will NOT commission pump stations on temporary power

4.2.1 General

Materials selection and installation shall comply with South East Water standards, namely AM2739 Corrosion Mitigation Specification and AM2760 Stainless Steel Specification.

Galvanised steel is not to be used, unless there is no alternative. Stainless Steel, grade 316 is preferred metal in wet areas.

4.2.3 Concrete Surfaces

All interior concrete surfaces of the wet well, valve chamber, detention tank & inlet MH including the underside of the access covers shall have corrosion controls implemented in accordance with:

- MRWA-S-307, table 307-E, and
- WSA 201 Manual for Selection and Application of Protective Coatings

Substrate surfaces shall be prepared, coatings shall be applied and cured coatings shall be inspected and tested in accordance with manufacturers recommendations. Modifications to coated surfaces shall be repaired in accordance with manufacturers recommendations.

6.2 Site Selection, Location and Layout

Provide all-weather access to each part of the facility and pressure main appurtenances for all routine and emergency, operation and maintenance activities as per AM2761 Vehicle Access Standard.

If the subdivision development does not proceed as expected and/or the pumping station is in an area as yet undeveloped, the developer is responsible for providing an all-weather access track from an established road, hard standing area and water supply taking into consideration current and future stage development

6.3.1 Inlet MH Location

Not to be located in a parking area for service vehicles such as crane truck unless it can be demonstrated that there is no practical alternative.

6.3.2 Inlet MH

South East Water does not require a sump or screens because the intent of the sewage network is to get all of the sewage debris to the sewage treatment plants. Isolation of the wet well within the inlet manhole is NOT required unless isolation in a wet well that already exists cannot be achieved or it is a large station that SEW's risk assessment determines requires double isolation for the sewage inflow.

Inlet MH access cover to MRWA-S-313B.

The inlet MH is not required to be vented.

The inlet MH is not required to house monitoring equipment unless SEW's risk assessment determines otherwise. This may include a requirement to hold a mobile standby pump during maintenance events involving full wet well isolation, e.g. for large stations. It may also include a BlockAid level sensor and transmitter.

6.3.3 Pumping Station Wet-Well Isolating Valve

The incoming sewer-isolating valve shall be a knife gate valve housed on the inside of the pump well. This valve shall have a non-rising spindle, a properly supported extension spindle and a valve key piece that allows the valve to be operated by an operator with a valve key from the top of the pumping station. The knife gate valve shall have a grade 316 stainless steel (SS316) body with SS316 blade and a resilient seat. If a custom valve key is required, it shall be supplied and safely housed at the pump station.

The valve shall be mounted to a flange end on the inlet sewer pipe in the well. If an existing station is being refurbished, and the inlet sewer pipe in the well has corroded, then the pipe shall be cut back to the well wall and a mounting flange fabrication used instead. The mounting flange shall be ductile iron or fabricated from SS316L and attached to the pump well with SS316 studs using chemical anchors. A mounting flange fabrication is NOT required for new pump stations. Standard Drawing **SEW_STD_000** shows examples of the valve mounting flanges.

A 25mm diameter valve spindle shall be used for DN150 to DN300 valves. A 38mm diameter valve spindle shall be used for DN375 valves. If the spindle length is greater than 6 metres, an intermediate spindle shall also be used.

The extension spindle shall be adequately supported from the pump well wall. Standard Drawings **SEW_STD_003** and **SEW_STD_004** show the arrangement for the extension spindle guide assembly and details for manufacture. Chemset anchors of SS316 shall be used to secure the spindle guide assembly to the pump well wall.

The valve spindle shall be accessible without the need to remove any covers and shall be housed at ground level within a gas tight valve-winding box as shown on Standard Drawing **SEW_STD_006**.

All valves to be clockwise closing.

6.4.1 Wet-Well Design (sump)

South East Water does not require sumps in the wet well unless it is a large pump station where such a sump will not be a trip hazard for maintainers moving about the well bottom. A sump is different to benching.

6.4.1 Wet-Well Design (drop pipe)

The top of the drop pipe shall have a 100mm diameter screw top cap so that top of the drop pipe can be manually accessed with a rod should debris get caught there. The bottom of the drop pipe shall be kinked so that the sewage doesn't fall directly on the well floor. The drop pipe discharge shall be angled away from the pumps so that the inflow doesn't adversely affect the hydraulics into the pump suction.

SEW does not require a high-level inlet line.

6.4.1 Wet-Well Design (dividing wall)

For small pumping stations (<80L/s), the Designer shall provide a single wet-well to retain the sewage inflow and house the pumping system. The inlet MH shall be connected to the wet-well by a single pipeline. The isolating valve shall be located within the wet-well.

For medium to large stations (80-200L/s) the Designer shall determine how the station can be taken off-line, i.e. how sewage will be diverted around the station, if maintenance access is required to work on, say, a pump pedestal seal. On lift stations this can sometimes be done by installing a high level by-pass line from the inlet manhole to the discharge manhole. On stations with larger pressure mains this may require a wet well with a dividing wall to a height above the high level alarm level and a bifurcated inlet manhole. With such an arrangement one half of the station can be isolated to take it off line whilst the sewage is handled normally in the other half of the well.

Alternatively a wet well - dry well arrangement may be required when the pump station includes tall / heavy pumps with a flow rate greater than 80L/s or motor size greater than 75kW.

6.4.2 Wet-Well Sizing

South East Water prefer wet-wells that are less than eight (8) metres deep to minimise the operations and maintenance issues that are experienced with deeper wells. South East Water will only consider a very deep well if it can be demonstrated that there aren't any options available for a well of the preferred depth. If SEW accepts a well greater than 8m, it is likely the site will need to cater for larger trucks.

6.4.5 Detention Time

When the calculated detention time is excessive the Designer shall carry out and provide documentation on a predictive analysis of hydrogen sulphide generation at both the pump station and point of discharge. This will require analysis of sewage entering from the reticulation system. The Designer will need to liaise closely with South East Water on proposed ventilation and odour control.

6.4.6 Benching

The maximum allowable grade of the benching is 30° to horizontal to facilitate future maintenance of the benching.

6.4.7 Washers

SEW requires wet well washers.

The Designer shall consider the following when designing wet-well washers:

- Wet-well washers clean by water volume; they're not intended to be high pressure cleaners. The best results are achieved with a slow rotation speed - one nozzle directed at the wall and the other at the pumps / guide rails / floats etc.;
- Wet-well washers don't need to operate every pump down. The wet-well washer is to be controlled by the PLC to run at appropriate intervals. Trials have shown that a fatty well can be kept clean with a program of a 1 minute wash every 6 hours using around 100 litres of water per day.
- The wet-well washer unit should be installed just above the cut-in level (say 1 metre) so that the spray can be directed at the cut-in level and below, where most of the fats build up. (Note that the washers don't mind being submerged once in a while if the level gets above the cut-in level.)

Install a backflow prevention device to the water supply for the wet-well washer.

6.5.1 Wet-Well Ventilation

Odour modelling is required for pump stations that receive industrial sewage and those that handle aged sewage (e.g. from upstream pump stations) to ensure that these odours don't cause an issue with nearby neighbours. The dispersal of gaseous emissions shall be modelled using AERMOD, which is the EPA approved air pollution model estimate emissions of wastes to air, e.g. gaseous plumes from vent stacks. EPA Victoria requires that AERMOD is used in accordance with the requirements set out in the State Environment Protection Policy (Air Quality Management) S240 Schedule C. EPA has guidelines on the recommended use of AERMOD:

- Construction of input meteorological data files for EPA Victoria's regulatory air pollution model (AERMOD) (publication 1550)
- Guidance notes for using the regulatory air pollution model AERMOD in Victoria (publication 1551)

Additional information about AERMOD can be found on the USEPA website.

EPA has previously used the AUSPLUME V6 model; however, this model is no longer supported for regulatory purposes.

SEW is progressively developing the AM2776 suite of standards for Corrosion and Odour Control.

6.5.3 Forced Ventilation

All pumping stations with forced ventilation shall have AERMOD modelling carried out.

All pump stations shall be designed such that forced ventilation can be installed later should it be required. A lay down area next to the vent and a 100 diameter electrical conduit from the main electrical board shall be provided to this location.

6.6.2.1 Emergency Storage

The emergency storage provides time for South East Water to implement its operational contingency plan in an emergency situation, e.g. a power outage. The emergency storage shall be capable of retaining the peak dry weather sewage inflow, from the ultimate development to

be serviced, for a nominal minimum of two (2) hours. South East Water may however require more than 2 hours storage to meet the requirements of the Environment Protection Act 2017 relating to general environmental duty or for stations that are located in areas that are remote or have accessibility issues e.g. traffic congestion. South East Water needs to be consulted during the station's planning stage to make this determination in relation to an increased storage requirement.

When an emergency storage tank is available, South East Water will also use this tank for maintenance activities, i.e. the sewer network will back up into the emergency storage when the wet well is off-line. For this reason the inlet pipe for the emergency storage shall take the inflows from the inlet manhole (rather than the wet well).

Should an additional storage tank be required, the following will need to be considered and discussed with South East Water:

- The manner in which the emergency storage will start to fill when the pump station's high alarm level is reached and the manner it will fully empty when the station returns to normal operation (including sloped floor to discharge)
- The installation of washer(s) for the reasons described in clause 6.4.7 but installed to wash at a higher level
- The installation of a water tap for South East Water's cleaning crew to connect their equipment to. If the emergency storage is directly adjacent to the wet well this tap may be the one in the cubicle used to wash down the wet well. If the emergency storage is some distance away a separate tap shall be installed; this tap shall have a secure closure so that the public can't readily access it and leave it flowing.
- Accessibility for confined space entry for cleaning and maintenance activities e.g. number of covers required (minimum of two covers), facilities to meet fall-from-heights regulations , positive isolation valves on the storage tank's inlet and discharge pipes
- Ventilation requirements during confined space entry and for normal operation
- Corrosion protection requirements
- Continuous level measurement including its safe maintenance procedure, e.g. restricted access point so instrument can be removed for periodic calibration without a fall from heights risk
- Configuration of storage tank and pipework as a single pipe into the wet well is preferred.

6.6.2.2 Emergency Storage Configurations

Emergency storage calculations are not to include gravity sewers smaller than DN300.

6.6.2.4 Access and Cover Arrangements for Emergency Storage Structure

A washing system is required.

A fixed ladder is required. SEW differs from WSA04 in this regard. When the storage has two or more access points this ladder shall be installed at the one with the higher floor level so that the storage can be manually washed down starting at the higher level.

Access covers shall be multipart 600mm x 900mm

6.6.4 Emergency Relief System

Appendix E contains SEW's former memorandum of understanding (MOU) with the EPA. The document is included because it includes the best available guidance on the selection of emergency relief system.

The Consultant shall supply all associated documentation to South East Water

A flap gate valve shall be installed to ensure that a positive and effective gas seal is achieved.

Where an emergency overflow relief pipe is installed into an unformed drain, creek or water course then the Designer will be required to indicate the impact of Annual Exceedance Probability 0.095, 0.049 and 0.010 storm events on emergency overflow relief pipe operation.

ERS design shall conform to MRWA Sewerage standards at <http://www.mrwa.com.au/Pages/Standards.aspx>.

6.7 Ladders And Platforms

SEW requires ladders in wet wells, valve chambers and storage tanks as described in AM2922 Fixed ladder and stairway Standard, which complements AS1657. Platforms are only required when required by AM2922. These need to complement confined space and restricted entry procedures as they assist people working in such spaces.

6.8 Wet-Well Access Covers

Wet well and all other covers shall comply with AM2757 Covers for Underground Structures.

6.10 Grit Collection

Grit collection is not ordinarily required but may be needed for catchments with an unusually high grit load.

6.11 Screens

Screens are not required as the preference is to transfer sewage debris to the treatment plant rather than capture it in the upstream network. .

6.12 Mixers

An electric mixer may need to be installed in the pump well when the sewage is expected to be heavily laden with debris or the well diameter is large in comparison with the pumping capacity, e.g. in partially developed catchments with small interim pumps.

