Development manual planning scheme policy (PSP)
SC6.4.11 Water and sewerage

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SC6.4.11.1 Water and sewerage infrastructure

(1) Introduction – planning and design guidelines

(a) General

This section has been developed to document the requirements for delivery of water and wastewater services to the community.

(b) Intent of the section

This section has been developed to detail relevant information pertaining to planning and design projects, and to collate Council practices not documented elsewhere. Its intended use is as a reference manual for:

(i) internal Council staff;

(ii) external consultants engaged to perform specific commissions; and

(iii) developments that include water and wastewater infrastructure.

(c) Application

These guidelines shall apply to sewerage and water supply distribution, collection, and pumping in the areas of:

(i) planning;

(ii) design;

(iii) technical specifications for approval;

(iv) preparation of technical contract documentation; and

(v) collection and submission of As Constructed details.

It excludes information on the presentation of drawings.

(d) Purpose

The purpose of these guidelines is to ensure that:

(i) all water supply and sewerage works are planned, designed and constructed to common standards throughout Townsville city and comply with codes and standards established by the relevant government authorities; including the *CTM Water Alliance Design and Construction Code*;

(ii) the reticulation and pumping systems provided are hydraulically adequate for the demands from the currently planned stage of development within any Water Supply/Sewerage Scheme at any point in time;

(iii) the total system of reticulation, pumping, and treatment, is progressively planned and developed with adequate capacity to meet the ultimate requirements of the particular Water Supply/Sewerage Scheme; and

(iv) the quality of water supplied, and the quality of effluent disposed by the Council meets acceptable minimum standards established by the relevant government authorities.

(e) Cairns, Townsville, Mackay (*CTM*) *Water Alliance Design and Construction Code*

Unless otherwise noted within these guidelines, the *CTM Water Alliance Design and Construction Code* (including associated references) applies to the planning, design and construction of all water and wastewater works in Townsville. The document is included as intrinsic material to the Development Manual.

(f) Acceptance of designs and documentation

Externally produced designs and documentation including drawings shall be certified by a Registered Professional Engineer of Queensland (RPEQ).

(2) Introduction – network modelling guidelines

(a) Reference and source documents:

Clause SC6.4.11.2 (4) and SC6.4.11.4 (3) Water and sewer network modelling guidelines must be read in conjunction with:

Clauses SC6.4.11.2 Water planning and design guidelines and SC6.4.11.4 Sewerage planning and design guidelines;

Cairns, Townsville, Mackay (*CTM) Water Alliance Design and Construction Code*; and

Townsville City Plan.

Editor's Note - These guidelines are not intended for use in building hydraulic services or irrigation design.

(3) Determining when to complete a network modelling analysis.

The circumstances under which a network model is required is listed under Clauses SC6.4.11.2 (4) Water network modelling, and SC6.4.11.4 (3) Sewer network modelling. The process flow chart in Clause SC6.4.11.9 Attachment A demonstrates the decision process that is to be followed when considering the requirement for a network analysis.

(a) Available information

Planning demand and loading rates for water and sewerage infrastructure design are listed in Part 4 Local Government Infrastructure Plan of the Townsville City Plan.

Council has established a number of sewer network models covering service catchments across the city. A map showing sewer catchments, modelling status and latest planning report information can be requested from the Development Assessment Unit (DAU) of Council.

A city-wide water network model is also available for use.

Editor's Note - Access to Council's citywide water and/or sewer network model/s are available to appropriately qualified users approved by the Strategic Infrastructure Planning Unit of Council.

Plans for Trunk Infrastructure (PFTI) are available and detail trunk infrastructure that is planned for by Council to service the Priority Infrastructure Area (PIA). These should also be referred to in order to determine if your development may affect or should take into consideration planned infrastructure in its vicinity.

(b) Conducting a preliminary needs analysis

An applicant for a development must follow the flow chart in Clause SC6.4.11.9 Attachment A for their development to identify any potential impacts on the water and sewer networks. Where an impact is anticipated, it is likely that an analysis will be required to demonstrate compliance with design standards. The level of modelling assessment required is dependent on the impact expected.

Editor's Note - Designers should contact the DAU of Council to confirm the level of modelling necessary. It is encouraged that this assessment be completed prior to application lodgement to ensure an efficient approval process.

Editor's Note - The "Preliminary Needs Analysis" will determine if:

(i) a network analysis is not required; or

(ii) you are required to do a simplified network analysis; or

(iii) you are required to do a detailed network analysis, involving establishment of a new model, or use an existing model; or

(iv) you need to incorporate a network modification in your application, with details specified by Council.

(v) If a network analysis is required, it must be done in accordance with these guidelines.

(4) Provision of the TCC network model data

(a) Requesting information to inform your analysis

Modellers may request boundary condition information from Council, and/or access to Council's network models by submitting a “Request for Network Modelling Information” form included in Clause SC6.4.11.9 Online Form A - Form M1 - Request for network modelling information.

Editor’s Note - Click here to view Online Form A - Form M1 - Request for network modelling information.

In most cases it is desired that boundary condition information is sufficient to enable a modeller to prepare their own network model. However, depending on the size or impact of the development being considered, it may be necessary for the modeller to utilise Council’s network models to demonstrate:

(i) in the case of the sewer network:

1. receiving network capacity is sufficient; and
2. modified or realigned infrastructure as a result of the development has not adversely affected existing or planned for system hydraulics; and

(ii) in the case of the water network:

1. network supply capacity is sufficient; and
2. existing network hydraulic capacity is not adversely affected by any changes to the supply network as a result of the proposed development.

Generally, where trunk infrastructure may be affected by the proposed works, Council’s network models must be used to verify the impact and identify required mitigation/augmentation options.

(b) Access to Council’s models

Access to Council's network model/s is available to appropriately qualified users approved by the Infrastructure Planning Unit of Council.

Editor's Note - For information on the approval process applicants should contact the Strategic Infrastructure Planning Unit of Council.

Council will make available copies of the relevant model/s to enable analysis of a development or for viewing existing network model information. The applicant must apply for copies of Council's network model/s by submitting the duly completed Agreement Contract Form - SC6.4.11.9 Online Form A - Form M1 - Request for network modelling information form. The modeller will need o agree to Council’s terms of use on this form.

(5) General requirements for network modelling

(a) Scale and spatial reference

“Simplified Models” may be developed as representative schematics of the proposed network. Manual calculations without the use of network modelling software may be permitted.

“Detailed Models” shall be constructed based on proposed design and/or development layouts. The layouts may be schematic but should remain representative of the proposed development layout. In order to enable import of models into Council’s existing network models, they shall be developed to the GDA1994 MGA Zone 55 coordinate system unless otherwise notified.

(b) Modelling timeframes

Refer to Sections 5.1 and 11.1 of the *CTM Water Alliance Design and Construction Code*. In particular, the reporting years shall coincide with the census collection years viz. 2026, 2031, 2036, and ultimate design scenario.

