SA Water

SOUTH AUSTRALIAN WATER CORPORATION

TG 11a

TECHNICAL GUIDELINE

THE DESIGN OF SEWERAGE SYSTEMS
(Extract of Parts 4 and 5)

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MAJOR CHANGES INCORPORATED IN THE MARCH 2009 EDITION

The following lists the major changes to the January 1998 edition of TG 11a, which have been incorporated in this edition:

1. Clause 4.4.1 – additional requirements inserted
2. Clause 4.8 – modified
3. Clause 4.10.1 – additional information inserted
4. Clause 4.11.3 – Removed
5. Clause 4.12 - additional information inserted
6. Clause 4.12.3 - additional information inserted
7. Clause 4.12.5 – modified
8. Clause 5.2 – the minimum PM pressure rating amended
9. Clause 5.15 - additional information inserted

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REFERENCED DOCUMENTS

DS 11a

DS 11b

Sewer Construction Manual (Red Book)

Water Supply Construction Manual (Blue Book)

Authorised Items for Sewer Systems – catalogue

SERVICES IN STREETS - A Code for the Design of Infrastructure Services in New and Existing Streets

SECTION 4: DESIGN OF PUMPING STATIONS

4.1 SCOPE

Pumping stations are required where low lying development areas are unable to be drained by **gravity** means to existing sewerage infrastructure, and/or where development areas are too remote from available sewerage infrastructure to be linked by gravity means.

This Section shall be read in conjunction with the SA Water Code of Practice for the Construction of Sewerage Systems, DS 11b, and Section M of the Sewer Construction Manual (SCM), which is dedicated to pumping stations.

4.2 LOCATION AND SITING OF PUMPING STATIONS

Whilst pumping stations are typically located near the lowest point in a development, the siting and orientation of each pumping station shall be considered individually and based on the following criteria:

- local topographic features including the slope of the ground, above and below ground obstructions and features,
- proposed layout of the particular development and of future developments,
- proximity of proposed and/or existing sewerage infrastructure,
- size and type of the pumping station,
- access considerations for operations and maintenance needs (including OHS&W issues),
- environmental considerations including visual impact, particularly the 15 metre high vent tube, odours, noise problems etc,
- availability of power, water etc,
- potential for site inundation (See Clause 4.3).

4.3 INUNDATION CONSIDERATIONS

Inundation of a station by flood waters can result in major environmental and health problems should raw sewage be flushed to the surface due to flooding of the sump, or as a result of total station failure due to a partially/fully submerged switchboard.

Inundation may also result in severe scouring around structures, particularly around the sump, valve chamber, ETSA supply pit, and possibly undermine critical components such as the electrical switchboard cubicle and the 15 metre high vent tube.

Accordingly, the Designer shall establish the levels of the top of the sump wall, top of valve chamber walls and top of the galvanised iron plinth supporting the electrical cubicle, so that those structures can not be inundated by a flood having less than a 1 in 100 year recurrence interval.

Furthermore, the surrounding paving shall be graded away from the sump, valve chamber, electrical cubicle, vent etc to prevent pooling and degradation of the

surface, and to ensure a safe working environment for operations and maintenance personnel (See Site Works in Clause 4.12.10).

4.4 LAND TENURE REQUIREMENTS FOR PUMPING STATIONS

4.4.1 Dedicated Allotment (Off Road Station)

All pumping stations (other than those in Clause 4.4.2) shall be located **off-road**, either on SA Water land, or on a dedicated allotment specifically acquired for the pumping station, or on land transferred by a Developer to SA Water.

The standard site size and layout for the most common type of station used by SA Water (ie non trafficable submersible type) is detailed in SCM Section M.

The size of the station site may need to be increased should odour control equipment, flow meters, retaining walls, embankments etc be needed, now or in the future.

Furthermore, any land required for access roads and/or vehicle turn-around areas, and for any cut and/or fill batters, shall be registered as an easement(s) to SA Water, and shall be labelled as:

- A right of way appurtenant to the allotment
- Easement to construct and maintain a roadway
- Easement to lay and maintain cables for transmission of electrical supply
- Easement to lay and maintain cables for telemetry purposes
- Easement for support of the pump station and roadway (batter, slopes, retaining walls if required)

Developers shall acquire and/or transfer the pumping station allotment and/or necessary easements to SA Water, at no monetary consideration to SA Water.

4.4.2 Stations in Road Reserve (Special Approvals)

In some very special circumstances (eg in unserviced built up areas) where a suitable dedicated allotment is not available, and where it is acceptable to SA Water, United Water (for the Adelaide area) and the Local Council, **approval may be given** to site a submersible type station (with trafficable cover - See Clause 4.10.4) within the road reserve, provided:

- the station sump and valve chamber are located in the road reserve but clear of the carriageway,
- the road is subject to **low** volumes of **local** traffic only,
- there is adequate room for a service truck and or crane to be parked within the carriageway adjacent to the station for several hours at a time, which will not restrict day to day traffic flows, and will not cause a safety hazard to operational and maintenance personnel or through traffic,
- ETSA supply, electrical cubicle, vent tube (15 metre high) and water supply point can be located in accessible, serviceable and safe locations, off the trafficable section of the road reserve.