Placement and orientation of mixers is critical to ensure efficient mixing of the well contents. A mixer shall be installed on its own guide rail, rather than sharing a pump guide rail, so that pumps can be lifted for maintenance without disturbing the mixer.

Mixers shall be sized to ensure that they draw only 85% of full load current under the most adverse well conditions. This gives some provision for the mixer to shed a lag if required, instead of the lag causing the motor to trip out on over-current.

The mixer shall be controlled by the PLC to resuspend heavy solids and reintegrate floating materials so that the pumps can more effectively move sewage debris out of the wet well. Hence the mixer shall commence just prior to pump start and to run a minimum of 2 minutes during pump operation. This will be dependent on station activity and the quality of the sewage inflow. South East Water may later alter the frequency and duration of operation as a consequence of local field experience at the station.

7.3 Pump Equipment

Proprietary pump discharge pedestal mounts often require the use of an eccentric (not concentric) reducer to allow sufficient distance between the pump guide rails and the vertical riser pipes for a pump's mounting claw to pass.

7.4 Pump Selection

Comply with Appendix A - South East Water specification 02-155-0 -Submersible Pumps- Submersible pumps shall have anodes installed to manufacturers specification.

Refer to standard drawing **SEW_STD_090 & 091**.

7.6.1 Pumping System

Where WSA 101 is specified in WSA04, replace with Appendix A South East Water specification 02-155-0 "Submersible Pumps"

7.6.2 Impeller Selection

Hard iron impellers are preferred when that option is available instead of cast iron impellers . Refer to approved products list.

Whenever the option exists the largest impeller for the pump curve set associated with a particular size motor and drive shall not be used when selecting a new pump. This means the largest impeller is then available in future if the actual pump duty point differs from the theoretical calculation, which sometimes occurs if the catchment's sewage mixture is unusual.

7.6.3 Motor Selection

Four pole motors are preferred to two pole motors for better operational reliability whenever the option exists. The motor shall have sufficient capacity in reserve.

7.6.5 Motor Cables

Motor cables to be three wires not six.

7.6.6 Pump Lifting Equipment

Guide rails are to be supported as shown on standard drawing SEW_STD_001 and provided in one continuous length. Use SS316 materials whenever possible.

The lifting equipment offered for pump removal must suit SEW's maintainer's lifting method, which ordinarily uses a crane truck as per AM2761_Vehicle Access Standard, noting the preference for smaller cranes trucks whenever possible as there are more of those in the truck fleet. The lifting capacity of a crane truck depends on the how far the crane needs to reach, i.e. how close the truck can park its crane to the pump when the truck's out-riggers are extended, noting that small cranes are generally on the rear, passenger side of the truck. Monorail hoists or jib crane hoist are used inside buildings and some sites may require other arrangements if agreed by SEW.

The pump lifting chain shall be as per AM2760_Stainless Steel Specification, manufactured to AS 2321-Short-link chain for lifting purposes. The chain shall be sized to carry the weight of the pump, taking into account load carrying reductions for angled two leg slings. The minimum chain size shall be 10mm for small pumps, but larger pumps will require a minimum of 12mm or 16mm depending on whether a lower bridle is used to attach to two eyebolts. The dee shackles shall be comply with AS 2741 —Shackles . Eyebolts provided by manufacturers, as part of the lifting equipment shall be manufactured to comply with AS 2317 —Collared eyebolts. The lifting chain shall be supported and retained as shown on standard drawing SEW_STD_008 by a small diameter stainless steel cable static line between the top of the chain and the top of the well adjacent to ground level, to retrieve the chain if dropped.

Alternatively, shackles may be proof loaded, tested and stamped stainless steel in sizes 10mm, 12mm, and 16mm or South East Water approved equivalent.

7.8.1 Pump Starters And Variable Speed Drives

Pump Starters and VSD's – Pump starter shall be electronic soft starter incorporating line and bypass contactors. It shall also include an isolation switch (for insulation resistance testing) on the dead side of the soft starter, used to isolate to megger pumps.

A label is to be fitted to warn “**do not megger pump sets before disconnecting them via the isolating switch**”.

South East Waster endeavours to minimise its energy usage. For this reason VSD's shall be considered on pumps above 15kW when the friction energy loss associated with the design flow rate is significant as indicated by the life cycle cost. The preferred practise is to program the system to batch pump at a low speed for most of the time and then to operate at the pressure main scouring velocity periodically, and as required by the incoming flow rate. The timing and

duration of the higher speed operation will be determined by the Designer in the original instance (generally an hour a day) and may be customised by South East Water in the longer term. South East Water doesn't use VSD's on smaller pumps because the potential pump energy savings are offset by the energy consumed by the VSD itself and the system's reliability is affected by the extra complexity.

Motors greater than 90KW controlled by a VSD shall be fitted with insulated bearings NDE (Non Drive End) & earthing ring installed on DE (Drive End). The stator windings shall have a minimum insulation voltage rating of 1,200V, nominal operating voltage of up to 430V and withstand maximum voltage gradient (dV/dt) not less than 5,200 V/ μ s.

Operation of equipment fitted with a VSD shall be limited to panel mounted control switches with manual speed control via a 10 turn potentiometer.

Motors fitted directly with an integrated VSD shall not be accepted.

Drives installed in corrosive atmospheres shall be supplied with conformal coated circuit boards (includes electronic soft starters.).

Ventilation arrangements to reduce operating temperatures to below the manufacturer nominated operating temperature shall be assessed according to the load, number of VSDs or other heat loads operating in parallel and the size of switchboard, switch room or building. For example, a 110 kW free standing VSD within a pump building may not require any additional ventilation compared with the same arrangement located within a switch room or switchboard.

To limit operational temperatures within the limits of the drive, measures may include:

- Venting VSD back channel heat directly external to the switchboard, switch room or building by means of vents, ducts or covers.
- Fan forced inlet or extraction within switchboards, switch rooms or buildings.
- Air conditioning within switchboards or switch rooms.
- Combinations of the above.

8.2.6 On-Site Generator

Any emergency on-site generator shall comply with AM2717 Standby Diesel Generator.

8.3.1 Power And Control Cubicle

All designs must use SEW's standard electrical drawings where applicable.

The electrical cubicle shall be installed on a concrete plinth that is an integral part of the wet-well top slab.

9.1 Control and Telemetry System - General

SEW's requirements are in the AM2832 Instrumentation and Control Standards and AM2847 Communications Standards.

9.6.2 Telemetry Hardware - Software

SEW's requirements are in the AM2780 Sewage Pump Station PLC, RTU & SCADA Standard Specification.

9.7 Operating Levels And Settings

South East Water does NOT use a low-level alarm (because it would use the same level measuring instrument as the normal pump cut-out in any case).

The cut-out level is the minimum submergence level of the pump PLUS 100mm to provide some margin for calibration drift of the level measuring instrument.

South East Water's Spill Alarm is set at 50mm below the ERS overflow level.

South East Water does NOT use the WSA04 Overflow Alarm because there's a risk that the calibration of the level measuring instrument may drift higher than this significant physical invert level.

9.8.2 Flow Measurement

A full bore magnetic flow meter is required at the start of the pressure main at each pump station.

Some suppliers say their flow meter sensor requires no maintenance so can be wrapped and buried, however SEW's experience is that in a raw sewage situation sensors will periodically need to be replaced, and doing this without spilling sewage is onerous / expensive. Hence SEW requires sensors to be installed in pits or above ground as per AM2832 Instrumentation and Control.

The performance of a sensor installed at a local high point is compromised by entrained air until it can be expelled so this configuration is not preferred. A by-pass line is required when specified in AM2832.

10.1 Pump Discharge Pipe Work

All penetrations of pipe work through concrete walls of the wet-well and valve chamber shall incorporate an approved puddle flange (thrust ring) or other such thrust device to provide adequate thrust restraint for all pressure surges and vibrations created by the pump. Grouting of penetrations through block outs shall be carried out using high quality non-shrink grout with at least the same strength as the parent concrete.

The pressure main shall be fitted with a scour line to enable the main to be drained back to the pump-well or into an adjoining sewer reticulation system. The valve to operate this scour shall be accessible from the surface via a gas tight winding box adjacent to the access cover within the valve chamber.

All buried pipe work in vicinity of the valve chamber and the wet-well shall have approved embedment to a depth of at least 200mm above the pipe.

Downstream of the pump stool, provide a nominal 1m straight pipe spool with flange connection to vertical pump discharge pipe to aid maintenance work. Designer to consider pump stool size and pump cut in level when determining suitable length.

10.1.2 Pump Discharge Pipework

Vertical pipework in the well shall be sized so the velocity of around 2m/s will transport grit, e.g. sand.

10.1.3 Pump Discharge Pipework Type

Use PE with stainless steel flanges and bolts or 316L stainless steel pipework when external exposed to sewage.

10.2.1 Isolating Valves

South East Water require valves to be:

- Resilient seated valves.
- Clockwise closing.
- Minimum pressure class shall be PN16

An isolation valve shall be located downstream of each non-return valve in the valve chamber. The isolation valve shall have a non-rising stem, cast iron body, bronze wedge and fusion bonded protective coating. Operation of the isolation valves for each pump from the surface is not required, but is to be handwheel operated, clockwise closing. However surface operation (via a winding box) of the pressure main scour valve is required without removing any valve chamber access covers. All valve-winding boxes are to be gas tight to prevent odours escaping from the installation. Refer standard drawing **SEW_STD_006** for details.

10.3 Valve Chamber

SEW's general requirements are in AM2884 Pit Standard.

Valve chamber floor shall be sloped to a drain pipe with a duck-bill check valve back to the wet well. Drain pipe shall ideally be straight so that it can be manually cleared of debris with a rod if required. South East Water doesn't use a P-trap in this instance because the water seal is lost once the water has evaporated, which allows sewage gases to escape.

The valve chamber shall ideally be integral with the wet-well. If an integral structure is not possible the valve chamber shall be adjacent to the wet-well and shall have an ability to shift relative to the wet well with ground movement.

10.3.1 Valve Chamber

Refer to Standard Drawing **SEW_STD_090 & 091**.

10.3.2 Valve Chamber Design

The wet-well roof slab shall incorporate the covers of the valve chamber unless otherwise approved. The valve chamber covers shall be large enough to enable crane access to remove valves for maintenance purposes. For valves greater than DN150, removal must be able to be carried out as a direct lift operation.

The valve chamber drain requirements are in Section 10.3.

Facilities for an emergency bypass pumping shall be provided on the scour line.

10.3.3 Valve Chamber - Dismantling Joints

South East Water requires approved dismantling joints to be provided on each pipeline in the valve chamber. Flanged elbows can serve as dismantling joints provided that there is sufficient clearance to remove the bolt sets with a spanner. Where Uniflanges are used, they shall utilise only stainless steel grade AISI 4100 set screws. The setscrew torque shall be tightened to the recommended level as shown below;

- | | | |
|--------------------------|-----------|-------|
| <input type="checkbox"/> | DN50-100 | 95Nm |
| <input type="checkbox"/> | DN150-375 | 125Nm |
| <input type="checkbox"/> | DN400—600 | 160Nm |

10.3.4 Pipework support

Vertical Pipework shall be supported at maximum 3m interval using supports as shown on standard drawing **SEW_STD_002**. It shall be possible to remove vertical pipe work for maintenance activities. For straight line or offset pipe assemblies between two parallel wall penetrations this may require a dismantling joint. All flange pairs shall be sufficient distance from the walls and floor to allow a person access with a spanner, generally 150mm clearance.

10.3.5 Valve Chamber Pressure Main Tappings

Tappings shall be fitted with down turned stainless steel tails to prevent accidental discharge into the face of maintenance personnel.

11.2.1 Location of Pressure Mains

South East Water requires the Designer to consult with them if other than options (a) or (b) are proposed. Any other location is to be agreed with South East Water prior to completing the final design.