(c) Model calibration

Refer to *CTM Water Alliance Design and Construction Code*.

(d) Modeller experience and qualifications

Network modelling must be carried out by professionals suitably experienced and qualified in the undertaking of network modelling analysis and design. Models, associated reports, and designs must be certified by the appropriately qualified and experienced RPEQ.

(6) Copyright and ownership of submitted models

When a technical report or study is submitted to Council as part of a development application, this report/study, along with all components of the submission, can be made available to the public as part of the notification stage. The report can be provided to anyone seeking the report during this stage and following the approval. Use of the report for any third-party use will be at the complete risk of the third party. It should be noted that only the approved report including any Council requested amendments, will be referred to in future.

Once a development application is approved Council is permitted to use the model for incorporation into its overall city water and sewer models to inform its infrastructure planning.

SC6.4.11.2 Water supply planning and design guidelines

(1) Introduction

(a) Scope

The work to be carried out under Clause SC6.4.11.2 includes the design of a water supply system either as a stand-alone project or as part of a development.

(i) Inclusions

Clause SC6.4.11.2 covers the design of water infrastructure elements as per the scope of the CTM Water Alliance Design and Construction Code.

(ii) Exclusions

Clause SC6.4.11.2 does not cover requirements for:

1. bulk water storage – dams etc; and
2. water treatment plant design considerations.

Bulk water supply infrastructure will be planned and designed by Council in conjunction with experienced specialist consultants.

(b) Reference and source documents

Clause SC6.4.11.2 is to be read in conjunction with the current version of the following documents:

Section SC6.4.3 Standard drawings

Editor's Note - Standard drawings other than water and sewerage (such as road crossings) also contain information on water and sewerage infrastructure and shall also be referred to.

Cairns, Townsville, Mackay (CTM) Water Alliance Design and Construction Code; and

Workplace Health and Safety Queensland, Safe Design of Structures – Code of Practice.

(c) Document precedence

The order of precedence (highest to lowest) of documents shall be:

(i) This section;

(ii) *Cairns, Townsville Mackay* (*CTM) Water Alliance Design and Construction Code*; and

(iii) Section SC6.4.3 Standard drawings.

(2) Water supply planning

(a) Scope

Water supply system planning covers the requirements of the water distribution and reticulation system from the bulk supply system to the service connections. This includes pump stations, storage reservoirs, trunk water mains, and reticulation mains.

(b) Hydraulic loading assessment

(i) General

Refer to Section 5 of the *CTM Water Alliance Design and Construction Code*.

Hydraulic loadings shall be determined in terms of equivalent persons (EP) and developed into flows using the unit loading factors and peaking factors detailed in the following sections.

(ii) Equivalent population estimations

The ultimate equivalent population (EP) used to determine design flows shall be determined from the following:

1. designated value of EP per hectare for each zone type provided in Section 4.2.3 of Part 4 of the Townsville City Plan;
2. the location of various zone types as specified in the Townsville City Plan;
3. an assessment of the ultimate population, including the expected peak occupancy rates and the quantity of undeveloped land for each zone type listed in the Townsville City Plan; and
4. estimation of contributing loads for “Special Purpose” zonings (university, refineries, hospitals, etc.) shall be determined by an analysis of historic consumption and consultation with the institution regarding future development.

Editor's Note - Where staging of the works is necessary, the planner is to consider the expected growth rate for the area to develop loadings for intermediate planning horizons. This shall be based on the Council Growth Model which is available from Strategic Infrastructure Planning Unit. This model is based on population projection information available from the Planning Information Forecasting Unit (PIFU) and Queensland Government Statistician’s Office.

(iii) Design flows

Peak demands are to be calculated in accordance with *CTM Water Alliance Design and Construction Code Section 5.*

(iv) Design criteria

Water supply systems shall be sized in accordance with the requirements of *CTM Water Alliance Design and Construction Code* Part B.

(c) Network planning

(i) Purpose

Network planning is to be undertaken to meet the objectives of the *CTM Water Alliance*

Design and Construction Code Part A.

(ii) Network modelling

A water network model is required for all code or impact assessable material change of use (MCU)and reconfiguring a lot (RAL) applications where:

1. new trunk and/or reticulation mains are to be constructed as part of a development; or
2. the development requires trunk infrastructure identified in Council's Plans for Trunk Infrastructure to be constructed ahead of its planned date, or out of sequence identified in master planning; or
3. the proposed land use results in an increase in demand greater than what is presently allowed for in the Townsville City Plan; or
4. water mains are required to be relocated or reconfigured as part of the proposed works, and these works are expected to change the hydraulics of the existing supply.

Council also requires the development of a network model for:

a) the preparation of Infrastructure Master Plans; and

b) the preparation of Plans for Trunk Infrastructure.

Network modelling shall be undertaken in accordance with the *CTM Water Alliance Design and Construction Code* Section 5.6.

(iii) Level of assessment

Depending on the type of works in question, simplified or detailed modelling may be required todemonstrate compliance with these guidelines. Simplified or detailed assessments are defined below:

1. Simplified assessment

An assessment that demonstrates network capacity through manual calculations, or through the use of simplified network models (schematic style models); and

2. Detailed assessment

An assessment involving the preparation of detailed network models based on proposed design and/or development layouts.

Water and sewerage network modelling guidelines outline the process to be followed to obtain Council advice as to what level of assessment is required.

(iv) Timeframes

Master planning and associated whole of life cost analysis shall be undertaken in accordance with timeframes as indicated in the *CTM Water Alliance Design and Construction Code* in addition to the existing scenario. In particular, the reporting years shall coincide with the census collection years viz. 2026, 2031, 2036, and ultimate design scenario.

Council may request that master planning consider provision to adjacent developments to enable an efficient trunk network.

(3) Bulk water storage and water treatment

(a) General

Bulk water storage and water treatment are considered trunk assets and are beyond the scope of SC6.4 Development manual planning scheme policy.

(4) Water network modelling

(a) Scope

A water network model is required where listed under the requirements of Clause SC6.4.11.2 (2)(c)(ii) above.

(b) Model requirements – simplified assessment

A simplified assessment involves the use of manual calculations or simplified network models to demonstrate compliance with design standards. A simplified assessment must include:

(i) assessment of design demands in accordance with the *CTM Water Alliance Design and Construction Code*;

(ii) where necessary, hydraulic calculations based on fixed boundary conditions for both peak hour domestic and fire- fighting demand;

(iii) calculations can be undertaken manually, using spread sheets, or using network modelling software. Where modelling software is used, the model files shall be provided to Council as part of the submission; and

(iv) a brief report covering the requirements of this clause. Sketches of results are to be provided where they make it easier to interpret results.

(c) Model requirements – detailed assessment

(i) Format

The current network modelling software must be used for the development of new water network models. Models shall be set up such that all scenarios and options considered for the study are incorporated into a single model file. The model file(s) shall be provided to Council as part of the submission.