4.5 HEAD AND FLOW CHARACTERISTICS (H/Q)

For both SA Water and Developer funded schemes, the technical design aspects of the pumping station involving sump diameter, sump depth, pump duty (ie the head/flow, H/Q characteristics) and the type and class of pumping main shall be the responsibility of the Designer, but verified by SA Water.

H/Q characteristics can only be determined from final Drawings for the pumping station and pumping main (Refer DS 11a Clause 7.3.3).

4.6 PUMPING STATION SELECTION OPTIONS

The Designer must select the appropriate station for the prevailing in-service conditions from the options detailed below.

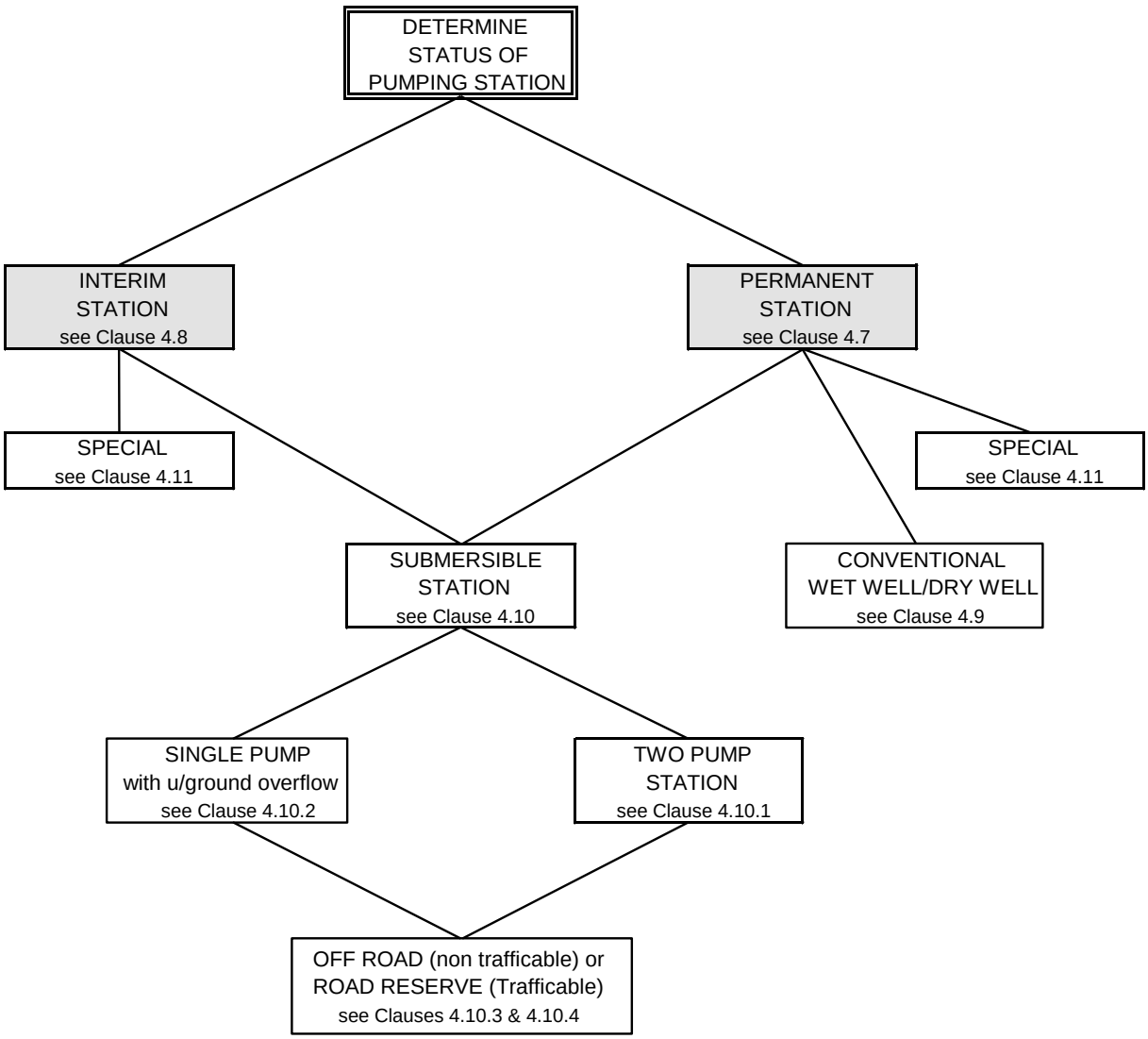

Figure 4.1 - Pump Station Options Flowchart

4.7 PERMANENT STATIONS

These can be either Conventional Wet Well/Dry Well stations or Submersible type stations.