11.3.6 Velocity In Pressure Main

The maximum velocity before discharge to the receiving sewer shall be 2m/sec

11.3.7 Sizing of Pressure Mains

Pressure main shall be minimum of 100mm diameter for maintenance reasons, e.g. reduce chance of blockage due to large sewage debris solids, balled rags, etc.

No reduction in pipe diameter is acceptable on the pressure main , except for inclined pipe sections that require a reduction to achieve minimum velocity noting that the minimum pipe diameter still applies in these cases.

11.9.1 Pressure Main Valves

The Designer shall submit plans of proposed valve location for approval from South East Water prior to completing design plans.

In determining the location of the air release valves the following factors are to be considered:

- Proximity to properties.
- Venting requirements and subsequent odour issues.
- Aesthetics of vent.

11.9.2 Isolating Valves

Locate isolation valves in long, large diameter pressure mains so that entire rising main doesn't need to be drained for maintenance activities.

11.9.3 Air Release Valves

SEW's requirements are in the AM2883 Sewage Air Valve Standard.

11.9.5 Scours

Any scour valve on the pressure main or at the pumping station is to be designed in accordance with AM2922 Sewer Scour Standard.

11.10 Septicity Control

If all possible design parameters have been addressed to minimise the septicity of the sewage in the pump station and pressure main, and a problem of septicity remains, it may be necessary to chemically dose the pressure main, pump well, and / or the reticulation lines leading to the pumping station.

Where it is considered necessary to dose to control odour / septicity then an odour assessment is required from the Designer detailing chemical dosing options, impacts, advantages / disadvantages, operating / capital costs of all dosing options.

South East Water has successfully used:

- Oxygen injection to maintain the sewage in an aerobic state.

- Ferox to lock the sulphides into solution and prevent release of hydrogen sulphide.
- Calcium Nitrate to lock sulphides into solution and prevent release of hydrogen sulphide.
- Magnesium hydroxide to raise pH and reduce evaporation of sulphides

Any chemical dosing system is to be designed in accordance with AM2776.4 Sewerage Chemical Dosing Unit (CDU) Standard.

11.11.2 Discharge MHs

The receiving structure including the cover shall have a protection system to minimise corrosion and shall be vented to minimise loss of water seals. Refer to Sewerage standard MRWA-S-307, MRWA-S-401, WSA201 for guidance on H₂S risk and required corrosion controls.

12.1.2 Geotechnical Assessment

The Designer shall commission a soil investigation to identify ground conditions and associated installation and structural risks and controls

12.2.2.1 Concrete Structures.

Structure shall be designed with a minimum concrete strength of 30MPa.

12.2.7 Top Slab

Concrete slab to all be one level and incorporate well covers, storage area for removed covers, electrical cabinet and valve pit.

The cover opening in the top of the well shall be large enough to allow for future pump upgrades associated with later stages of catchment development. The slab shall not present a trip hazard to personnel working on the installation or to the general public. Landscaping is required to blend the finished surface of the slab into the surrounding terrain.

The slab is not to be located in an area that would be subject to local flooding. All water from surrounding area is to drain away from top slab.

Design loadings shall be stated on drawings.

13.1.2 Water

The Designer shall determine water demand and pressure requirements of equipment proposed and foreseeable future upgrades. The Designer shall establish that the proposed property service is sufficient. A metered water property service of minimum DN32 and a static pressure of at least 20m head shall be provided to ensure the wet-well can be cleaned manually. The Designer shall detail the installation of backflow prevention devices in

accordance with AS/NZS 3500.1 —Plumbing and drainage – Water services. The device and the fire hose reel are to be housed within a separate section of the control cubicle. As fire systems have a mandatory maintenance requirement, but this washdown system will not be used for fire fighting, the equipment shall be painted green rather than red and there shall be no fire service labels.

It shall have at least 18m of 19mm diameter PVC fire fighting hose complete with a brass jet type grip operation nozzle.

The cubicle size is to be large enough to allow maintenance of the back flow prevention device. Rubber hose not to be used.

The contractor shall purchase and install a water meter and a remote reading device for each South East Water pumping station.

13.1.3 Telephone / Telemetry Lines

Delete clause.

13.3 Security

Facility security shall be provided in accordance with AM2759- Facility Resilience and Security Technical Standards.

13.4 Fire Control

SEW will assess whether infrastructure is in a fire-prone location and therefore whether a fire control plan is required.

15.1 Documentation - Operation And Maintenance Requirements.

Replace Appendix E of WSA101 with Appendix A South East Water specification 02-155-0 “Submersible Pumps”.

15.1 Documentation - Contingency Plans

The contingency plan shall incorporate the following;

1. Functional requirements for ERS (Provided at functional design stage).
2. A plan of the drainage system that the ERS is discharging into. The plan is to show the location of drainage pits, size of drains and flow paths until the drainage system discharges into an open creek, river or waterway. The plan shall detail locations where access may be gained to carry containment activities, such as sandbagging and shall nominate other containment options.

15.1 Documentation - Design records

(b) SEW's requirements are in AM2755 Testing, Commissioning, Completion and Handover Standard.

Submission of the final design shall also include the completed design checklist. Refer to **Appendix B**.

15.4.3 Recording Of As-Constructed Information

All design drawings shall comply with AM2488 Drafting Specification

All As Constructed Information shall comply with AM2488, AM2775- Maximo Template and the MRWA Survey Manual.

18.3 Electrical Equipment

SEW's requirements are in the AM2848 Approved EIC Equipment List.

18.6 Fasteners

Use nylon insert lock nuts where possible, particularly in locations subject to vibration from pumps.

Use chemical type anchors (such as chemset) in concrete, not mechanical type (such as dynabolt).

APPENDIX A: PUMP SPECIFICATION

SPECIFICATION: 02-155.0

Submersible Centrifugal Sewage Pump

PREFACE

This specification was prepared by South East Water and is based directly on the Water Services Association of Australia (WSAA) Sewage Pumping Code Working Group 'Draft' Standard for Submersible Sewage Pumps.

The objective of the specification is to provide design, manufacturing and performance requirements for manufacturers of submersible electric pumps and ancillary equipment.

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SCOPE OF DOCUMENT

This specification covers the design, manufacture, inspection, works testing, supply, delivery and pre-commissioning of submersible type pumps as may be specified in the Technical Data Sheet.

(Submersible type pumps are those that are designed to be immersed in the liquid when operating, but may operate non-submerged.)

SCOPE OF SUPPLY

The Contractor shall include within the scope of supply: -

- the pump unit, including all integral equipment required for the operation of the pump in the intended service including drive motor and instruments,
- for a pump specified for wet well service, a discharge support bend complete with coupling device and guide rail brackets
- for a pump specified for dry well service, a suction bend and mounting stool
- labour materials and instruments required for the setting to work and commissioning of the pump (as required in the Technical Data Sheets),
- spare parts and tools and
- operation and maintenance manuals.

The pump unit shall be supplied completely assembled, with the other ancillary equipment supplied separately. Installation of the pump and ancillary equipment may be required (refer to the Technical Data Sheet).

The workmanship, equipment, accessories and materials provided in accordance with this specification shall comply in design, construction, installation and performance with the latest relevant Australian Standards or in their absence the latest relevant British Standards or international ISO Standards.

The Contractor shall ensure all equipment and materials supplied are in accordance with requirements of all relevant authorities and that all required approvals are obtained.

REFERENCED CODES AND STANDARDS

The following Australian Standards are referenced within this document:

Number	Title
AS1111	ISO Metric Hexagon Commercial Bolts & Screws.
AS1112	ISO Metric Hexagon Nuts, including thin nuts & castle nuts.
AS1217	Acoustics – Determination of sound power levels of noise sources.
AS1359.102	Rotating Electric Machines – Methods For Determining Losses & Efficiency.
AS1359.109	Rotating Electric Machines – Noise Limits.
AS1359.114	Rotating Electric Machines – Vibration Measurements & Limits.
AS1444	Wrought Alloy Steels – Standard & Hardenability (H) Series.
AS1449	Wrought Alloy Steels – Stainless & Heat Resisting Steel Plate, Sheet & Strip.
AS1646	Elastomeric Seals For Waterworks Purposes.

AS1830	Iron Castings – Grey Cast Iron.
AS1833	Iron Castings – Austenitic Cast Iron.
AS1939	Degrees Of Protection Provided By Enclosures For Electrical Equipment.
AS2074	Steel Castings
AS2317	Collared Eyebolts
AS2417	Roto dynamic Pumps - Hydraulic performance acceptance tests - Grades 1 and 2
AS2768	Electrical Insulation Materials – Evaluation & Classification Based On Thermal Endurance
AS2842	Fluid Power – O’ Rings & Housings – Inch Series, Metric Conversion.
AS3000	SAA Wiring Rules.
AS3679.1	Structural Steel – Hot-Rolled Bars & Sections.
AS3709	Vibration & Shock – Balance Quality Of Rotating Rigid Bodies.
AS4087	Metallic Flanges For Waterworks Purposes.
AS4158	Thermal-Bonded Polymeric Coatings On Valve & Fittings For Water Industry Purposes.
AS4680	Hot-Dip Galvanized (Zinc) Coating On Fabricated Ferrous Articles.
AS5000.1	Electric Cables - Polymeric insulated - For working voltages up to and including 0.6/1 kV Electric Cables – Approval & Test Specification

TECHNICAL REQUIREMENTS

System Characteristics

The system characteristics are as stated in the Technical Data Sheet. The required Guarantee Point is given for the purpose of performance testing under AS 2417-2001 Roto dynamic Pumps - Hydraulic performance acceptance tests – Grade 1 and 2, and is subject to the tolerances stated therein for the Class of test (1 or 2) stated in the Technical Data Sheet.

Secondary duty points, if stated, are given for the purpose of defining the required shape of the pump head-quantity characteristic curve. Allowable deviation from these secondary points, for guarantee, shall be to the following extent:

Grade 1	Grade 2
Flow Rate +/- 3% +/-6%	Pump Speed +/-1% +/-2%

Pump Selection

The pump selected shall have a specific speed range $N_q = 20$ to 80 with a stable head-quantity characteristic curve (i.e. negative gradient from zero flow to end-of-curve).

The pump shall be selected to: -

- meet all of the duty points within the range of 55% to 110% of the pump’s optimum flow rate (i.e. Best Efficiency Point), with the Guarantee Point as close to the optimum flow rate as possible,
- attain a maximum achievable flow, for continuous operation, not less than 20% greater than the highest flow duty point.

The Contractor shall adjust the duty point flow rates, specified in the Technical Data Sheet, as follows to accommodate reduction in performance with time: -

Pumps with fully shrouded impellers	0%
Pumps with semi-open impellers	5%
Pumps with screw-type impellers	10%

The pump supplied shall be fitted with an impeller diameter no greater than 95% of the maximum size impeller for that casing.

Operating Speed

The pump's operating speed shall not be greater than that specified in the Technical Data Sheet. If the pump is required to operate at various speeds, driven by a variable speed drive unit, the pump shall be selected such that the maximum supply frequency to the motor is less than 50 Hz and the minimum frequency preferably less than 80% of the maximum.

Under no circumstances shall the minimum operating frequency be less than 20 Hz.

Efficiency and Power Consumption

Normally the pump shall be selected to maximise operating efficiencies without modification. Polishing or coating of the impeller may be undertaken in special cases where aggressive or abrasive materials are being pumped.

Power consumption of the pump shall not exceed 95% of the motor rated power output:

- at zero flow,
- at any point within the operating range, or
- at any point corresponding to flows 20% beyond the maximum operating range.
- Referring to the installation sketches, the pump shall not draw more than: -
- 85% of full load name plate current at duty point (ultimate duty point in the case of a staged development), or
- 90% of nameplate full load current with the water level at spill level in the well.

The motor output shall be rated for as when operating in air (i.e. allowance is not to be made for additional cooling effect due to immersion in liquid)

If the Technical Data Sheet to this Appendix requires an additional allowance to be made for a future increase in performance output (either by fitting a larger impeller or increase in speed), the rated motor shall be sized for the increased performance requirement

Net Positive Suction Head (NPSH)

The pump shall be selected to have a Net Positive Suction Head Required (NPSHR) not in excess of 10 meters head at any point between zero flow and 120% of the maximum operating range flow.