(d) Scenario planning

A scenario plan must be developed by the modeller prior to commencing modelling such that each scenario required for analysis is identified and that differences between scenarios are clearly understood.

The modeller must utilise parent and child scenarios and alternatives such that common information for each scenario is inherited to child scenarios, and that unique changes are clearly identifiable. A “parent” scenario should be applied for each design horizon or stage, and ultimate development. The following model structure provides an example of a model scenario structure.

1000- Existing Peak Day Demand (Extended Period Analysis)

1100- Existing Peak Hour Demand (Steady State Analysis)

e.g. Scenario 1110 - Existing Peak Hour with Infrastructure Option 1
e.g. Scenario 1120- Existing Peak Hour with Infrastructure Option 2 (Preferred)

1121- Existing Fire Fighting Assessment (Steady State analysis, automated)

2000- Ultimate Peak Day Demand (Extended Period Analysis)

2100- Ultimate Peak Hour Demand (Steady State Analysis)
e.g. 2110- Ultimate Peak Hour with Infrastructure Option 3 (Preferred)

2111- Ultimate Fire Fighting Assessment (Steady State analysis, automated)

As shown the scenario structure naming should be clear and transparent as to which design

case it represents, and the preferred option applied for the design should be marked.

(e) Technical specification

(i) Hydraulic method

Modelling must be undertaken using the Hazen Williams hydraulic calculation method, with pipe friction coefficients as listed in Clause SC6.4.11.2 Water and Clause SC6.4.11.4 Sewerage planning and design guidelines.

(ii) Losses across valves

Where control valves are required in the system, the valve should be modelled with appropriate loss factors/curves. The modeller must ensure that loss factors applied for design of a system can be achieved in reality by available products, and where possible apply the loss factor or curve for a design valve.

(iii) Pump curves

A design duty (single point pump curve) may be used initially when designing a pumping system however the modeller is to ensure that the pump duty proposed can be achieved by readily available pumps. Where possible an actual pump curve for a design pump shall be applied for modelling purposes. The pump curve/s shall illustrate compliance with the minimum and maximum velocity limitations.

(iv) Pump controls

Pumps shall be modelled with simple controls where possible. The modeller must consult with Council when applying pump controls to ensure it meets the requirements of Townsville Water operators.

(v) Reticulation

Master Planning Models shall model trunk infrastructure but may be requested to include non-trunk infrastructure, where deemed necessary by Council. Refer to Part 4.6 Definitions of theTownsville City Plan for the definition of trunk infrastructure.

Design Models shall model reticulation down to a DN63 pipe.

(f) Demands

(i) General

Design demands are to be calculated in accordance with Clause SC6.4.11.2 (2) of Water and sewerage planning and design guidelines.

Demands must be applied as Peak Day demand in litres per second (L/s), with the appropriate diurnal pattern applied for the particular land use.

Demands should be applied at the nearest network node, and within 40 m of the property boundary.

Where a node represents demands generated from different land uses, separate demand entries should be applied to the node to enable quick identification of the source of the demand.

(ii) Use of unit demand factors

The current network modelling software must enable unit demand factors to be applied, such that the resultant demand from the unit load, loading rate, and peaking factors are calculated as part of the modelling process. The use of this feature is required for master planning models, enabling tracking of design EPs modelled.

(iii) Diurnal patterns

Diurnal patterns represent fluctuations in demand load across a day. Patterns for various land uses are included below.

Table SC6.4.11.1 – Water Demand Daily Diurnal Variations

TIME	Demand Curve 10	Demand Curve 14	Demand Curve 17
	100% Commercial/ Industrial	100% Residential Former Townsville Area	Parks Demands
12:00 AM	0.63	0.26	3
12:30 AM	0.63	0.27	3
1:00 AM	0.65	0.31	3
1:30 AM	0.69	0.33	3
2:00 AM	0.76	0.34	3
2:30 AM	0.78	0.40	3
3:00 AM	0.76	0.44	3
3:30 AM	0.65	0.48	3
4:00 AM	0.52	0.54	3
4:30 AM	0.50	0.63	3
5:00 AM	0.56	0.70	3
5:30 AM	0.69	0.75	3
6:00 AM	0.82	0.81	0
6:30 AM	1.01	0.94	0
7:00 AM	1.12	1.02	0
7:30 AM	1.22	1.11	0
8:00 AM	1.32	1.18	0
8:30 AM	1.37	1.21	0
9:00 AM	1.41	1.08	0
9:30 AM	1.45	0.95	0
10:00 AM	1.47	0.83	0
10:30 AM	1.48	0.75	0
11:00 AM	1.50	0.68	0
11:30 AM	1.50	0.63	0
12:00 PM	1.50	0.57	0

12:30 PM	1.50	0.54	0
1:00 PM	1.49	0.52	0
1:30 PM	1.48	0.53	0
2:00 PM	1.44	0.54	0
2:30 PM	1.39	0.58	0
3:00 PM	1.31	0.68	0
3:30 PM	1.22	0.74	0
4:00 PM	1.11	0.93	0
4:30 PM	0.98	1.15	0
5:00 PM	0.86	1.55	0
5:30 PM	0.71	2.02	0
6:00 PM	0.61	2.43	0
6:30 PM	0.64	2.55	0
7:00 PM	0.74	2.57	0
7:30 PM	0.82	2.49	0
8:00 PM	0.89	2.28	3
8:30 PM	0.93	2.07	3
9:00 PM	0.97	1.88	3
9:30 PM	0.99	1.51	3
10:00 PM	0.97	1.28	3
10:30 PM	0.93	0.94	3
11:00 PM	0.84	0.65	3
11:30 PM	0.71	0.44	3
12:00 AM	0.63	0.26	3