Permanent stations are required to provide an on going service, and are to be designed with adequate provision to facilitate future upgrading to cater for ultimate flows.

In particular, sump size and depth **must** be adequate to cater for ultimate needs. In some cases, the initial smaller pumps may need to be upgraded in the future to match ultimate flows.

ETSA power supply to the station must meet ultimate needs at the outset (OR at least 1.5 times the initial design loading in cases where it is not possible to quantify the ultimate load).

4.8 INTERIM STATIONS

Interim stations (also known as temporary stations) may be required pending the completion of approach sewers or completion of another stage of the development (sometimes only a few years later), after which time the interim station will no longer be required.

Interim stations must perform to exactly the same standards during their in service 'life' as set for permanent stations, irrespective of how long or short that 'life' becomes, and accordingly, the same design considerations exist for both interim and permanent stations.

This applies equally for ancillary works associated with interim stations such as access roads, earthworks involving cut and fill, site drainage aspects, etc, as station failure will be attended by the same heavy service vehicles (sometimes articulated tankers) as permanent stations.

4.9 CONVENTIONAL WET WELL/DRY WELL STATIONS

Conventional Wet Well/Dry Well pumping stations usually contain larger pumping units than those required for submersible type pumping stations. The pumping units are installed in the dry well whilst the sewage is stored in the adjacent wet well.

Conventional stations are necessary where the design flows and pumping heads exceed the capacity of the Standard Submersible Type Station eg flows > 50 litres per second and combined static and dynamic head > 50 metres.

Pumping plant generally comprises centrifugal pumps. To ensure that the centrifugal pumps are always primed, the pumps are located below the level of sewage in the wet well. Conventional stations are often equipped with multi-stage pumps.

The design of these stations is not covered in this document in view of their unique nature and also due to the relatively infrequent need for such a station. Conventional stations will always be permanent facilities, located on their own dedicated allotment.

4.10 SUBMERSIBLE TYPE SEWAGE PUMPING STATIONS

Submersible pumping stations used by SA Water utilise a single combined pump chamber/sump, containing centrifugal pumping unit(s) immersed in the sewage.

Current SA Water approvals exist for various proprietary brands of submersible stations. However, approvals are limited to stations equipped with two pumps and for off road use on a dedicated allotment.

The capital cost of a submersible station is considerably less than that of a conventional station of comparable capacity.

Submersible type sewage stations can be either:

- Permanent or Interim (See Clauses 4.7 and 4.8)
- Two Pump or Single Pump (See Clauses 4.10.1 & 4.10.2)
- Standard Non Trafficable or Trafficable (See Clauses 4.10.3 & 4.10.4)

4.10.1 Standard Two Pump Configuration ('Stand By' Pump arrangement)

These are equipped with two pumps, a 'duty' pump and the 'stand by' pump, to ensure maximum security of operation with regard to pump failure or pump chokes.

Each pump must be capable of individually handling the design flow for the particular site (ie identical pump duties).

Under normal conditions, there is only one pump in operation at any one time. The 'stand by' pump is only brought into service (automatically) to operate either:

- simultaneously with the 'duty' pump, should the liquid level rise substantially within the sump as a result of:-
  - a partially choked 'duty' pump, OR
  - extreme inflow conditions arising from major storm events which illegally or otherwise introduce surface waters into the sewerage system, or even inundate the sump
- OR undertake the role of 'duty' pump for the station in the event of either a failure or overload of the initial pump.

Two Pump submersible stations shall be used:

- for flows up to a maximum of 50 litres per second (sump dia = 2.2 m), or up to 70 L/s (sump dia = 3.2 m)
- where the combined static and dynamic head is less than 50 metres.

All standard Two Pump submersible stations (whether Permanent or Temporary) shall have a cylindrical pumping chamber/sump of either 1800 mm or 2100 mm diameter, depending on inflow rate (See Clause 4.12.3).

The design of a Standard Two Pump Submersible station is detailed below in Clause 4.12.

4.10.2 Single Pump Configuration (with underground 'overflow')

Submersible stations with a **single pump** (ie no 'stand by' pump) are only permissible as part of a sewerage system which incorporates an underground 'overflow' pipe linking that sewerage system to an adjacent sewerage system independent of the Single Pump station.

In the absence of a 'stand by' pump, the underground 'overflow' must act as a viable flow control mechanism should that single pump fail, or become choked, or perhaps be unable to cope with unprecedented excessive inflows.

A critical element of the design of the 'overflow' is that in the event of pump failure (of the only pump), influent sewage is only permitted to partially surcharge the underground pipe network in that catchment (to the particular invert level of the underground 'overflow' pipe), and thence flow over into the adjacent sewerage system without **any risk** of surcharging householder drains or flooding properties or overflowing to the ground surface, in either of the two sewerage systems involved.