The NPSHR of the pump shall be based on actual 3% head drop method test results, adjusted by calculation to represent a 1% head drop.

Minimum Submergence

The pump shall be guaranteed to operate continuously at the manufacturers' minimum submergence level stated in the Technical Data Sheet, without:

- formation of vortices, or

- over heating of the motor

Noise

If specified for dry well service or operating at minimum submergence, the Sound Pressure Level (SPL) of the pump unit shall not exceed 85dB(A) measured on a one metre radius and in accordance with AS1359.109.

Vibration

When operating at minimum submergence level and at a submergence of 20m head, the vibration of the pump unit shall not exceed the limits specified in AS1359.114, Grade N.

DESIGN

General Arrangement

The pump unit shall be a composite of the drive motor and the pump wetted end. The latter shall be joined to the former by means of an oil chamber housing containing the shaft sealing devices. The impeller shall be mounted on the one-piece motor shaft.

The whole unit shall be orientated shaft vertical with the motor above the pump.

If specified in the Technical Data Sheet for wet well service, the pump unit shall be supported on a separate discharge bend manufactured with integral mounting feet

If specified in the Technical Data Sheet for dry well service, a mounting stool designed to accommodate a separate suction bend shall support the pump unit

PUMP

Solids Handling Capacity

Unless otherwise stated in the Technical Data Sheet, the pump will be required to pump unscreened sewage. Unscreened sewage shall be deemed to include: -

- frangible solids
- hard solids (e.g. grit, sand and stones)
- fibrous solids (e.g. rags, rope, and sanitary napkins)
- mineral and other oils.

The pump (impeller and casing ports) shall be non-clogging and non-ragging, designed to pass a sphere of the following minimum diameters:

Discharge Port Diameter	Minimum Sphere Passing Capability
Up to 100 mm	75 mm
150 – 300 mm	100 mm
350 mm and over	150 mm

Alternative sphere clearances to those stipulated above will be considered, provided evidence of reliable operation over time, in a similar environment, can be produced by the supplier, and endorsed by the end user.

Grinder type pumps are considered to not comply with the requirements of this Specification and are therefore a special case. Grinder type pumps will only be considered after consultation with South East Water representatives.

Impeller

The impeller type shall be designed to pump raw un-macerated sewage and be of a proven design to provide non-ragging and non-clogging performance throughout its life.

In particular the impeller shall: -

- be of an approved grade of cast iron (AS1830, Grade T220 or superior), and shall be accurately finished to reduce friction, leakage loss, and recirculation, to a minimum. Alternative materials having the same or better wear characteristics will be considered as an alternative.
- be dynamically balanced prior to assembly in accordance with AS3709, grade G6.3.
- have streamlined vanes designed to smoothly pass all solids noted in 4.2.2.1 above.
- have adjustable components or replaceable seal rings (refer Section 0) to enable the efficiency and capacity of the pump to be re-established at minimal cost and maximum intervals.

Casing

The pump casing shall comprise of a volute separate to the motor casing. The volute shall be manufactured to be easily removed for impeller inspection and cleaning.

The pump casing components shall be of an approved grade of flake-graphite grey cast iron (AS1830, Grade T250 or superior) or wear resisting high-chrome iron. Spheroidal graphite irons and carbon steels are not acceptable.

The volute wall thickness shall be sufficient to accommodate pressures up to 1.5 times the design head, after loss of 25% of the wall thickness due to erosion, etc.

If specified in the Technical Data Sheet for wet well service, a pump shall have a volute shaped so that the discharge nozzle aligns with the centreline of the pump, such that the pump induces a single plane moment only on the discharge support bend.

If specified in the Technical Data Sheet for dry well service, a pump shall have the volute incorporate in-built hand-holes to enable the operator access for impeller inspection (discharge ports DN250 and larger).

Wear Rings / Plates

Renewable sealing rings and wears shall be fitted to pumps with shrouded impellers. Wear ring (s) shall: -

- be of dissimilar corrosion and erosion resistant materials and
- have a minimum hardness 50 Brinnell higher than the impeller sealing ring(s), to prevent galling during operation.

Pump / Motor Shaft

The shaft shall be machined from solid one-piece bar stock of stainless steel in accordance with AS1444, Grade 316 (or South East Water approved equivalent) and have a ground finish over its entire length.

Other shaft materials with a proven history of reliable performance will be considered as an alternative to the grade of shaft stated above.

The shaft shall be designed such that: -

- for fixed speed pumps, the first lateral critical speed is not less than 150% higher than the maximum operating speed of the pump,
- for pumps required to operate at varying speeds, the first lateral critical speed is not less than 300% higher than the maximum operating speed of the pump.

The first lateral critical speed shall be calculated for the maximum diameter impellers able to be fitted to the pump, without any support from wear ring (s) or neck ring (s).

The maximum lateral deflection of the shaft shall be determined to establish permissible internal clearances, taking into account all lateral hydraulic reactions on the impeller and any external loads.

Shaft Seal & Seal Chamber

Sealing of the shaft between the pump and motor shall be by independent hard faced mechanical seals contained within an oil bath or lubricated chamber providing sufficient cooling and lubrication of the seal faces to ensure optimum performance.

Each mechanical seal shall be: -

- of robust construction, designed to withstand the adverse operating conditions associated with sewage pumping, and be
- guaranteed for a minimum life of 5000 hours under normal sewage pumping conditions. (i.e. 50% to 110% of BEP flow)

Seal face materials shall be: -

Top Seal-- Silicon Carbide / Graphite
Bottom Seal-- Silicon Carbide / Tungsten Carbide

Alternate configurations of seal materials utilising silicone carbide, tungsten carbide, and cemented carbide, will be considered provided the supplier guarantees in writing, the wear resistance (life) and sealing capacity of the configuration offered.

The seal chamber shall incorporate: -

- oil fill and drain points and
- a leak detection device in pump units 7.5 kW and over, enabling water leakage past the lower mechanical seal to be detected, and an alarm signal generated.

Seals located in the pumped medium above the impeller do not comply with this requirement.

Reverse Rotation

All pump components shall withstand, without damage, the effects of reverse rotation due to reverse flow through the pump up to 120% of normal direction rated speed.

MOTOR

General

Generally, the motor shall be in accordance with the requirements of AS1359 and be of type tested design. Motors shall be capable of sustaining a minimum number of starts per hour in accordance with the following table: -

Limiting Motor Rating (kW)	Maximum Starts Per Hour
≤ 15	12
>15	8

It is assumed for the figures stated above, that the starts occur generally evenly spaced over the hour. i.e. 12 starts per hour occurring approximately every 5 minutes.

The motor shall be: -

- 415V, 50Hz, 3 phase, 4 pole or greater (6 or 8 pole) induction type with a maximum synchronous speed of 1500 rpm, unless otherwise stated in the Data Sheet.
- rated IP68 for submerged operation, in accordance with AS1939,
- resistant to corrosive gases such as may be found in municipal sewers (e.g. methane, hydrogen sulphide),
- suitable for direct-on-line and reduced-voltage starting, using either star delta, auto transformer, electronic soft starter/soft stop or VSD types and
- have an earthing terminal provided within the power supply terminal box.

The motor manufacturer shall be informed if the motor is to be used in conjunction with a VSD of PWM type so that the manufacturer can take into account the increased level of harmonic currents and the increased voltage stress on the insulation. Motor windings shall have an impulse withstand voltage rating and a dV/dt rating engineered to the characteristic output of the VSD and the length of cable between the motor and VSD. Furthermore, the motor manufacturer and remedial measures taken to offset any detrimental effects shall take the effects of common mode currents flowing through the bearings into account.

The locked rotor current shall not exceed a maximum of 7 times the rated full-load current.

Although submersible pumps are not subject to the new legislation relating to high efficiency motors, South East Water selects pumps based on -Whole Of Life Costs , and therefore urges all suppliers of submersible equipment to embrace the legislation and supply high efficiency submersible motors.

Housing

The motor housing shall be designed to withstand submergence to a depth of 20 metres head without leakage. The motor casing shall incorporate lifting brackets or lifting eyes to AS2317 for ease of installation. The pump unit when suspended shall hang vertically at an attitude enabling easy engagement /disengagement of the pump onto the pump pedestal mounting claw and sealing face.

Cooling

The motor shall be designed and adequately rated to operate in air with convective cooling, i.e. without additional cooling effect due to immersion in the fluid.

Motors shall be rated to not overheat during continuous operation under any hydraulic conditions, including non-submerged conditions.

Protection

The motor shall be protected from overheating by either: -

- a minimum of one (1) positive temperature coefficient (PTC) thermistor, embedded in each of the three (3) stator windings. Each thermistor to be connected in series to terminals adjacent to the stator terminals and encapsulated and compatible with the motor selected or

- resistance temperature detector (RTD) elements (100 Ω).

Alternative protection devices will be considered provided anecdotal evidence is available from 3rd party users as to their suitability.

A moisture detection device shall be fitted in the motor stator housing, and the cable termination housing if fitted.

Insulation

Winding insulation temperature rating shall be not less than that specified as Class F to AS2768.

Cables & Motor Entry Glands

Cables shall be flexible, multi-core, insulated, sheathed and suitable for immersion in industrial as well as domestic sewage. Cables shall comply with AS5000.1.

The contractor shall ensure that cables are configured to support the starting method referred to in the Technical Data Sheets.

Cables incorporating additional cores for RTD / thermistor protection and moisture detection shall have the additional cores provided with secondary sheaths.

All cables entering the motor are to be glanded to a single demountable flange.

The length of electrical cable required for each motor shall be 15 meters unless stated differently in the Technical Data Sheet.

Motors specified for VSD operations shall have screened cables with no less than 85% optical screening.

Bearings

The motor bearings shall be: -

- of metric dimensions,
- fully sealed and pre-greased,
- designed for a L10 Rating Fatigue Life of at least 70,000 hours at the maximum operating speed and
- be stocked in Melbourne by specialist bearing suppliers.

Bearing mountings shall be designed to allow for variations in shaft temperature. Thrust bearings shall be fitted to take all axial loads due to hydraulic thrust.

Protective Coatings & Surface Treatments

The pump design shall be such that the corrosion protection is fully effective for all surfaces exposed to sewage or sewer gases. All surfaces that cannot be coated and tested shall be of corrosion resistant material.

The design of all components shall be such that a polymer coating can be applied and tested fully for conformity with AS4158. The coating shall be continuous across the full width of all joints, gaskets and seals.

Surface coatings shall be applied after all hydrostatic testing has been completed.

Auxiliary items, unless they are manufactured from corrosion resistant materials, shall be hot-dip galvanized to AS4680 or coated with a protective coating to AS4158.

ANCILLARY ITEMS

Discharge Support

If specified in the Technical Data Sheets, each pump intended for wet well service shall be supplied with a discharge support designed with the following features:

- a support foot suitable for bolting to the pump well floor, capable of resisting all static and dynamic loads induced by the pump and discharge pipe work.
- a de-coupling 'duck-foot' joint able to be manipulated from the top of the pump well by lifting or
- lowering the pump, without the need of special devices, and able to maintain a leakage free seal between pump and pipe work during all operational conditions.
- an anchor point for mounting of vertical guide rail, located to ensure that the pump can be raised and lowered in the pump well without lateral deviation and
- a vertical flanged discharge port

Guide Rails

As specified in the Technical Data Sheets the pump shall also be supplied with guide rails to suit the standard dimensions for the pump pedestal. The guide rails shall be designed to permit the pump to slide freely and seat correctly when lowered into the working position.

Brackets

If specified in the Technical Data Sheets brackets shall be provided to support and attach the guide rails to the wet well wall. Each pump shall be supplied complete with: -

- a top mounting guide rail brackets and
- intermediate mounting guide rail brackets suitable for connection to discharge pipe work
- flanges. The brackets shall be sufficient in number to ensure excessive loads are not placed on the guide rails, but not less than required for 3.0 metre centres.