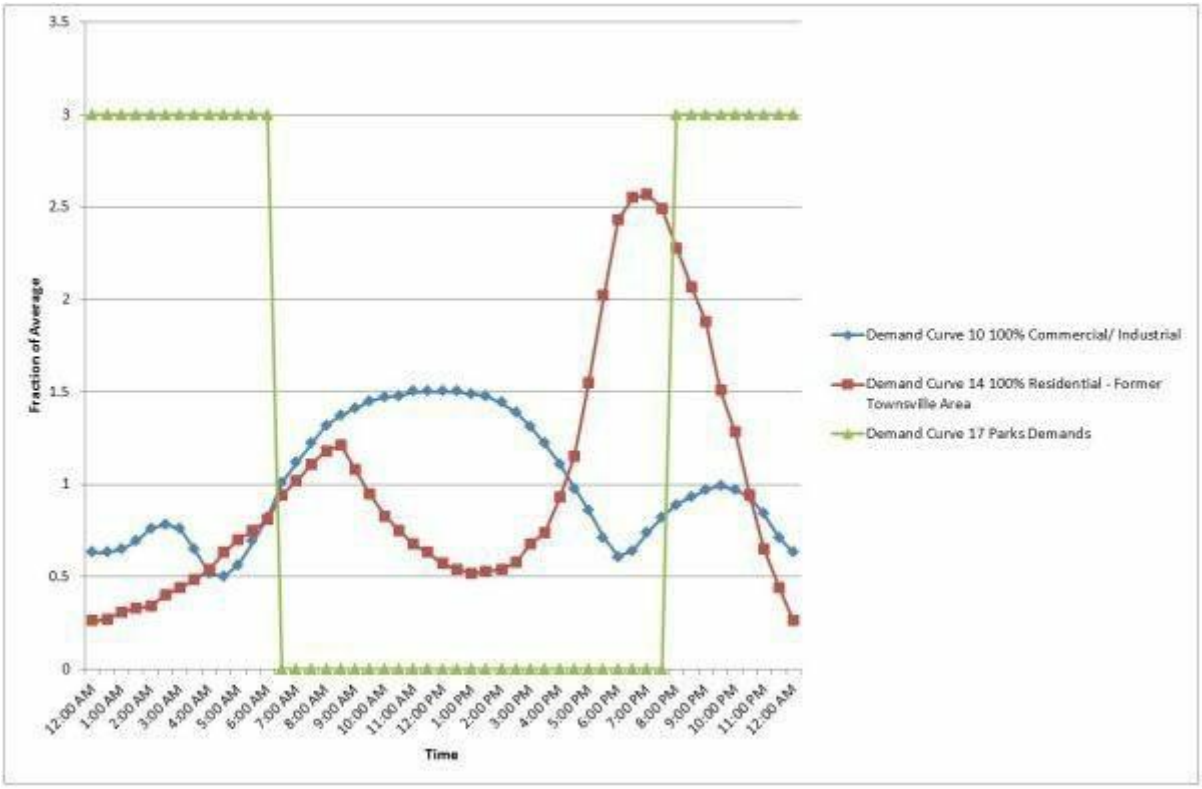

Figure 6.4.11.1 - Water Demand Daily Diurnal Variations

(g) Scenarios

(i) Extended period analysis

Refer to *CTM Water Alliance Design and Construction Code Section 5.6.2*.

(ii) Steady state analysis

Refer to *CTM Water Alliance Design and Construction Code Section 5.6.1*.

(iii) Boundary conditions

Demands may be applied directly as Peak Hour demand, or at Peak Day demand with peaking factor to represent Peak Hour.

(iv) Fire-fighting analysis

Refer to *CTM Water Alliance Design and Construction Code Section 6.1.3*.

(h) Reporting requirements

A water network modelling report must be prepared to document the process, assumptions and analysis employed through modelling to develop the infrastructure design and/or master plan.

The following provides details of sections to be incorporated into the modelling report. The modeller may provide further information as needed to justify decisions made through the modelling and design process.

(i) Introduction

1. development locality, lot/plan description, application number (if applicable);
2. objectives of study – design/master plan; and
3. brief methodology – describe level of modelling undertaken (simplified/detailed),

software used, reference to model overview in its appendix.

(ii) Population and demand assessment

1. population assessment based on land use categories, site plan showing layout and land use;
2. demand assessment showing demand calculation and peaking factors applied;
3. summary table showing total demand, with breakdown for each land use category, Average Day (kL/d), Peak Day demand (kL/d or L/s); and
4. summary table showing demand breakdown for each service catchment, where applicable.

(iii) Modelling assessment

1. modelling method – simplified or detailed assessment;
2. scenarios analysed, including description or reference to design standards applied;
3. modelling assumptions;
4. existing network description, including proposed connection points; and
5. modelling assessment:
   a) existing system capacity;
   b) existing system + ultimate development; and
   c) augmentations, new infrastructure options analysis including assessment of options at interim stages as specified in the *CTM Water Alliance Design and Construction Code* and shall coincide with the census collection years viz. 2026, 2031, 2036, etc., and ultimate design scenario.

(iv) Options analysis

Option analysis to be completed in accordance with *CTM Water Alliance Design and Construction Code*.

(v) Summary

1. preferred option, justification, capital works program.

(vi) RPEQ Certification statement as detailed Section SC6.4.2 Development application guidelines.

(vii) Appendix

1. for detailed models, model overview to be included in appendix (covering scenario structure, options and clearly outlining which scenario represents the design solution);
2. model map showing model layout (nodes, pipes, labels, and any relevant boundary conditions. e.g. reservoirs or head points applied); and
3. tabulated data and results – to be provided at peak hour analysis and firefighting analysis:

Nodes	Element ID Node Elevation Peak Hour Demand

	Calculated Hydraulic Grade (m) Calculated Pressure (m) For fire-fighting analysis Available fire-fighting flow Available pressure at firefighting demand
Pipes	Element ID Pipe diameter Material and class Length Start node Stop node Hazen Williams C value Flow rate Velocity Headloss gradient
Pump Stations	Element ID Pump type (fixed, variable speed) Pump configuration (duty/standby, etc.) Pump curve, if selected
Reservoirs	Element ID Reservoir capacity Top water level Bottom water level

(viii) pump stations - system resistance curve/s with pump curve/s overlaid. Pump curve/s may be duty point however the designer shall consider the capability of pumps on the market to meet such a duty (I.e. it needs to be physically achievable).

(5) Pump stations

(a) General

This section covers the design of:

(i) water supply pumping stations to service reservoirs; and

(ii) smaller booster pumping stations to boost pressure in the distribution system.

(b) Capacity and pump sizing

For sizing of all pumps refer to Refer to *CTM Water Alliance Design and Construction Code* Section 6.2.

(i) Pump station capacity

For sizing of all pumps refer to *CTM Water Alliance Design and Construction Code* Section 6.2.

(ii) System resistance curves

System Resistance Curves covering all expected duties of the pumps, including maximum and minimum head cases shall be prepared. A net positive suction head available (NPSHA) curve shall also be prepared.

(c) Building structure and general arrangement issues

(i) General

Refer to *CTM Water Alliance Design and Construction Code* Section 6.2.1.

(ii) Materials

Pump stations shall be contained in above ground structures, constructed from reinforced masonry block and/or reinforced concrete walls with concrete or metal (Colourbond) roofs.

(iii) Buildings - General

Level of pump station floor to be located a minimum of 300 mm above 1% AEP flood level.

(d) Pipework

(i) Each pump shall be provided with suction and discharge isolation valves and a non-slam non- return valve on the pump discharge.

(ii) At least one easily removable piece of pipework is required on each pump to enable efficient removal and replacement.

(iii) Steps and walkways in accordance with AS 1657 Fixed platforms, walkways, stairways and ladders - Design, construction and installation shall be provided over pipework such that access is readily available to both sides of each pump.

(e) Power supply and telemetry/instrumentation

Refer to *CTM Water Alliance Design and Construction Code* Section 6.2.5. Refer to water service provider for specific requirements.

(6) Storage reservoirs

(a) General

Storage reservoirs are considered trunk infrastructure. Consult with Council for specific requirements.

(7) Water mains

(a) General

(i) Extent

Mains shall be provided to service all properties within the development. Developer to refer to Council for any trunk mains to be allowed for in development design.