The 'overflow' could comprise either a graded underground pipe (or pipes) linking the two sewerage systems, laid approximately one 'pipe diameter' above the highest invert level of the recipient sewerage system, OR could comprise a 'summit' access chamber, whereby the two sewerage systems are directly connected by the 'summit' access chamber, but each grading away from it to their respective systems.

Either of these two 'overflow' facilities are satisfactory.

Single Pump submersible stations are relatively uncommon as usually it is not possible to incorporate an underground 'overflow' in the system, mainly due to either topographical reasons, or the physical characteristics of the sewerage system and/or the lack of availability of another independent sewerage systems nearby.

All Single Pump stations shall have an 1800 mm diameter (minimum) cylindrical pumping chamber/sump.

The layout and siting of a Single Pump station is identical to that of a Standard Two Pump submersible station.

4.10.3 Standard Non Trafficable Station (On a Dedicated Off Road Site)

These are by far the most common sewage pumping station used and are located **off-road** on a dedicated allotment (See Clause 4.4.1).

These submersible stations are termed non trafficable as the sumps are fitted with a reinforced concrete cover slab incorporating a pair of light weight

aluminium hinged covers suitable for pedestrian traffic only. The Valve Chambers are fitted with light weight aluminium hinged covers. In addition, the sumps and valve chambers are constructed 250 mm proud of the finished surface level to ensure vehicles can not be accidentally driven over them.

SCM Section M details the general arrangement and site details of a Standard Non Trafficable submersible type station.

Standard non trafficable submersible stations can be either:

- Permanent or Interim (See Clauses 4.7 and 4.8 above)
- Two Pump or Single Pump (See Clauses 4.10.1 and 4.10.2 above)

4.10.4 Trafficable Stations (Flush with Surface)

These submersible stations are termed trafficable as the sumps and valve chambers are fitted with reinforced concrete cover slabs which incorporate heavy duty opening metal access covers. The covers are capable of taking light vehicle loads.

The concrete slabs and covers are finished flush with the finished design surface levels.

Apart from the trafficable covers over the sumps and valve chambers, trafficable stations are similar to standard off road submersible stations in every other respect.

Trafficable stations can be used:

- within the Road Reserve, where especially approved (See Clause 4.4.2), OR
- where the station may be subject to some occasional vehicular traffic (eg parks), AND
- in those developments where for either environmental and/or visual reasons it is essential to conceal the station as much as possible.

Trafficable Stations can be either:

- Permanent or Interim (See Clauses 4.7 and 4.8 above)
- Two Pump or Single Pump (See Clauses 4.10.1 and 4.10.2 above)

When addressing inundation considerations (See Clause 4.3) and establishing final site levels, it is critical that the Designer remembers that the sump and valve chamber covers are flush with the design surface levels, compared to those of a Standard submersible station in which the covers are 250 mm proud of the surface.

4.11 SPECIAL PUMPING STATIONS

4.11.1 Submersible Stations With Tandem Pumps

In some design circumstances, very large pumping heads may demand that a submersible station be equipped with pumps in tandem, or 'piggyback', thus also necessitating a tandem set of 'stand by' pumps.

In these cases, the tandem pumps of both the 'in service' set and the 'stand by' set can be housed within a larger valve chamber.

4.11.2 Grinder Stations

These special stations are utilised very infrequently and for very specific situations. Currently there are **no existing** SA Water approved 'proprietary' grinder stations available for immediate use.

Grinder stations generally involve very low flows (up to 3.5 litres per second) and high head capability (say 20 to 30 metres), perhaps to service small remote communities or tourist establishments or caravan parks etc with the following design characteristics:

- low peak flow demand
- possibly long pumping distances, and
- particularly for handling effluent with a high fibrous content.

Under the above circumstances it would generally be impractical to install a larger standard submersible station with the usual larger pumping main.

Grinder stations can be a variation of a submersible station, except utilising special submersible type centrifugal pumps fitted with either a grinding or cutting mechanism as part of the impeller to reduce the sewage to a smaller particle size, suitable for pumping through a small diameter pumping main (say 50 mm or 63 mm MDPE). The usual larger size of pumping main generally associated with standard submersible stations would not be acceptable for low flow applications as the resultant flow velocities would generally be too small to achieve the minimum self cleansing requirements.

Grinder installations are some times also used as a pre-treatment process of fibrous effluent before being pumped up into small private treatment installations that may not be equipped with the usual 'solids' screening structures.

is still being developed and is nominally designed to remain in operation for up to 12 months. Where it is proposed to use this type of station the proponent (eg Developer) is required to initiate a proposal to SA Water to enable a mutually agreeable solution to be negotiated. Areas to be resolved include:

4.12 DESIGN REQUIREMENTS FOR A STANDARD SUBMERSIBLE STATION

Standard Submersible stations are synonymous with the following notable characteristics:

Usually Permanent.
Two Pumps ('In service' pump and 'Stand by' pump)
Off Road (Dedicated allotment)
Non trafficable.