Suction Bend & Mounting Stool

The suction bend shall be manufactured from the same material as the pump.

The mounting stool shall be manufactured from cast iron (grade as per the pump volute) or stainless steel in accordance with AS1444, grade 316L.

Bolts, Screws & Dowels

All bolts, nuts, studs and screws shall be manufactured from materials that are electrolytically compatible with the components being secured and shall be designed to comply with AS1111 and AS1112. Stud bolts shall not be used unless required for tapped holes.

Flanges

Suction and discharge branches shall have a pressure rating not less than the pressure rating of the casing.

Discharge flanges shall be drilled to AS 2129 Table 'E'.

Pipe flanges shall comply with the requirements of AS4087, for sizes within the range covered by the appropriate table, and shall be machined full face or include an 'O' Ring groove or a raised face as listed in the Technical Data Sheet.

Pipe flanges sizes and rating outside the scope of AS4087, or flanges requiring special dimensions and drilling to match existing pipe work, shall have: -

- Flange dimensions, face sealing and drilling as detailed in the Technical Data Sheet.
- Flange thickness determined by the Contractor in accordance with AS1210. In other respects
- AS4087 shall apply.

The backs of flanges shall be machined or spot faced for the seating of bolts and nuts.

Nameplates

A nameplate manufactured from stainless steel to AS1449, grade 316 and shall be affixed to the body of the pump unit by means of suitable stainless steel screws. The nameplate shall be stamped or engraved with the following information: -

- Model / Type Descriptor
- Serial Number
- Rated Speed & Direction Of Rotation
- Duty Point
- Impeller Diameter (fitted)
- kW Rating
- Voltage
- Locked Rotor & Full Load Current
- Power Factor
- Class Of Insulation
- Degree Of Protection
- Total Weight
- Date Of Manufacture

A second identical nameplate shall be supplied loose.

Motors with thermistors or RTD's fitted shall be supplied with (loose) warning labels;

WARNING: THERMISTORS OR RESISTANCE TEMPERATURE DETECTORS INSTALLED, DO NOT MEGGER.

MANUFACTURING

Materials

General

Where a specific material for a component has not been stated in this document, materials for manufacture shall be as listed in the Technical Data Sheet.

Preferred Material Grades – Castings

Preferred grades for cast materials stated in the Data Sheet are: -

Grey Cast Iron	AS1830, grade T220 or better.
Austenitic Iron	AS1833, grade S-Ni Cr 20 2.
Stainless Steel	AS2074, grade H6C.
Carbon Steel	Not a preferred material.
Spheroidal Graphite	Not a preferred material.

Alternative materials with a proven history of reliable service to those stated in 1 to 3 above will be considered as an alternative to those specified.

The responsibility lies with the supplier to prove to South East Water that the materials offered, will provide the same or better reliability than the materials specified.

Castings shall be close and uniform in grain, homogeneous and free from blowholes, porosity, shrinkage, cracks and other injurious defects. Filling of holes shall not be permitted unless allowable under Australian Standards. Castings shall be properly cleaned and fettled and all lumps and rough areas smoothed.

Stainless Steel

Stainless steel plate and bar subjected to welding during the manufacture of any component shall be a low carbon and stabilized grade such as AS1449, grade 316L. All welding shall have passive treatments carried out once the fabrication is completed.

Stainless steel casings shall be a stabilized grade in accordance with AS2074, grade H6C. Stainless steel in shafts, spindles or similar shall comply with AS1449, grade 316 or better.

Graphite greases, graphite packing and graphite compounds shall not be used in contact with stainless steel.

Mild Steel

Mild steel shall conform to AS3679.1, grade 250.

Seals

Material for seals, other than mechanical seals, shall be natural rubber, synthetic polyisoprene or a mixture of natural rubber and nitrile rubber. The rubber hardness shall be as required by the seal design for the pressure specified and, if required, shall be reinforced with Kevlar fabric.

Subject to the approval of South East Water, other elastomers with durability and mechanical properties at least equivalent to the materials specified may be substituted.

„O“ Rings

O' Rings for flanges shall comply with AS4087. O' Ring sealing components shall comply with the relevant sections of AS1646 and AS2842.

Machining

Machining shall be concentric, square to line and true. All sharp edges and burrs shall be removed. Boltholes shall be drilled and spot faced for bolt head and nut. Mating parts shall be match marked. All components and the assembled rotating element shall be interchangeable for pumps of the same type, designation and size.

Bosses shall be provided for all tapings. The use of setscrews in castings shall be avoided. Dowels shall be provided between components requiring accurate locating in position.

INSPECTION AND TESTING

Materials

The Contractor shall carry out material testing as required in the Technical Data Sheet.

All materials testing shall be carried out by a testing laboratory accredited by the National Association of Testing Authorities (NATA) for the class of test being undertaken, and, if required, shall be witnessed by a representative of South East Water .

Materials and/or components specified as requiring testing shall not be used in the work without prior approval of South East Water .

Workshop Assembly

If specified in the Technical Data Sheets that works inspection(s) is/are required to be carried out by South East Water , the pump unit shall be progressively assembled in the Contractor's works in such a way that the fitting of all parts and all essential movements can be checked.

Type Tests

The Contractor, if requested to do so, shall provide 'Type Test Certificates' for type and size of submersible pump supplied. Where 'Type Test Certificates' are not available the Contractor shall perform and document type tests at the Contractor's works on the first submersible pump of each design. Type tests shall include the following minimum requirements: -

- temperature rise,
- momentary overload,
- high voltage,
- efficiency,
- power factor,
- DOL locked rotor starting current and
- DOL locked rotor torque.

Flow, head, power, vibration (if feasible), and other required parameter measurements shall be taken at several flow rates to provide definable smooth curves for Head, Efficiency, Pump Absorbed Power and Motor Electrical Power (all versus Flow Rate) extending from zero flow to the maximum achievable flow required. The test flow rates shall include: -

- zero flow,
- the guarantee point,
- any secondary duty points,
- maximum achievable flow.

If required by the Technical Data Sheet, tests to determine the pump's NPSHR shall be conducted. NPSHR testing shall be carried out at a minimum of five (5) flow rates, equi-spaced between zero flow and the maximum achievable flow (one point to include the latter flow).

The performance of each pump shall be tested using the motor to be supplied under the contract.

All tests shall be conducted in accordance with AS2417, AS1359.109 and AS1359.114 as applicable and may be witnessed by a South East Water representative. The Contractor shall give a minimum of three (3) working days notice of commencement of tests.

An interim copy of the test sheets shall be submitted to South East Water immediately following the tests.

SITE PERFORMANCE/COMMISSIONING TESTS

Test Requirements

The Contactor shall, if requested in the Technical Data Sheets, carry out site based performance/commissioning tests to demonstrate the suitability of the pump unit for the intended service. The tests shall include: -

- checks for mechanical damage to the pump unit, including corrosion protection systems,
- demonstration of the mechanical operation of raising and lowering apparatus,
- electrical integrity of cabling and motor,
- measurements of flow, head and power at flows approximating those used for the works tests,
- checks for formation of vortices at minimum submergence,
- checks for excessive vibration at minimum submergence, and
- checks for excessive noise.

An interim copy of the test sheets shall be submitted to South East Water immediately following the tests.

Test Officer

The Contractor shall nominate a test officer for the duration of the tests, who shall be responsible for: -

- the submission of the Test Plan, Procedures & Method Statements,
- the conduct of the tests,
- recording / analysis of results and
- the submission of the Contractor's Test Report to South East Water for acceptance. Unless stated otherwise in the Technical Data Sheets the Contractor shall provide all test instruments, excepting flow meters. All instruments shall be calibrated by a NATA certified testing authority as required by the Australian Standards.

Analysis & Presentation Of Test Results

Comparisons between test results and guaranteed performance will be made in accordance with AS2174 and AS1359.33.

Rejection of Pump Units

South East Water may reject the pump unit should the performance during works tests: -

- fall outside the specified limits for the guarantee point or secondary duty points,
- fail to operate at the maximum achievable flow,
- fail to meet the guarantees for NPSHR or vibration and
- indicate poor mechanical or electrical design or manufacture.

South East Water may reject the pump unit should the Contractor not satisfy South East Water during pre-commissioning, that the pump unit meets the specified service requirements.

Warranty Period

Any defects developed within a period of twelve (12) months from the date of commissioning, or 18 months from delivery whichever the sooner, other than fair wear and tear, shall be rectified by the Contractor on receipt of notice from South East Water and at no cost to South East Water.

PACKING, TRANSPORTATION & DELIVERY

Labels & Markings

All items shall be individually labelled prior to packing. Labels shall include the following information:

- Property of South East Water
- Contact Number
- Item / Part Number

Where items are manufactured for specific mating component parts, they shall all bear individual identification numbers and reference to the mating part identification numbers.

Packing

All items shall be individually packaged for long-term storage in a tropical environment, with external labelling

Crating of items for transportation shall be designed and constructed to withstand the loads imposed during transportation. Goods received in damaged packaging or crating may be returned to the Contractor for re-manufacture and/or re-inspection and testing.

Crates shall be clearly marked in black-stencilled lettering with the following information: -

- Consignee's name and delivery address as given in the Contract,
- Consignor's name and contact point and contact number.

SPARE PARTS & TOOLS

The Contractor shall supply and deliver one (1) complete set of any special tools required for the dismantling, service and re-assembly of the pump unit.

DOCUMENTATION

The Contractor shall prepare and supply drawings, installation, operation and maintenance documentation.

The manuals and technical data sheets shall fully describe all specified equipment and clearly show its mode of operation and, as a minimum, contain the following information: -

- a concise description of each pump type and ancillary equipment, together with a complete performance specification,
- a concise description of the mode of operation of each part or sub-system,
- procedures for installation and commissioning of each part or sub-system,
- procedures to be followed for testing, maintenance and fault finding. The fault finding table shall list fault indication, possible causes and remedies.
- special precautions to be taken in replacement and/or adjustment of each item,
- a comprehensive routine maintenance and testing program based on that recommended by the manufacturer,
- a spare parts list for all items plus component assembly drawings of the pump and ancillary equipment,
- a list of supplier's names and addresses to enable any parts to be ordered correctly,
- any other information or instructions necessary to fully operate and maintain the equipment in a complete and satisfactory manner and
- a set of pump assembly drawings on CD format.

TECHNICAL DATA SHEETS

NOTE:

If the pumps being quoted are fully described in a catalogue that the consultant has previously handed to a mechanical engineer at South East Water / „us“ – Utility Services you only need to specify the complete model number; there is no need to also fill in the Technical Data Sheets attached to this Appendix unless the information is not described in the pump catalogue.