(b) Water main sizing

(i) Demands

Refer to *CTM Water Alliance Design and Construction Code* Table 4.1 and Section 6.3.

(c) Mains layouts and general arrangements

(i) Configuration

1. Distribution mains shall comply with the following:

a) configuration and extent of distribution mains is to be determined to suit the requirements of the ultimate development to the approval of Council, and

b) connections to reticulation mains network, unless required under the project and approved by Council.

(ii) Temporary dead ends are not permitted for more than the 12-month defect liability period, temporary loops are to be installed prior to end of defect liability period.

(iii) Pipe jointing

Pipelines should generally be rubber ring jointed. Mild steel cement lined pipes will normally be rubber ring jointed unless there are specific reasons for installation of continuously welded pipe segments. PE pipe shall be connected by butt thermal fusion. The use of electrofusion couplings are subject to approval by Council.

The following applies for flanged Joints:

1. flanged pipework shall be used where necessary at connections, to transfer thrust, or provide beam action for the pipeline to span;
2. flange classes shall be selected to suit the pipeline design pressures; and
3. flange classes shall be to AS/NZS 4087 Metallic flanges for waterworks purposes except where connecting to existing flanges from a different standard. Minimum flange classes shall be:

a) Class 14 for Steel Cast Iron; and

b) Class 16 for DICL.

(iv) Pipe anchorage

TYTONLOK joints or similar may be approved by Council in special circumstances. Marker tape shall be provided above the pipe to clearly show the extent of the restrained jointing.

(v) Above ground water mains

Above ground construction is to be approved by Council and shall comply with the requirements of the *CTM Water Alliance Design and Construction Code* and associated references.

(vi) Restoration

Refer to *CTM Water Alliance Design and Construction Code* and associated references.

For restoration under roadways refer to SEQ-WAT-1204-1.

(vii) Trenchless construction

Trenchless construction methods may be required as part of design. Trenchless construction shall be in accordance with *CTM Water Alliance Design and Construction Code* and associated references.

Trenchless construction shall also be considered where crossing of environmentally sensitive areas is deemed necessary as part of design.

(viii) Stop valves

The following applies:

1. stop valves for reticulation shall be provided in accordance with the requirements of *CTMWater Alliance Design and Construction Code* and associated references;
2. stop valves shall be provided so that a maximum of ten dwellings are isolated for maintenance purposes, and a maximum of four valves to be closed to isolate any section of reticulation main (maximum of one block to be shut down within the ten dwellings);
3. valves shall be located to avoid conflicts with driveways, telephone house service pits, and underground electrical boxes; and
4. stop valves are to be located on either side of a road crossing.

(ix) Envelopers

Refer to *CTM Water Alliance Design and Construction Code* and associated references.

SC6.4.11.3 Water supply construction

(1) Introduction

(a) Scope

This policy section provides standards, advice, and guidelines for the construction of water supply infrastructure including:

(i) mains up to DN600 nominal size; and

(ii) small pump stations.

This section excludes the construction of:

(i) reservoirs, including repainting of reservoirs;

(ii) treatment plants;

(iii) dams;

(iv) headworks, including bores and weirs;

(v) dosing plant; and

(vi) larger pump stations.

The Contractor shall carry out the work, and supply materials meeting the requirements of the reference documents, and, in particular, in accordance with the requirements of the *Water Supply Code of Australia* except as otherwise specified herein.

(b) Reference and source documents

References to the *Water Supply Code of Australia* are made where there are parallel sections or equivalent clauses to those in this section. Where not called up as part of this section, these references are identified by part and section numbers and enclosed in brackets thus (WSA Part, Section).

Reference and source documents that must be read in conjunction with this section are as follow:

(i) SC6.4 Dvelopment manual planning scheme policy sections:

Section SC6.4.3 Standard drawings

Section SC6.4.18 Concrete works

Editor's Note - Section SC6.4.3 Standard drawings shall take precedence over the Water Services Association of Australia (WSAA) standard drawings. Where any standard drawing used in conjunction with this section includes technical requirements that conflict with this section, the requirements of this section shall take precedence.

(ii) Australian standards:

Editor's Note - References in this section or on the drawings to Australian Standards are noted by their prefix AS or AS/NZS. Where not otherwise specified in this section or the drawings, the Contractor shall use the latest Australian Standard, including amendments and supplements, available within two weeks of close of tenders.

AS/NZS 1111	*ISO metric hexagon commercial bolts and screws*
AS/NZS 1112	*ISO metric hexagon nuts*
AS/NZS 1260	*PVC-U pipes and fittings for drain, waste, and vent applications*
BS7786	Specification for unsintered PTFE tapes for general use
AS 681	*Elastomeric Seals – Material requirements for pipe joint seals used in water and drainage applications*
AS 1289.5.4.1	*Methods of testing soils for engineering purposes – Method 5.4.1: Soil compaction and density tests- Compaction control test – Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.6.1	*Methods of testing soils for engineering purposes – Method 5.6.1: Soil compaction and density tests- Compaction control test – Density index method for a cohesionless material*
AS 1289.5.7.1	*Methods of testing soils for engineering purposes – Method 5.7.1: Soil compaction and density tests- Compaction control test – Hilf density ratio and Hilf moisture variation (Rapid method)*
AS 1349	*Bourdon tube pressure and vacuum gauges*
AS 1432	*Copper tubes for plumbing, gasfitting and drainage applications*
AS 1444	*Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties*
AS/NZS 3678	*Structural steel – hot rolled plates, floorplates and slabs*
AS/NZS 1477	*PVC pipes and fittings for pressure applications*
AS 1565	*Copper and copper alloys – Ingots and castings*
AS 1579	*Arc welded steel pipes and fittings for water and waste water*
AS/NZS 1594	*Hot-rolled steel flat products*
AS 1627.4	*Metal finishing – Preparation and pre-treatment of surfaces - Part 4: Abrasive blast cleaning of steel*
AS 1646	*Elastomeric seals for waterworks purposes*
AS 1657	*Fixed Platforms, walkways, stairways and ladders – Design, construction and installation*
AS 1830	*Grey cast iron*
AS 60529	*Degrees of protection provided by enclosures (IP Code)*
AS/NZS 2032	*Installation of PVC pipe systems*