SCM Section M details the general arrangement and layout of a Standard submersible type of station, including the sump, 'control' access chamber, inlet sewer, valve chamber, ETSA supply, venting, telemetry, fencing, siteworks etc.

The design of the pumping station involves determining the:

• Station duty	(Head/flow H/Q characteristics must be determined for immediate and ultimate development needs)
• Sump capacity	(Diameter and depth)
• Type and Class of Pumping Main	(See Section 5)
• Arrangement and Layout of the Station	(See SCM Section M)
• Siteworks	(See SCM Section M)
• On-site sewage storage facility	Capacity for at least 2 hours at average inflow, in the event of a general power failure
• Levels:-	
- Site levels	(See SCM Section M)
- Levels of adjoining roadway	(Top of kerb, water table inverts, crown etc)
- Access roads and turn-around area	(If applicable)
- Sump and valve chamber inverts	
- Top of sump wall & top of valve chamber wall	
- Incoming sewers	
- Valve chamber pipework and pumping main	(See Inundation Section 4.3)
- Flood levels	
• Vehicle Access Details	(Including Access Roads and Turn-around Area, if applicable, and relationship with the adjoining public road)
• Electricity Supply Requirements	

4.12.1 'Control' Access Chambers

The 'Control' Access Chamber (See SCM Section L) shall be cylindrical with a minimum internal diameter of 1500 mm and shall be fitted with a trafficable cover and finished flush with the design surface level.

4.12.2 Inlet Sewer

The sewerage scheme served by the pumping station shall be designed such that all sewers in that system shall flow to the 'Control' Access Chamber and thence, via a single 'Inlet Sewer' into the pumping station sump.

The inlet must be diametrically opposite the pumps to avoid turbulence of the incoming flows which can result in air entrainment into the pump suctions, causing pump cavitation. This is particularly important when the effluent level is drawn down to its lowest level during any pumping cycle.

The Inlet Sewer shall enter the sump via a 'jump up' as shown in SCM Section M, and to accommodate the 'jump up', the minimum centre to centre distance from the 'Control' Access Chamber to the sump shall be 5.5 metres.

4.12.3 Pumping Station Chamber/Sump

The precast concrete cylindrical pump chamber/sump can be either DN 1800 mm, DN 2200 mm or DN 3200 mm.

The Standard station is fitted with a reinforced concrete cover slab incorporating a light weight aluminium hinged cover (See Clause 4.10.3).

The sump contains the two pumps, pump bases, guide rails, lifting chains, delivery pipework and liquid level control mechanisms.

The sump diameter is determined by the inflow rate, and can be selected from the following data:

Table 4.1 - Sump Diameter Selection

Sewage Inflow (L/s)	Sump Diameter (mm)
<10	1800
11 - 50	2200
50 - 70	3200

The depth of the pump sump below the inlet sewer invert shall be a minimum of 1.4 metres. Larger depths (or larger sump capacity) may be necessary if the number of pump starts per hour is excessive.

The maximum overall sump depth (from the top of the structure to sump invert) shall not exceed 8 metres.

4.12.4 Valve Chamber

The depth of the valve chamber will depend principally upon the combined effect of the following factors:

- 750 mm minimum cover over the pumping main,

(for stations adjacent to a public road, the dominant design condition will be achieving this depth of cover at the alignment of the kerb and water table),

- the pumping main being 'level' within the station site,
- the site gradient for drainage of surface waters.

NOTE: A site gradient for drainage purposes towards the street (compared to a similar gradient towards a rear reserve, for example) will result in a significantly deeper valve chamber, in view of the mandatory 750 mm cover over the pumping main at the location of the street water table, and the need to keep the pumping main 'level' within the site.

The design of the pumping main shall commence at the outlet side of the valve chamber (See Section 5).

4.12.5 Switchboard Cubicle

The switchboard cubicle, including the switchboards and other associated components, shall be in accordance with SA Water documents TS79 and TG13.

4.12.6 ETSA Service

The Designer shall determine the ultimate duty of the pump station and apply to ETSA Corporation for the Service Rating.

The design of the ETSA Service Pit is such that it protrudes significantly above the ground surface, and thus has been very carefully sited on the standard drawings in SCM Section M to ensure it is well clear of the dual swing doors located on both the front and rear faces of the electrical cubicle.

4.12.7 Vents at Pumping Stations

Educt vents are required at all pumping stations. All vents shall be 300 mm in diameter and 15 metres high. Details of the vents, including assembly details and the underground connecting pipework are shown in SCM Section J.