Project Title: _____

Pump Descriptor: _____

Section 1 - General

1.1	Manufacture's Name	
1.2	Manufacture's Address	
1.3	Model Number	

Section 2 – Pump Hydraulic Design

		Required	Tendered
2.1	Mounting Arrangement (Dry/Wet Well)		
2.2	Suction Eye Area		
2.3	Impeller Free Passage		
2.4	Impeller Diameter		
2.4.1	Fitted		
2.4.2	Maximum		
2.4.3	Minimum		
2.5	Minimum Submergence		

Section 3 – Pump Mechanical Design

		Required	Tendered
3.1	Casing		
3.1.1	Volute Type (single/double)		
3.1.2	Suction Port Diameter		
3.1.3	Discharge Port Diameter		
3.1.4	Material	Flake Graphite Cast	
3.2	Casing Wear Ring		
3.2.1	Material		
3.2.2	Surface Hardness		

3.2.3	Fixing Method/Material		
3.3	Casing Fixings		
3.3.1	Bolt/Stud Material	Stainless Steel to AS1444, Grade 316	
3.3.2	Nut Material	Stainless Steel to AS1444, Grade 316	
3.4	Impeller		
3.4.1	Type		
3.4.2	Clearing Vanes Fitted?	Yes	
3.4.3	Material	Flake Graphite Cast Iron to AS1830	
3.4.4	Attachment Method		
3.4.5	Retention Method		
3.4.6	Locknut Material	Stainless Steel to AS1444, Grade 304	
3.5	Impeller Sealing Ring(s)		
3.5.1	Material		
3.5.2	Surface Hardness		
3.5.3	Fixing Method/Material		
3.6	Wear Plate		
3.6.1	Material		
3.6.2	Fixing Method/Material		
3.7	Shaft		
3.7.1	Material	Stainless Steel to AS1444, Grade 316	
3.8	Mechanical Seal		
3.8.1	Type		
3.8.2	Arrangement		
3.8.3	Manufacturer		
3.8.4	Model Nr		
3.8.5	Rotating Surface Material	Silicon Carbide/Graphite	
3.8.6	Stationary Face Material	Silicon Carbide /Tungsten Carbide	
3.8.7	Spring(s) Material		
3.8.8	Elastomer Material		
3.9	Seal Chamber		
3.9.1	Material	Flake Graphite Cast Iron to AS1830	
3.9.2	Oil Filling Point Incorporated?	Yes	
3.9.3	Drain Point Incorporated?	Yes	

3.9.4	Recommended Oil		
3.10	Leakage Detection Device		
3.10.1	Manufacturer		
3.10.2	Type		
3.10.3	Model		

Section 4 – Motor Electrical Design

		Required	Tendered
4.1	Power Supply	415V / 3ph / 50Hz	
4.2	Rating (kW)		
4.3	Poles	4	
4.4	Efficiency		
4.4.1	Full Load (%)		
4.4.2	¾ Load (%)		
4.4.3	½ Load (%)		
4.5	Power Factors		
4.5.1	Full Load		
4.5.2	¾ Load		
4.5.3	½ Load		
4.6	Locked Rotor		
4.6.1	Torque (Nm)		
4.6.2	Current (A)		
4.7	Full Load		
4.7.1	Speed (rpm)		
4.7.2	Torque (Nm)		
4.7.3	Current (A)		
4.8	Protection		
4.8.1	PTC	Yes	
4.8.2	RTD	No	
4.8.3	Moisture Protection	Yes	
4.9	Motor Cables		
4.9.1	Type		
4.9.2	Additional Cores		
4.9.3	Demountable Flange		
4.9.4	Length (m)	15	

Section 5 – Motor Mechanical Design

		Required	Tendered
5.1	Insulation	Class F	

5.2	Temperature Rise At Full Load	Class B	
5.3	Rotor Characteristics (AS1359)	Yes	
5.4	Bearings		
5.4.1	Manufacturer		
5.4.2	Type	Deep Groove Ball, Grade C3	
5.4.3	Series Nr – DE		
5.4.4	Series Nr – NDE		
5.4.5	Rating Fatigue Life (L10)	70,000 Hrs	

Section 6 – Inspection & Testing

		Required	Tendered
6.1	Materials		
6.1.1	Composition Certificates	No	
6.1.2	Composition Tests	No	
6.1.3	NDT	No	
6.3	Assembly Inspections	No	
6.4	Performance		
6.4.1	Motor Tests	Yes, Over 22kW	
6.4.2	Pump Tests	Yes, Over 7.5kW	
6.4.3	Class Of Test	C	
6.4.4	NPSHR (m)		
6.5	Commissioning		
6.5.1	Site Performance Tests	No	
6.5.2	System Commissioning	No	

Section 7 – Ancillary Equipment

		Required	Tendered
7.1	Discharge Support Bend		
7.1.1	Material	Flake Graphite Cast Iron to	
7.1.2	Discharge Flange Rating	AS4087, Class 16	
7.2	Lifting Guides		
7.2.1	Type	NA	
7.2.2	Material	NA	
7.2.3	Size	NA	
7.2.4	Top Bracket Material	Flake Graphite Cast Iron to AS1830	
7.2.5	Intermediate Bracket Material	No	
7.3	Suction Bend		

7.3.1	Material	Flake Graphite Cast Iron to AS1830	
7.3.2	Discharge Flange Rating	AS4087, Class 16	
7.3.3	Hand Hole Fitted	Required	
7.4	Support Stool		
7.4.1	Material	Flake Graphite Cast Iron to AS1830	
7.4.2	Support Plinth Required?	No	

Section 8 - Documentation

		Required	Tendered
8.1	Certified Drawings		
8.1.1	General Arrangement	Within 2 Weeks of Placement of Order	
8.1.2	Sectional Arrangement	Within 2 Weeks of Placement of Order	
8.2	Certificates		
8.2.1	Materials	Prior To Delivery	
8.2.2	Hydrostatic	Prior To Delivery	
8.2.3	Performance	Prior To Delivery	
8.3	Operation & Maintenance Manuals	Prior To Delivery	

Section 9 – Spare Parts & Tools

9.1 Spare Parts & Tools Tenderer to List Items to be included in the Tender

Performance Sheet

Project Title: _____

Pump Descriptor: _____

	Guarantee Point		Secondary Duty 1		Secondary Duty 2		Secondary Duty 3		Maximum Achievable Flow	
	Required	Offered	Required	Offered	Required	Offered	Required	Offered	Required	Offered
Flow Rate (l/s)										
Head (m)										
NPSHR (m)										
Efficiency – Pump (%)										
Efficiency – Motor (%)										
KWh/1000litres										
Speed (RPM)										

Pump Submission Sheet

Item	Required Information	Option A	Option B	Option C
A	Pumps			
B	Type			
C	Impeller Dia Short Term 1			
D	Impeller Dia Ultimate 2			
E	Throughput size (Sphere Clearance) Impeller 1			
F	Throughput size (Sphere Clearance) Impeller 2			
G	Pump Efficiency Short Term			
H	Pump Efficiency Ultimate			
I	Motors			
J	Type			
K	Speed			
L	Rating (shaft power)			
M	Voltage			
N	Current – full load			
O	Current - start			
P	Starter			
Q	Motor Efficiency at full load			
R	Motor Efficiency at 3/4 load			
S	Motor Efficiency at 1/2 load			
T	Maximum Permissible Starts per hour			
	Other			
a	Weight of complete unit			
b	Lifting equipment (Chain and Shackles grade etc.)			
c	Discharge pipework diameter			
d	Pump width			
e	Pump length			
f	Minimum Pump Separation Recommended			

g	Minimum Well diameter required	
h	Recommended minimum access opening for	
i	Short term supply costs (excl GST)	
j	Ultimate supply cost – 2 new impellers	
k	Minimum Submergence for pump	
	Initial Duty Point Operation	
1	Running current at duty point - Amps	
2	Shaft KW at duty point	
3	%of Motor Rated Power at Duty Point	
4	Overall Efficiency at Duty Point	
5	BEP flow at Duty Point	
6	% of BEP flow at duty point (must be between 55%	
7	Expected pump life at BEP in hrs	
8	Expected pump life at This Duty Point in	
	Final Duty Point Operation	
9	Running current at duty point - Amps	
10	Shaft KW at duty point	
11	%of Motor Rated Power at Duty Point	
12	Overall Efficiency at Duty Point	
13	BEP flow at Duty Point	
14	% of BEP flow at duty point (must be between 55%	
15	Expected pump life at BEP in hrs	
16	Expected pump life at This Duty Point in	
	Costs	
17	Cost of Major repair from seal failure	
18	Estimated Maintenance and Repair Costs Based on 25% run time p.a. (3 hrs per day for each pump) and 1100 hrs per year	
19	Year 1	
20	Year 2	
21	Year 3	
22	Year 4	

23	Year 5	
24	Year 6	
25	Year 7	
26	Year 8	
27	Year 9	
28	Year 10	
29	Year 11	
30	Year 12	
31	Year 13	

Analysis by South East Water			
SEW	Required motor efficiency under AS1359.102.2		
SEW	Pump Cost (\$/hr) based on life of 15 years		
SEW	ADWF (assume = PWWF/6) L/s		
SEW	Operate how often (x minutes / day) at ADWF		
SEW	Electricity Cost (@ \$0.18/kWhr)		
SEW	Power Cost over 1 yr		
SEW	Power Cost over 15 yrs		
SEW	Extra Cost to cheapest pump to run over 15 yrs		
SEW	Operation per day at ADWF (Hrs)		
SEW	Hrs per year		
SEW	Cost per kWhr		
SEW	Power consumption at Duty Point (Kw)		
SEW	Cost to run pump per year (ignoring starting		
SEW	Running costs for 15 years		
SEW	Running Costs Difference over 1 year		
SEW	Running Costs Difference over 15 years		
SEW	Difference in purchase price (\$)		
SEW	Break-Even (years)		

Power Cost per kWhr 0.18

APPENDIX B - DESIGN CHECKLIST

Design Audit for Sewerage Pumping Station and Pressure Main.

Item	Complete	Date / Initials
WET WELL		
1. Design Capacity minimum 2hr @ PDWF provided. Clause 4.5.5.1		
2. Computations for flotation confirm minimum FS of 1.1. Clause 4.4.3.1		
3. Coating of concrete surfaces specified Clause 4.1.2		
4. Top slab to incorporate all below ground structures. Clause 4.5.3.9		
5. Wet well shall be self draining. Clause 4.5.3.10		
6. Covers in accordance with Clause 4.5.7		
7. Minimum wet well diameter complies. Clause 4.5.2.2		
8. Cut in Cut out volumes comply. Clause 4.5.2.2		
9. Wet Well washers comply. Clause 4.5.11		
10. Concrete strength specified. Clause 4.5.3.2		
11. Clearance from overhead power lines. Clause 4.7.3		
12. Ladders comply with standard Drawing SEW STD 005		
13. Penstock complies. Clause 4.5.1.2 and Standard Drawing SEW STD 000		
14. Pipe work complies. Clause 4.6.1.1		
15. Pipe supports comply with standard drawing SEW STD 002 and clause 4.6.3.3		
16. Pump well inlet pipe complies with clause 4.5.2.1(h)		
17. Computations for pump selection inclusive of NPV. Clause 4.2.3		
18. Approved pumps. Clause 4.2.3		
	/.....
EMERGENCY RELIEF STRUCTURE		
Complies with Standard drawing SEW STD 061 and clause 4.5.5.3.2		
	/.....
VALVE CHAMBER		
1. Pit Accessible. Clause 4.6.3.1		
2. Pipe supports comply with. Clause 4.6.3.3		
3. Pressure main tapping's in accordance with Clause 4.6.3.4		
4. Ladders comply with standard drawing SEW STD 005		
5. Operation of valves without need to remove cover. Clause 4.6.3.1		
6. Chamber is self-draining. Clause 4.6.3.1		
7. Valves Clockwise closing. Clause 4.6.2		
8. Pipework and fittings comply with Clause 4.6.4.8.1		
INFRASTRUCTURE		
1. Water supply in accordance with clause 4.8.1.1		
2. Lighting in accordance with clause 4.8.1.3		
3. Access Road in accordance with clause 4.7.3		
4. Bollards in accordance with clause 4.5.7		
5. Switchboard location complies with clause 4.7.8		
6. Termination of generator connectors comply with clause 4.3.4.6		
7. Telemetry mast complies with clause 4.4.5		
8. Site drainage complies with clause 4.8.1.5		
	/.....
PRESSURE MAIN		
1. Minimum pipe class as per clause 4.6.4.8.2		
2. Computations verifying velocity complies with clause 3.5.3		

3. Discharge MH copies with clause 4.6.8		
4. Air valve complies with clause 4.6.2 & 4.6.5.2 and standard drawing SEW_STD_060		
5. Scour Valve assembly complies with standard drawing SEW_STD_060		
	/.....

APPENDIX C - SUBMISSION OF PRECOMMISSIONING DOCUMENTATION

SOUTH EAST WATER PRE-COMMISSIONING CHECKLIST FOR NEW WASTE WATER SITES

Requirements by Contractor

The following checklist is required to be fully completed, signed and returned to South East Water before a joint commissioning is scheduled.