ASNZS 2033	*Design and installation of polyolefin pipe systems*AS 2129 *Flanges for pipes, valves and fittings*
AS/NZS 2280	*Ductile iron pipes and fittings*
AS 2419.2	*Fire hydrant installations – fire hydrant valves*
AS 2528	*Bolts, studbolts and nuts for flanges and other high and low temperature applications*
AS/NZS 2566.1	*Buried flexible pipelines – Structural design*
AS/NZS 2566.2	*Buried flexible pipelines – Installation*
AS/NZS 2638.1	*Gate valves for waterworks purposes – Part 1: Metal seated*
AS/NZS 2638.2	*Gate valves for waterworks purposes – Part 2: Resilient seated*
AS 2738	*Copper and copper alloys – compositions and designations of refinery products, wrought products, ignots and castings*
AS/NZS 3000	*Electrical installations (known as the Australian/New Zealand Wiring Rules)*
AS/NZS 3008	*Electrical installations – selection of cable (Set)*
AS 3439	*Low voltage switchgear and control gear assemblies (Set)*
AS/NZS 3518	*Acrylonitrile butadine styrene (ABS) compounds, pipes and fittings for pressure applications*
AS 3571.1	*Plastics piping systems - Glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin - Part 1: Pressure and non-pressure drainage and sewerage which may not be relevant to this section*
AS 3571.2	*Plastics piping systems — Glass reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin - Part 2: Pressure and non-pressure water supply*
AS 3681	*Application of polyethylene sleeving for ductile iron piping*
AS/NZS 3690	*Installation of ABS pipe systems*
AS 3879	*Solvent cement and priming fluids for PVC (PVC-U and PVC-M) and ABS pipes and fittings*
AS 3862	*External fusion-bonded epoxy coating for steel pipes*
AS 3952	*Water supply –Spring hydrant valve for waterworks purposes*
AS 3996	*Access covers and grates*
AS/NZS 4087	*Metallic flanges for waterworks purposes*
AS/NZS 4129	*Fittings for polyethylene (PE) pipes for pressure applications*
AS/NZS 4130	*Polyethylene (PE) pipes for pressure applications*
AS/NZS 4158	*Thermal-bonded polymeric coatings on valves and fittings for water industry purposes*
AS/NZS 4321	*Fusion bonded medium density polyethylene coating and lining for pipes and fittings*
AS/NZS 4680	*Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*

AS/NZS 4765	*Modified PVC (PVC-M) pipes for pressure applications*
AS 4794	*Non-return valves for waterworks purposes – Swing check and tilting disc*

(iii) Other:

Department of Energy and Water Supply	*Planning Guidelines for Water Supply and Sewerage, April 2010 Chapter 6 amended March 2014*
Water Services Association of Australia (WSAA)	WSA 03 – 2011 - *Water Supply Code of Australia*
International Erosion Control Association (IECA)	*Best Practice Erosion and Sediment Control*, 2008

BS 410	Specification for test sieves
BS 7786	*Specification for unsintered PTFE tapes for general use*
ISO 3310	*Test sieves – Technical requirements and testing (set)*

(2) Materials

(a) General

The Contractor shall comply with the requirements of the manufacturer's recommendations regarding the handling, transport and storage of materials and as further specified in this section.

Prior to the delivery of products and materials, the Contractor is expected to obtain relevant product or material certification from the manufacturer which shall be presented to the Superintendent if requested.

The Contractor shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits.

If the Contractor proposes to use alternative products and materials other than the products and materials authorized by Council, the design drawings and this section, an approval from Council is required prior to delivery and use of alternative products or materials.

(b) Unplasticised and modified PVC (uPVC and PVC-M)

Unplasticised PVC (uPVC) and modified PVC (PVC-M) pipes and fittings for mains and suction pipes shall comply with AS/NZS 1477 and AS/NZS 4765, shall be suitable for use with rubber ring (elastomeric) seals complying with AS 1646 joints, and shall be of the class and size as shown on the design drawings. (WSA 03 – 2011, Part 1, Section 4.)

PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS/NZS 2032 and AS/NZS 2566.1.

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

(c) Acrylonitrile Butadine Styrene (ABS)

ABS pipes and fittings shall comply with AS/NZS 3518 to the class, size, use, shape, and colour as shown on the design drawings and installed in accordance with AS/NZS 2566.2 and AS/NZS 3690.

ABS pipes and fittings shall be joined in accordance with the manufacturer's instructions using solvent cement to AS 3691.

(d) Glass Reinforced Plastic (GRP)

The use of this material is not permitted by Council.

(e) Ductile Iron (DI) pipe and fittings

Ductile iron (DI) pipes and fittings shall comply with AS/NZS 2280 and shall be of the class, size, and lining, as shown on the design drawings, and installed in accordance with AS/NZS 2566.2.

Jointing shall be with rubber rings (elastomeric), complying with AS 1646, to the class and type as shown on the design drawings.

Flanges shall be to the table shown on the design drawings. Bolts and nuts for flanged joints shall be galvanised, or stainless steel as for the pumps specified herein, unless shown otherwise on the design drawings.

All pipework shall be sleeved externally with polyethylene sleeving in accordance with the requirements of AS 3681 unless specified otherwise to be coated and lined. All fittings shall be fusion bonded coated, in accordance with AS/NZS 4321, or wrapped. The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

(f) Steel pipeline and fittings

Steel pipelines and fittings shall comply with AS 1579 and AS/NZS 1594 and shall be of the class, size, lining, and coating as shown on the design drawings. (WSA 03 – 2011, Part 1, Section 4).

The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

The jointing system shall be rubber ring (elastomeric), complying with AS 1646, unless shown otherwise on the design drawings.

The Contractor shall not lay continuously welded steel pipelines parallel to, when in close proximity to high voltage power lines.

(g) Copper pipe and fittings

Copper tube and fittings shall comply with AS 1432 and shall be of the size and type as shown on the design drawings.

The Contractor shall install copper tube, capillary, and compression fittings, insulated from ferrous mains, as shown on the design drawings (WSA 03 - 2011).

(h) Polyethylene (PE)

Polyethylene pipe shall comply with AS/NZS 4129 and AS/NZS 4130 and shall be of the class and size as shown on the design drawings and installed in accordance with AS/NZS 2033 (WSA 03 – 2011, Part 1, Section 4).

Jointing shall be by butt thermal fusion or by electrofusion couplings, or with compression fittings.

Fittings up to 110 mm shall comply with AS/NZS 4129. Fittings from 110 mm to 600 mm shall be ductile iron in accordance with AS/NZS 2280 and coated internally and externally in polyethylene in accordance with AS/NZS 4129.

The Contractor shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown on the design drawings.

(i) Steelwork

Structural steelwork, including ladders, brackets, and covers, complying with AS 1657, shall be abrasive blast cleaned to AS 1627.4 Class 2.5 and hot dip galvanised to AS/NZS 4680. (WSA 03 – 2011, Part 1, Section 4.)

(3) Valves and hydrants

(a) General

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

The Contractor shall ensure that the valves and hydrants are installed to facilitate maintenance. The Contractor shall take into account the manufacturer's recommendations, the requirements shown on the design drawings, the type of connection, lubrication of connecting bolts, and the location of valves within valve chambers or type of backfill material. (WSA 03 – 2011, Part 2, Section 15.13.)

The type of external corrosion protection of buried valves and hydrants shall be fusion bonded medium density polyethylene coating to AS 3862 and AS/NZS 4321 or thermal bonded polymeric coating to AS/NZ S4158.

Flanges shall comply with AS 2129 and AS 4087 and shall be of the class and size shown on the design drawings.