The location of the vent on the pumping station site are shown in SCM Section M.

Whilst educt vents can be placed remote from the pumping station in circumstances where it is necessary to conceal the educt vent from view, vents can not be located further than 20 metres from the pump sump.

The 300 mm diameter in ground ventilation pipework linking the vent tube and the sump must be graded towards the sump at a minimum gradient of 0.5% as detailed in SCM Drg J3.

The invert of the vent pipe entering the sump shall be located a minimum of 750 mm above the high liquid level position in the sump. This will avoid submerging (or partly submerging) the vent inlet during the normal sewage level fluctuations within the sump (during each pumping cycle), between the low and high liquid level control switches.

Unless the sump is very shallow and the total pumping head is very low, SA Water will not tolerate deepening the sump to avoid 'submerging' the vent inlet into the sump as a result of siting the vent remote from the station, particularly on a site falling steeply away from the station.

4.12.8 Odour Control Equipment

Under certain conditions, depending on the age, temperature and composition of the raw sewage, it may be necessary to reduce the sulphide build up in the pumping main by the installation of odour control equipment in the pumping station site.

Under these circumstances, additional land will be required at the pumping station site to accommodate the odour control equipment.

In Developer funded schemes, the cost of provision and installation of all odour control equipment, including the provision of additional land shall be fully borne by the Developer.

4.12.9 Water Service

A 40 mm water service to the station (for sump wash down purposes) is required at all pumping stations and shall be located as shown in SCM Section M.

4.12.10 Site Works

Each pumping station site shall be graded and paved to ensure surface water is adequately drained away from the site (as detailed in SCM Section M), and into appropriate drains.

Cut-off drains or embankments may be needed around stations to re-direct surface water, collected from adjacent areas, away from the station and/or access road and vehicle turn-around areas.

Cut and fill batters for general siteworks and for access roads shall be as detailed in SCM Section M.

Design and natural surface levels shall be shown on the Drawings at all corners of the pumping station site and other pertinent locations.

The natural surface levels of the surrounding area immediately adjacent to the station shall also be shown (to define the general landscape levels and gradients,

or cut or fill), including levels at the vehicular entrance way, at top of kerb, street water table and back of footpath.

4.12.11 Access Roadway

Where a pumping station does not abut a roadway, an access roadway as well as a vehicle turn around area (See Clause 4.12.12) is necessary.

The maximum permissible gradient is 10% for compacted rubble pavements. Steeper gradients are permitted if the access roadways are bitumen sealed.

The design of access roadways including widths, camber, gradients, curve radii, batters, paving etc. shall be as detailed in SCM Section M. (See Clause 4.12.12 for the design of vehicle turn around areas).
It is essential that the design provides for adequate transition gradients from both the roadway into the pumping station, and also into and out of the vehicle turn around area.

For long roadways (exceeding 100 metres) with longitudinal gradients greater than 7.5%, or with sharp curves, or with steep cut and/or fill batters, SA Water may demand a wider than usual roadway over the critical sections.

In some circumstances, speed restriction signs, guard rails and/or painted hazard boards (to relevant Australian Standards) may need to be incorporated in the design for safety reasons, and/or where required by local councils/authorities.

4.12.12 Vehicle Turn Around Areas

The design of vehicle turn-around areas including widths, camber, gradients, curve radii, batters, paving etc shall be as detailed in SCM Section M.

To facilitate vehicle manoeuvrability, straight sections of roadway shall be provided at each end of the vehicle turn around areas as detailed in SCM Section M.

4.12.13 Earthworks

Earthworks and compaction requirements are detailed in SA Water Standard Specification for the Construction of Sewerage Systems, DS 11b.

4.12.14 Fencing

Each ‘Standard’ pumping station site shall be fenced to at least the minimum standard as detailed in SCM Section M.

Fencing is not required around trafficable pumping stations, however protection will be required for the switchboard cubicle and the vent.

Guard rails and/or painted hazard boards (to relevant Australian standards) may need to be incorporated in the design for safety reasons (eg where required by local councils/authorities).

4.12.15 Landscaping

Should any landscaping of pumping station sites, and/or planting of screening trees etc. for beautification purposes be required by Developers, then such work shall be carried out fully at the Developer's cost providing it has been approved by SA Water and does not conflict with local Council requirements.

SECTION 5: DESIGN OF PUMPING MAINS

5.1 SCOPE

Pumping mains shall be kept as short as possible to reduce maintenance and the detention time of untreated sewage in the pipeline, thus preventing septicity and the generation of gases resulting in odour problems and corrosion damage to parts of the sewerage system.

The location of pumping mains in roadways shall be in accordance with Clause 5.3.

The grading of pumping mains shall be in accordance with Clause 5.4.

The minimum size of a pumping main for untreated sewage (not macerated) is 100 mm diameter.