Please note: in the event of a commissioning being abandoned due to works not completed or operational, South East Water **will** recover costs incurred.

STATION NAME: _____

STATION NUMBER: _____

- | | | |
|--|------------------------------|-----------------------------|
| Supply Authority Power available | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| Provision of sufficient water for all testing purposes | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| Fresh water discharge flushing system operating as per design | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| Ancillaries (GPO's, lighting etc) tested and working correctly | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| Telemetry radio survey completed satisfactorily | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| Station telemetry points list supplied | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| Established telemetry communications and verified inputs locally | Yes <input type="checkbox"/> | No <input type="checkbox"/> |

Verification Of As Constructed Levels and Operation.

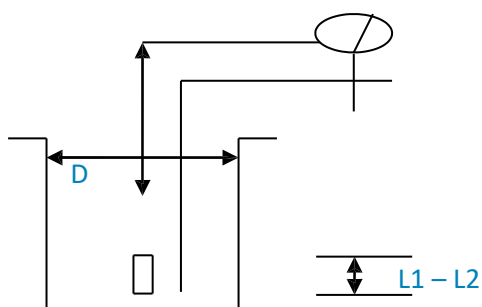
Note: Levels taken from well cover down

Setting/Alarm	Measurement	Operational function (contractor to verify correct operation)
Spill Alarm	M	Yes <input type="checkbox"/> No <input type="checkbox"/>
H/L back up pump 2 start	M	Yes <input type="checkbox"/> No <input type="checkbox"/>
H/L back up pump 1 start	M	Yes <input type="checkbox"/> No <input type="checkbox"/>
High level alarm	M	Yes <input type="checkbox"/> No <input type="checkbox"/>
H/L pump cut out/ Transfer	M	Yes <input type="checkbox"/> No <input type="checkbox"/>
Duty pump cut-in	M	Yes <input type="checkbox"/> No <input type="checkbox"/>
Duty pump cut out	M	Yes <input type="checkbox"/> No <input type="checkbox"/>
Low level alarm (indication only)	M	Yes <input type="checkbox"/> No <input type="checkbox"/>
Wet well level indicator		Yes <input type="checkbox"/> No <input type="checkbox"/>
Level controller span	O-	
Level controller datum	MAHD	

Level settings according to design: Yes No NA

APPENDIX D: PROCEDURE FOR PERFORMANCE TESTING OF PUMPS

Contractor to complete for all pumps:



- Ensure pressure main is fully charged prior to testing.
- If pump is VSD driven, operate at 50 Hz during pump testing
- Measure levels (stick & measuring tape) as well as record gauge levels
- Install temporary pressure gauge at valve pit for measuring Hs (static head) and Ht (total head)
- Undertake quick shut head test and record pressure prior to testing actual pump duty

Var	Parameter	Value
	Date of Test	
	Pump Make & Model	
	Pump Serial Number	
	Pump No (position)	
	Rated rpm	
	Rated motor power	kW
I	Measured steady state current (operating) – if ammeter	A
P _a	Measured steady state electrical power delivered (1 pump operating) This may be taken from the electricity company meter if there is no power or current metering at soft starter or VSD display.	kW
H _{max}	Measured Shut head (when delivery valve closed)	m
H _{maxT}	Theoretical Shut Head	m
t	Time to pump (b/w cut in & cut out)	s
L ₁	Pump Start level (measured at pump start)	m
L ₁	Pump Start level (level gauge)	m
L ₂	Pump Stop level (measured at pump stop)	m
L ₂	Pump Stop level (level gauge)	m
D	Measured well inside diameter	m
V	Operating Volume, $V = \pi \cdot D^2 / 4 \cdot (L_1 - L_2)$	m ³
Q _c	Calculated average flow rate, $Q_c = V/t$	l/s
Q _m	Measured flow rate (from flow meter)	l/s
H _c	Head correction factor = elevation difference b/w pressure gauge and mid operating level $(L_1 - L_2) / 2$	

H _{sm}	Measured Static Head (no pumps operating) (from pressure gauge when pressure main full)	m
H _s	Static Head, $H_s = H_{sm} + H_c$	m
H _{tm}	Measured Total Head (one pump operating)	m
H _t	Total Head, $H_t = H_{tm} + H_c$	m
P _h	Hydraulic Power, $P_h = 0.0098 \times Q_c \times H_t$	kW
I	Measured steady state current (operating) – if ammeter available (check soft starter / VSD display)	A
P _e	Electric Power (from electricity meter, power meter or ammeter- measured electrical power delivered while 1 pump operating. This may be taken from the electricity company meter if there is no power or current metering at soft starter or VSD display. $P_a = 3^{0.5} \times V_L \times I$ (if using ammeter)	kW
E	Overall Efficiency = $P_h/P_e \times 100$ (measured)	%
E _e	Expected Efficiency (from pump datasheet)	%

Test performed by : _____

Pressure gauges calibrated according to QA requirements: Yes No

Pump performance satisfactory: Yes No

Pump performance results as compared to tender offer- satisfactory: Yes No

General Contractor Comments:

All information has been supplied and verified ready for Commissioning

_____/_____/_____
----- Signed (Contractor) Date

----- Print name

Note: The telemetry is to be fully ready for commissioning day (refer South East Water supplementary manual for requirements)

South East Water use only

Level information and Operational function satisfactory: Yes No
Pump performance results as compared to tender offer satisfactory: Yes No
Pump motor information readings satisfactory: Yes No
Telemetry commissioned satisfactorily: Yes No

General South East Water Comments:

All information has been supplied and verified at Contractor Pre-commissioning

/ /
----- Signed (South East Water) Date

----- Print name

APPENDIX E - EPA PROTOCOL

EMERGENCY RELIEF STRUCTURE PROTOCOL

SOUTH EAST WATER LIMITED AND ENVIRONMENT PROTECTION AUTHORITY

BACKGROUND

As a continuation of the Memorandum of Understanding (MoU) signed between Melbourne Water (MW) and Environment Protection Authority (EPA) in 1994, a new MoU has been executed between the South East Water (SEW) on 1 February 1996. This demonstrates SEW's commitment to Best Practice Environmental Management.

SEW and EPA acknowledged that - (a) in order to -

- (i) ensure the occupational health and safety of SEW staff and contractors; (ii) safeguard public health and safety;
- (iii) protect sewers and sewerage treatment plants from damage-

SEW is obliged to construct and maintain Emergency Relief Structures (ERS's) at appropriate points in its sewerage system and to allow emergency releases from sewers through such Structures from time to time;

- (b) SEW is not required to apply for work approvals or waste discharge licences under the Environment Protection Act 1970 for ERS's designed only to operate in an emergency.

Section 4.2 of the MoU sets out the actions to be followed by the SEW before it decides to construct any ERS.

PURPOSE

The purpose of this *Protocol* is

- provide guidelines to internal SEW Design Engineers and Consulting Engineers employed by SEW or Developers to design sewerage systems to enable them to take all necessary steps needed to comply with Section 4.2 of the MoU in designing sewerage systems;
- establish appropriate consultative mechanisms and procedures and agreed principles to avoid delays; and,
- reflect a commitment to the Quality Assurance Principles in achieving efficient work practices.

GUIDELINES

Investigate Whether an ERS is required

The designer/consultant should show evidence that an exhaustive investigation has been carried out to determine whether an ERS is required to ensure that occupational health and safety, public health and safety, or the safety of the sewerage system is maintained.

Such evidence should include -

- design computations to demonstrate that uncontrolled spillage would take place in the system without the construction of an ERS;
- Longitudinal Section plans of the sewers and hydraulic grade lines showing the location/s of such uncontrolled spillage;
- plans showing alternative locations for the ERS;
- all relevant data used and any assumptions made in the design computations; and,
- any other information the designer/consultant deem relevant.

Investigate Alternative Means to Avert or Reduce the Risk of the Sewer Overflowing

The designer/consultant should show evidence that complete investigation has been carried out to consider all possible alternative means to avert or reduce the risk of the sewer overflowing. The designer/consultant should provide a complete description of all the options considered. Brief description of the methodology adopted in evaluating the options should also be provided together with the ranking of the options. The preferred option is to be selected and reasons for its selection should also be submitted.

Assess the Likely Impact upon the environment of any release from the ERS In assessing the impact upon the environment of any release via the ERS, the designer/consultant should provide:

- a list of possible causes of spillage (pump failure, power failure, rising main burst, blockages etc) in the particular circumstance and the methods of overcoming them;
- computations for the estimated rates, duration and frequency of spillage via the proposed ERS;
- information regarding the type of overflow arrangement provided in the ERS and whether the pipe work has the effect of providing grease and solid retention facility and if so for what duration;
- a statement regarding the quality of the sewage in terms of its BOD and septicity;
- a statement whether the spillage can be prevented from spreading and contained for easy clean up;
- an assessment of the impact on the receiving waters of the spillage in terms of the expected dilution;
- an assessment of the impact on other properties; and,
- as assessment of the impact on the fauna and flora of the area.

Assess the Need to Incorporate Detention Facilities to Delay Spillage

The designer/consultant should assess the need to install a detention facility to delay discharges to the environment via the ERS.

Some of the situations for such a requirement would be:

- dry streams being used as receiving waters;
- very little dilution in the receiving waters;
- highly sensitive area just downstream of the ERS;
- spreading of the spillage cannot be contained for easy clean up;
- very septic sewage;
- pump station failure due to pump or power failure; and,
- rising main burst.

Detention facilities that are considered appropriate to the situation are:

- purpose built holding tanks/emergency storage facilities;
- storage capacity available within the sewer system upstream of the ERS; and,
- control volume within a pump well.

The designer/consultant should list the possible causes of spillage in the given situation and estimate:

- the rate and duration of spillage via the proposed ERS; and,
- the response time required to stop the spillage.

The designer/consultant should then consider alternative detention facilities appropriate for the particular situation and select the preferred facility and give reasons for such selection and provide: the volume of a holding tank/emergency storage facility to detain the spill for the duration of the estimated response time, if a holding tank is selected as the preferred detention facility; and plans used to estimate the available storage capacity within the upstream sewerage system, if the latter is selected as the preferred detention facility.

Where the -control volume of the pump well is selected as the preferred detention facility, the pumping stations are to be designed in accordance with the SEW's design criteria. They are:

- no dry weather spills; and,
- the ability to transfer the flow generated from a 1 in 5 year storm event.

In order to achieve the above level of service, the pumping stations shall:

- be connected to a telemetry system, to notify a central location of fault conditions;
- have competent and current documentation for operating and maintenance procedures and systems;
- have a stand by pump installed in the wet well to provide backup should the duty pump fail; and,
- have at least a two hour storage capacity of Peak Dry Weather Flow (in the sewer system upstream and/or the wet well between high level alarm and the pumping station spill (ERS) level); OR
- have a by-pass pipe line.

In addition to the above requirements, for specific pumping stations of high criticality as nominated by SEW, the installation of a stand by/back-up electricity supply is mandatory. The provision of an additional electric feeder from a different bus in the electricity supply authority sub-station or an -on site Diesel Alternator set would satisfy this requirement.

The designer/consultant should provide copies of design computations and plans for the pumping station.

Assess the Capacity of Sewers in the Catchment is Sufficient to Handle Likely Flows The designer/consultant should assess whether the capacity of the sewers in the relevant catchment is sufficient to handle likely flows.

Existing sewers will be deemed to have sufficient capacity where flows resulting from a 1 in 5 year rainfall event are contained. Contained means:

- flows in sewers greater than or equal to 300 mm diameter will be contained within the surcharge capacity; and,
- flows in sewers less than 300 mm diameter will be contained within the on grade capacity.

New and Rehabilitated Sewers must be able to contain flows resulting from a 1 in 5 year rainfall event for the design life of the system. Design must allow for increase in sewage flows from catchment development and upstream sewer system deterioration.

Capacity must be determined:

- using hydraulic modelling for sewers greater than or equal to 300 mm diameter; and,
- using Water Industry Technical Services Manual (WITS Manual) for sewers less than 300 mm diameter.
- The designer/consultant should provide copies of design computations and/or hydraulic models used for the purpose.