(b) Stop valves

Sluice valves shall be resilient seated valves manufactured in accordance with AS/NZS 2638.2. The valves shall be flanged where permitted by Council unless shown otherwise on the drawings *(*WSA 03 - 2011, Part 1, Section 8.2).

Ball valves shall be flanged where permitted by Council unless shown otherwise on the design drawings (WSA 03 - 2011, Part 1, Section 8.2).

Butterfly valves shall be flanged where permitted by Council unless shown otherwise on the design drawings (WSA 03 - 2011, Part 1, Section 8.2).

Knife Gate valves shall be flanged where permitted by the Council unless shown otherwise on the design drawings (WSA 03 - 2011, Part 1, Section 8.2).

Scour valve assemblies shall be as shown on the design drawings.

Valves shall be operated by a removable key. The Contractor shall size "Tee Key" valve operators and hand wheels to operate the valves under all operating conditions throughout their full range with no greater than 180 Newtons applied to the ends of the key bar or the rim of the wheel.

Hand wheels, where specified, shall display an embossed or engraved arrow, together with "open" and/or "close" corresponding to the valve operation.

(c) Air valves

Air valves shall be of the double air valve type with integral isolating valve of minimum size DN80 and shall be installed as shown in the design drawings (WSA 03 – 2011, Part 1, Section 8.4).

Air valves shall be installed such that they can be maintained without affecting supply.

The Contractor shall obtain the consent of Council for the use of other types of air valves.

(d) Non-return valves

Non-return valves shall be of the swing check type to AS 3578 or AS 4794 of cast iron or steel body, cover, and disc with bronze body and disc seat rings. The leaf shall swing clear and provide an unobstructed waterway (WSA 03 – 2011, Part 1, Section 8.5). Wafer style non-return valves shall not be used.

The body cover shall be located and sized to allow the valve flap to be removed and the seat to be inspected without removing the valve body.

Where shown on the design drawings, non-return valves shall have an extended spindle, minimum grade 316 stainless steel complying with AS/NZS 3678, fitted with an adjustable counterweight, together with a proximity switch to indicate a no flow condition.

No flow switches shall have the following features:

(i) Be of the eccentric cam operated limit switch type.

(ii) Have a minimum rating of 10 amps, 240 V AC, 50- Hz.

(iii) Be oil tight and dust proof to IP 65.

(iv) Be suitable for 25 mm conduit entry.

(v) Be mounted on rigid stainless-steel complying with AS/NZS 3678 adjustable brackets. The brackets shall be free of sharp edges and exposed corners.

(e) Spring hydrants

Spring hydrant bodies shall be manufactured in accordance with AS 3952 and installed in accordance with AS 2419.2 except as varied below (WSA 03 - 2011, Part 1, Section 8.8).

The top of spring hydrants shall be between 100 mm and 300 mm below finished surface level as detailed in SEQ-WAT-1302-1. If necessary, this shall be achieved using hydrant risers of various heights.

Spring hydrants shall be protected internally and externally with fusion bonded coating in accordance with AS 4158, or equivalent protection approved by the Superintendent.

(4) Pipeline construction

(a) General

The Contractor, employees, or subcontractors, engaged in excavations, including tunnelling, are to be accredited for the work. Proof of accreditation must be provided to the Superintendent for approval prior to the release of the hold point.

The Contractor shall not change the pipeline alignment without prior concurrence of Council. The Contractor shall provide full details, of any proposed changes to the pipeline alignment, to the Superintendent for submission to Council. The Superintendent shall obtain the decision of Council prior to the release of the hold point.

(b) Location

The location of the mains and pump stations, sizes of mains, types of chambers and covers, and the classes of pipes shall be as shown on the design drawings. The pipelines shall be laid to grades and locations shown on the design drawings and to tolerances in the Water Supply Code unless directed otherwise by the Superintendent (WSA 03 – 2011, Part 2, Section 21). The Contractor shall confirm the locations immediately prior to construction

(WSA 03 – 2011, Part 2, Section 11).

(c) Cover over pipelines

The minimum depth of cover to be provided for mains, measured vertically from the finished ground level to the top of any socket, shall be in accordance with SEQ-WAT-1200-2:

Lesser cover may be provided where special protection of the pipelines has been shown on the design drawings or directed by the Superintendent; and

the maximum cover shall be 1200 mm, however, greater cover may be provided where special situations occur, where there is conflict with other services or to meet grading requirements.

(d) Crossings

Where a pipeline crosses a road, creek or involves features shown on the design drawings, under the control of any Authority, the Contractor shall carry out the work in accordance with the requirements of that Authority. The Contractor shall provide written notification to the Authority of the intention to carry out the work and pay the appropriate fees. (WSA 03 - 2011, Part 2, Section 15.16.) The Contractor shall obtain the written approval from the Authority prior to commencement of work. Such written approval shall be supplied to the Superintendent if requested. The Superintendent shall advise at the time of notification by the Contractor whether the option to request the written approval is to be exercised.

Where shown on the design drawings, the Contractor shall use trenchless methods for the installation of the mains. The installation of the main by open trenching shall not be permitted over the lengths designated for trenchless installation (WSA 03 – 2011, - Part 2, section 15.15).

The Contractor shall address, in its method statement for trenchless conduit installation, the following:

(i) general description of method and sequence of operation;

(i) size, depth and position of temporary pits required;

(ii) use of specialist subcontractors;

(iii) specialist equipment to be used; and

(iv) grout type and method of injection.

The encasement pipe shall be as detailed on the design drawings. The encasement pipe shall extend 1 m behind the back of kerb on either side of the carriageway.

The carrier pipe shall be positioned on support cradles and the carrier pipe shall be centrally located within the encasement pipe.

After installation and pressure testing of the carrier pipe, the Contractor shall fill the annular space between the carrier pipe and the encasement pipe with suitable grout or cementitious grout filler.

Where the carrier pipe is ductile iron cement lined (DICL), any length of pipe which is enclosed within the encasement pipe need not be wrapped in polyethylene tubing.

(e) Earthworks

The Contractor shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the design drawings or as directed by the Superintendent within the specified tolerances.

With excavation near existing underground services and structures, the Contractor shall be responsible in obtaining approval of the appropriate Authority and comply with all the requirements of the approval including having regard for drainage, dewatering, silt control, noise abatement, proximity to existing buildings and generally for the amenity of adjacent owners (WSA 03 - 2011, Part 2, Section 13). The Contractor shall locate, protect, and repair, as necessary, all services affected by the Works at the Contractor's expense.

The Contractor shall leave a clear space of 600 mm minimum between the edge of any excavation and the inner toe of stockpiles. No excavated materials shall be stockpiled against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be stockpiled separately and utilised to restore the surface after backfilling.

At the completion of work each day, the Contractor shall install safety fencing to statutory requirements along the edges of open excavations to isolate them from the public. The Contractor shall provide fenced walkways and vehicular crossings across trenches to maintain access at all times from carriageway to individual properties or within individual properties and advise all affected residents beforehand. All installations shall be of adequate size and strength and shall be illuminated to prevent accidents.