Refer Clause 7.3.3 for pumping main requirements on the Drawings.

5.2 TYPE AND CLASS OF PUMPING MAIN

The type and class of pumping main will be dependent upon the head (H) and flow (Q) characteristics for each specific site and for ultimate development trends.

The pumping head (H) shall be a combination of both Static lift and Dynamic head.

The inflow to the station will be dependent upon the catchment area and the possibility of other pumped flows entering the contributory system from other pumping stations.

Pumping Stations shall be sized (eg sump size, power requirements, etc) for ultimate H and Q characteristics, but may be initially equipped with smaller pumping plant to cater for initial development trends and flows.

For PVC pumping mains, the minimum acceptable pressure rating shall be Class 12, primarily based upon fatigue failure characteristics of PVC mains resulting from cyclic loadings rather than H/Q design analyses. Design of each pumping main shall include cyclic fatigue failure analyses.

SA Water may provide the ultimate flow needs for pumping stations. In some cases, SA Water may also provide the design H/Q characteristics for pumping stations. Otherwise these shall be the responsibility of the Designer.

Special pumping main materials may need to be specified on the Drawings for buried or suspended creek crossings, etc.

5.3 LOCATION OF PUMPING MAINS

5.3.1 In Roadways

In roadways, pumping mains shall be located in accordance with the provisions of 'SERVICES IN STREETS - A Code for the Design of Infrastructure Services in New and Existing Streets', and in particular, in accordance with the sketch in Annex B as referenced in Clause 2.1.1. Otherwise pumping mains shall be located in public thoroughfares or reserves to ensure ease of access for maintenance and to reduce the risk of damage to private property in the event of pipe failure.

Pumping mains shall **not** be located in private properties.

Pumping mains shall **not** be located in a trench shared with other services, but shall have their own dedicated trench.

Refer to DS 11a Clause 2.2 for clearances between pumping mains and other services in roadways.

5.3.2 In Easements

Where a satisfactory route in roads is not available or viable, then pumping mains shall be laid in easements. Easements for pumping mains shall be exclusively for sewerage purposes and other authorities shall not be permitted to share the sewerage easement to accommodate their facilities.

Easements are not required where pumping mains are laid in road reserves but shall be required where laid through council reserves, ovals or thoroughfares.

The easement widths for pumping mains shall be as determined below:

Table 5.1 - Easement Width Determination

Pipe Size (mm)	Easement Width (metres)
50 to 150	7
200 to 375	10
450 to 600	15

Drawings shall be submitted for pumping mains in accordance with the requirements provided herein (refer Section 7).

5.4 GRADING OF PUMPING MAINS

Pumping Mains shall be individually graded in accordance with the following criteria:

- From the sump into and through the valve chamber and within the station site itself, the pumping main shall be graded 'level' (allowing due consideration for construction tolerances).

- Thereafter and wherever possible, the pumping main shall be graded so that it is continuously rising. This is to ensure the pumping main is kept full at all times and does not empty after each pump cycle, thus averting odour problems and minimising corrosion.
- The highest point in the pumping main shall be adjacent to the discharge access chamber (refer SCM Section H).
- If falling grades can not be avoided, a local 'high' point (made up of pipe bends and fittings) shall be incorporated in the design immediately prior to the discharge Access Chamber (refer also to Clause 5.9), to ensure that the pumping main is always kept full and does not empty after each pumping cycle for the following reasons:
  - in general, to **avoid** large volumes of potentially foul air being expelled from the pumping main with each pump start, most likely resulting in unnecessary odour problems and complaints from local residents,
  - for pumping mains of Ductile Iron (DICL), or Mild Steel (MSCL), or other corrosive material, to **prevent** exposure and consequential damage to the internal surfaces of the pipeline by the corrosive action of sewer gases and the sewerage environment.
- Where intermediate high points along the main (ie. changes from rising to falling gradients) can not be avoided, air-relief valves and chambers shall be installed at these high points.
- The type and configuration of the air-relief valve assembly shall be as shown in SCM Section M, and the appropriate references shall be prominently shown on the Drawings.
- Where low points can not be avoided (ie. laying beneath a river), a pump-out branch shall be installed on the main (refer clause 5.13 and SCM Section M).
- Mains can be installed deeper than the minimum 750 mm final cover (where approved by SA Water) as a means of eliminating **intermediate** high points.

5.5 MINIMUM COVER AND MECHANICAL PROTECTION

During sewerage construction, earthworks, or road construction etc, the minimum cover to ensure mechanical protection of the pumping main shall be no less than 600 mm. The design minimum cover (and final cover) to the pumping main shall be no less than 750 mm.

Where the minimum depth of cover can not be achieved (beneath creeks or at crossings with other services etc), adequate mechanical protection shall be provided for the pumping main similar to that for sewers as detailed in Clause 2.5.2.