Discuss the Design and Location of the Proposed ERS with EPA

After completing all relevant steps appropriate for the particular situation from 3.1 to 3.5 above, the designer/consultant should forward to the Responsible Person (see Section 4 below) of SEW a complete set of computations, drawings and all other relevant materials together with a *one page summary* document detailing the investigations and findings. This summary document shall be forwarded by SEW to the Responsible Person of the EPA for information and comments, if appropriate.

The designer/consultant will allow a minimum of twenty one working days from the lodgement of the summary document with SEW before finalising the detail designs. The EPA may choose to make any comment/recommendations to SEW within ten working days of receiving the summary document. SEW will forward such comment/recommendations to the designer/consultant for consideration in the final detail designs.

A standard design component of all ERS's is the installation of an electronic level recorder to monitor surcharge levels. Alarms from the recorder are directed via SEW's telemetry system to alert the communications centre of any spillage via the structure.

Responsibility

The designer/consultant shall be responsible to carry out and complete all works in compliance with the SEW's Quality System, ISO 9001, WITS Manuals and all other conditions as stipulated in the -offer made to the developer related to the particular development. Forwarding copies of the summary document, design computations, drawings, other relevant materials and the summary document as referred to in Section 3.6 shall in no way exonerate the designer/consultant from his obligations to carry out the work correctly and accurately and in compliance with the SEW's Quality System, ISO 9001 and WITS Manuals.

The Responsible Persons for the purpose of this ERS Protocol for its duration are:

Organisation: South East Water
Name: Mr Rex Dusting, Manager Sewerage Asset Planning
Location: 20 Corporate Drive, Moorabbin 3189
Telephone: 9 552 3739
Fax: 9 552 3625

Organisation: EPA
Name: Mr Andrew Dunn
Location: 45 Princes Highway, Dandenong
Telephone: 8710 5579
Fax: 9794 5188

Duration of the Protocol

This protocol is operative for the duration of the SEW/EPA Memorandum of Understanding.

Date of Issue

19 July 2002.

This version of the ERS Protocol supersedes all previous versions.

EXAMPLE

Emergency Relief Structure Protocol

IS AN ERS REQUIRED?

An ERS is required at the pumping station location for the following reasons:

- It is the lowest point on the sewage collection system;
- Possible spillages are a public health and safety hazard;
- To provide a controlled overflow for the system during extreme emergency situations;
- Detention storage is provided so that an overflow will only occur if no corrective action is performed.

Relevant ERS levels are as follows:

Description	Relevant levels within Catchment (m AHD)
Invert level of lowest incoming sewer	31.6
Invert level of pump sump	30.3
Overflow level of ERS	37.25
Lowest manhole top level within catchment (Located next to pumping station)	38.3

FACTORS THAT REDUCE THE RISK OF WASTEWATER OVERFLOWING

The following facilities have been included in the design of the scheme to reduce the risk of wastewater overflows:

- The pumping station well has been sized to provide detention storage.
- Standby pump for use during duty pump failure.
- Alarm facilities to warn operators of high wastewater levels.
- Rising main diameter no smaller than pump discharge.

IMPACT ON THE ENVIRONMENT

Possible causes of spillage are tabulated below:

Types of Failure	Overcoming Failure
Pump Failure	Standby pump available
Power Failure	Detention storage
Rising main Blockage	Detention storage

The peak dry weather flow (PDWF) for Stage 1 of the pumping station is estimated at 20L/s. The total detention storage required to provide 2 hours storage at PDWF is 144m³. (VERIFY WITH SOUTH EAST WATER MINIMUM STORAGE REQUIRED, CAN BE GREATER THAN 2HRS)

Additional detention storage will be added to the system as part of the future upgrades planned for this station.

The ERS for this station connects to the main pump well and overflows to the adjacent drain as shown on the attached plan. The effluent will have undergone the following treatment prior to discharge:

- Trapping of floatables and grease in the pump well and manholes.
- Detention in the pump well and manholes to enable settling of suspended solids.
- Trapping of solids in a 5mm mesh screen.

The partially treated sewage will then discharge to the floodway to the east of the pump station.

There are no alternative locations for the ERS which will provide the same level of public health and safety protection.

The pumping station will be monitored 24 hours a day via South East Water’s telemetry system. In the event of a spill, South East Water will take pre-planned action in accordance with an emergency plan which incorporates the following actions:

- Control any spill using education tankers;
- Contain the spill and initiate clean-up using appropriate labour and equipment;
- Monitor the effect of any spill;
- Report the spill to EPA within the criteria of South East Water’s sewer spillage checklist (SFS-SFG-146).

DETENTION FACILITIES

The design brief for the station requires a 2 hour detention storage volume at Peak Dry Weather Flow (PDWF).

The 2 hour storage volume has been established as the maximum time required for an operator to arrive at the pump station with mobile pump out facilities and to carry out repairs if necessary.

The storage system has not been designed for Peak Wet Weather Flows (PWWF). South East Water intend to provide Excess Storm Flow Facilities (ESFLOW) at a later date to detain the wet weather flows if the system becomes overloaded.

The detention storage exceeds the 2 hour PDWF requirement for Stage 1 as shown in the table below

	Volume Cu.m.	Initial PDWF
Manholes 2Nos. 1800mm	28	23 mins
Manholes 6Nos. 1500mm	57	48 mins
Pump well	217	181 mins
In line 533m of 600dia	151	126 mins
Total Storage	453	6hrs 18mins

CAPACITY OF SEWERS

All sewers within this scheme will be designed to accommodate the peak wet weather flows as determined using the Water Services Association of Australia Sewerage Code.

Example Calculation for Emergency Storage.

Manholes

HGL level @ MH	MH
base level	
37.50	31.9
37.60	32.1
37.75	32.33
37.90	32.55
38.00	32.76
38.15	33
<hr/>	
226.90	194.64
<hr/>	

1.5 m dia
1.77 area
57.10 m³ 6 manholes

37.25 31.70
37.25 31.60

74.50 63.30

1.8 m dia
2.54 m²area
28.50 m³

Sewers

20.5 m
4.5 m
52 m
82 m
96 m
87 m
87 m
104 m

533 m

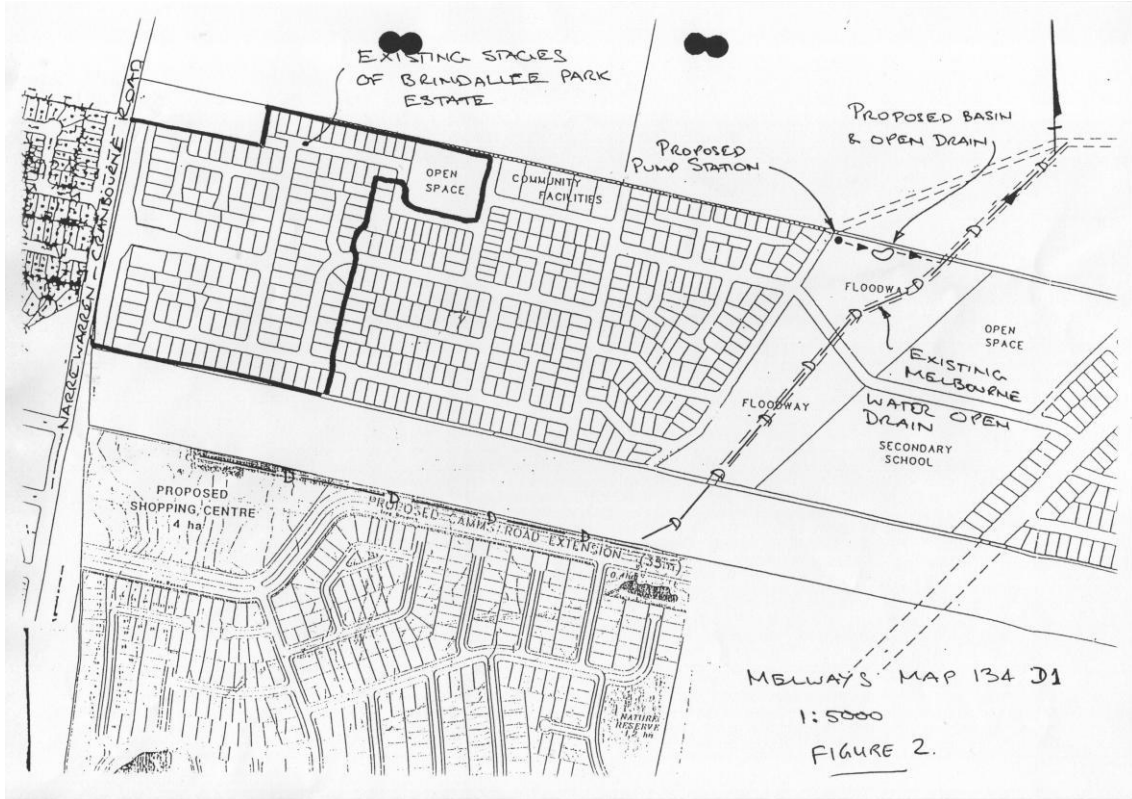
0.6 m dia
0.28 m²area
150.70 m³

Wet well

Spill alarm
37.25 31.6
5.65 m above alarm level
7 m dia
217.44 m³

217.44	Wet well
150.70	Sewers
28.50	2 manholes 1800mm
57.10	6 manholes 1500mm
453.74	m ³ Total volume

378 minutes at 20l/s PDWF.
6 hours 18 mins



EXAMPLE PLAN

APPENDIX F - TELEMETRY DATA SHEET

TELEMETRY DATA SHEET

Item	Response
1. Where does the SPS pump too?	
2. What SPS are located immediately downstream	
3. Pump delivery capacity at operating head	
4. Levels for pumps and discharge point	
5. Friction loss	
6. A full list of all points connected to the telemetry system (with their PLC reference numbers or where hardwired, their RTU terminal numbers, as applicable)	
7. Pressure Main Nominal dia and actual ID.	

<p>8. The span and distance from the bottom of the well of the Vega probe.</p>	
<p>9. The as constructed (or configured) levels for all operating and alarm points.</p>	
<p>10. The as constructed level (m AHD) of:</p> <ul style="list-style-type: none"> a) The face of the Vega Probe; b) Top of wet well. c) Overflow d) Pressure main Invert Level e) Landing platform(if applicable) f) Inlet sewer inverts level. g) Bottom of wet well. h) The capacity of each pump in normal operation from results of the mechanical / electrical commissioning tests. i) The span of power / current transducers and flow meters installed (if applicable) j) The capacity in cubic metres of the installed incoming sewer MH and the wet well itself 	

APPENDIX G - SCHEDULE OF DOCUMENTS TO SUBMIT

SCHEDULE OF DOCUMENTS TO SUBMIT

DESIGN

1. Design Checklist.
2. Pump Selection System curves & NPV
3. Schedule of Technical Data.
4. Contingency Plan.
5. Water Hammer Analysis
6. Odour Analysis.
7. Structural Computations.
8. H₂S Analysis of Pressure Main.
9. Risk assessment.
10. ERS requirements.

PRECOMMISSIONING

1. Pre-commissioning Checklist.
2. Radio Survey Results.
3. Factory pump test results.

COMMISSIONING

1. Telemetry Data Sheet.
2. Watershed Data Sheet.
3. Operations and Maintenance Manuals inclusive of pump system curves – 2 hard copies, 1 digital copy.
4. As Constructed drawings (Civil, Mechanical, Electrical, Structural etc) of the SPS and Pressure Main – 2 digital copies on disc.
5. Plant Data Sheets – 2 hard copies, 1 digital copy.
6. PLC Program – 2 digital copies.
7. Job Safety analysis for all routine maintenance tasks to be performed at the SPS.
8. Copy of concrete compressive strength and slump test results - 1 digital copy.
9. Contingency Plans.
10. Factory or type test pump test results
11. Switchboard factory & site acceptance test certificates completed and signed.