NOTE: The pumping main at the valve chamber may be considerably deeper than 750 mm, to accommodate the minimum cover beneath the kerb and water table at the street boundary, (and also maintain a 'level' gradient within the pumping station site) and/or accommodate local depressions in the soil profile. When this occurs, valve extension spindles and access ladders are required in the valve chamber.

5.6 EMBEDMENT

The embedment material and compaction for pumping mains shall be in accordance with SCM Section G.

5.7 ALIGNMENT AND GRADIENT CHANGES

For rubber-ring jointed pipelines, all alignment and/or gradient changes shall be made by:

- Using standard commercially available rubber ring jointed bends (long radius where available).
- Minor changes in direction can be incorporated at each socket / spigot rubber ring joint in accordance with the manufacturer's specification, (greater rotation causes spigot to faucet binding and joint failure).
- Combination of the above.

5.8 BEND LOCATIONS AND JOINT DEFLECTIONS

All bend locations, and/or joint deflections where used, shall be shown on the Drawings as detailed in Clause 7.3.3.

5.9 CONNECTION INTO DISCHARGE STRUCTURE

The pumping main shall be connected to the discharge Access Chamber (soffit to soffit) in accordance with SCM Section H.

The Designer shall ensure that the 'high' point of the pumping main is as close as possible to the discharge Access Chamber (refer Clause 5.4).

The design shall include an analysis of potential odour problems and the possible need for venting.

5.10 THRUST BLOCKS AND ANCHORS.

Concrete thrust blocks will be required at all bends (horizontal and vertical) and at all junctions, in-line stop valves (and temporary dead-ends where applicable) on pumping mains with rubber ring joints. The thrust blocks/anchors shall be designed to resist the hydraulic forces developed in the pumping main during hydraulic testing.

Thrust blocks shall be poured against sound undisturbed faces of excavations and the concrete shall be kept clear of the pipe joints.

For Anchor and Thrust Block Design refer to **Water Supply** Construction Manual Section B.

5.11 TYTON-LOK JOINTS FOR DICL PUMPING MAINS

In lieu of concrete thrust blocks for DICL pumping mains only, Tyton-lok joints may be specified to restrain the internal forces on the pipeline.

Where the Tyton-lok jointing method is used, the Designer must ensure that there is sufficient 'restrained length' of the buried pipeline to balance the internal forces on bends, in-line stop valves, etc. The 'restrained' lengths shall be determined from the **Water Supply** Construction Manual, Section B and these lengths shall be shown on the Drawings.

5.12 ISOLATING VALVES

Isolating valves shall be installed on pumping mains at regular intervals not exceeding 1500 metres.

Each isolating valve shall be installed with a sewer air-relief valve and pump-out branch, as an assembly, as detailed in SCM Section M. In addition a 'Combination Indicator Sign and Post' shall be installed for each specific site, as detailed in SCM Section M.

5.13 PUMP-OUT BRANCHES

Pump-Out branches shall be installed at all low points, (ie. changes from falling grades to rising grades), and at every 500 metres, so that sections of the pipeline can be drained (or pumped out) for maintenance purposes.

Two types of pump-out branch are available as detailed in SCM Section M, with the specific selection based upon actual site conditions. A Sewer Pump-out Branch Indicator Sign and Post shall also be installed at each specific site, as detailed in SCM Section M.

Air relief valves (as part of an isolating valve set) may be used in lieu of Pump-out branches where their locations coincide with that of the proposed Pump-out branch.

5.14 AIR-RELIEF VALVES

Where approved by SA Water, air-relief valves shall be installed at all high points (ie changes from rising to falling gradients) along the pumping main.

Two sizes of air-relief valve assemblies are detailed in SCM Section M. A Sewer Air Valve Indicator Sign and Post shall also be installed at each specific site, as detailed in SCM Section M.

5.15 CORROSION PROTECTION

Some pump station components would require corrosion protection for the stations which are located close (say up to 1 km) to the coastline and in high ground water (salinity):

- Grade 316 or 316L stainless steel would be required for the following (as per WSA 04-2005 Sewerage PS Code page 70 and SA Water TS79):
  - The cabinet and parts (including doors, panels, bracing, stiffening, internal brackets, plinths, and other structural components)
  - Components that are located in continuously wetted areas in the pump sump
  - Miscellaneous items such as fasteners, mounting brackets, hinges etc

- In addition the vent and bolts (for the vent base) to be made from grade 250 steel and conform to AS 3678. The vent would need to be coated internally and externally with epoxy in accordance with SA Water TS 84. The bolts, nuts and washers are also required to be hot dip galvanized to AS/NZS 4791 after manufacture (SA Water TS 54).

- Concrete for sewerage applications is to conform to TS-3c.

For corrosion protection of DICL, MSCL, uPVC and CI pipes, valves and fittings, refer to SA Water Sewer Construction Manual (aka Red Book) Section M.