The Contractor shall carry out erosion and sedimentation control at all construction sites in accordance with *Best Practice Erosion and Sediment Control*.

The Contractor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open. (WSA 03 – 2011, Part 2, Sections 13.1 and 13.2.).

(f) Minimum trench widths for pipelines

The minimum clear width of trench (inside internal faces of timbering or sheet piling, if used) to a height of 150mm above the top of the pipe shall be as shown in Table SC6.4.11.2.

Table SC6.4.11.2 - Minimum Trench Widths

Nominal Size of Pipe (DN)	Minimum clear width of trench (mm) (inside timbering or sheet piling, if any)	
	Pipe other than PVC/PE	PVC/PE Pipe
100	450	450
150	450	450
200	500	450
225	550	500
250	550	500
300	600	550
375	700	650
400	700	650
450	750	700
500	850	800
525	850	800
600	950	900

Where the design drawings provide for a trench to be excavated across a paved or improved surface, the width of the trench shall be kept to a minimum. Bitumen and concrete surfaces shall be carefully cut, by saw-cutting or other means approved by the Superintendent, to provide a neat straight line free from broken ragged edges. The Contractor is responsible in obtaining approval from the relevant Authority and/or owner before starting any excavation across paved or improved surface.

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

(g) Excavation depth

The Contractor shall excavate trenches to 75 mm below the underside of the pipe barrel and socket or coupling except for mains to be laid on other than rock foundations or as otherwise shown on the design drawings.

The excavation shall be carried out such as to ensure solid and uniform support for each pipe over the whole length of barrel with chases provided for joints and wrapping.

(h) Support of excavation

The Contractor shall adequately support all excavations to statutory requirements as the Works proceed. When withdrawing supports, the Contractor shall exercise every precaution against slips or falls (WSA 03 – 2011, Part 2, Section 13.5).

The Contractor shall ensure that timber is left in place where its removal may endanger structures in the vicinity of the excavation.

(i) Pipe bedding

When excavation of the trench has been completed, the Contractor shall obtain the Superintendent's approval prior to commencing pipe laying, jointing, and bedding. The Superintendent’s approval of the excavated trench is required prior to the release of the hold point.

Crusher screenings shall only be used for pipe bedding where sand or other non-cohesive material is not readily available locally or where the Contractor can demonstrate that its use will not impede operations (WSA 03 – 2011, Part 2, Section 14.).

Pipes (excluding PVC/PE pipes) may be laid directly on other than rock foundation. The Contractor shall provide non-cohesive granular bedding, having a minimum thickness of 100 mm below the barrel and socket of the pipe, where rock or other hard material occurs in the bottom of the trench. The bedding material shall conform to the “sands” classification described in SEQ-WAT-1200-1, either loose clean sand and /or medium dense clean sand.

For PVC/PE pipes, irrespective of foundation, the material to be used for pipe bedding (underlay a minimum of 75 mm below the underside of the pipe barrel and socket, side support and overlay to a depth of 150 mm above the top of the pipe) as shown in Figure 5.1 in AS 2032 shall be in sand or other non-cohesive granular material, either crushed, natural or blended, and its grading shall fall within the limits in Table SC6.4.11.3, except that where the materials cannot be reasonably sourced from within the vicinity, the Contractor may use materials satisfying the classification in the second paragraph above provided also that the material meets the requirements for passing sieve sizes 9.5 mm and 6.7 mm shown in Table SC6.4.11.3.

Table SC6.4.11.3 - Grading of Bedding Material for PVC and PE Pipes

Sieve size aperture width (ISO 3310)	Equivalent BS sieve size (BS 410)	Percentage passing
9.5 mm	3/8 inch	100
6.7 mm	1/4 inch	90 - 100
425 µm	No. 36	40 - 90
150 µm	No. 100	0 - 10

All mains laid on grades steeper than 50% shall be encased in concrete as detailed on the design drawings.

(j) Laying and jointing pipes

Unless detailed otherwise in this section, the Contractor shall install pipes in accordance with AS/NZS 2032, AS/NZS 2033, AS/NZS 2566.1 or AS/NZS 3690 as appropriate (Refer WSA 03 – 2011, Part 2, Sections 15 and SEQ-WAT-1102-1 SEQ-WAT-1103-1 and SEQ-WAT-1105-2).

Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Contractor and, if required by the Superintendent, the Contractor shall suspend each one in a sling to enable the Superintendent to inspect it. If directed by the Superintendent, the Contractor shall oil valves and repack valve glands.

The Contractor shall ensure that the interior of the pipeline is clean and free from obstructions. Plugs shall be used to prevent foreign matter entering sections of pipeline which are left uncompleted overnight.

The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling, and initial testing. Any temporary supports shall be removed prior to completion of backfilling.

Except where solvent cement joints are needed to make up or install fittings, joints in pipelines shall be flexible, rubber ring (elastomeric) joints, either roll on or skid type or, where shown on the design drawings, mechanical joints, either fixed flange or bolted gland type.

For pipes with rubber ring (elastomeric) joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. The Contractor shall make the joint such that the witness mark shall, at no point, be more than 1 mm from the end of the socket.

Pipes may be cut as needed or directed by the Superintendent to suit closing lengths, to remove damaged pipe or fittings or to remove sockets (if necessary) when jointing a socketed fitting.

For field cuts, a mechanical pipe cutter shall be used, except that PVC/PE pipes may be cut using a power saw or a fine-toothed hand saw and mitre box. For field cuts of ductile iron or steel, the Contractor shall ensure that fire-fighting equipment, in working order, is on the site prior to the field cuts being made. If the Contractor proposes to use a petrol engined pipe cutter in an excavation, the Contractor shall ensure that a safe atmosphere is maintained in the excavation at all times.

The Contractor shall prepare the ends of any pipes cut in the field to the manufacturer's written instructions, or as directed by the Superintendent.

Where pipes are cut in the field, the Contractor shall make a witness mark on the pipe using a felt tip marking pen at the length specified by the manufacturer from the end of the pipe. The Contractor shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the Contractor shall refer to the socket manufacturer for the correct marking depth.

Where PVC/PE pipes are to be joined to ductile iron pipes, the joints shall be made by inserting a PVC/PE spigot into a ductile iron socket. Ductile iron spigots shall not be joined to PVC/PE sockets. Alternatively, multi fit mechanical couplings or flanged adaptor couplings may be used to join pipes of different materials.

The Contractor shall conform to the relevant statutory and work, health and safety requirements when cutting and disposing of asbestos cement pipes and submit a method statement for approval of the Superintendent.

Flexibly jointed pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The Contractor shall comply with the manufacturer's written recommendations in respect of maximum deflection for each joint provided that no joint shall be deflected to such an extent as to impair its effectiveness.

The maximum angle of deflection between adjacent pipes shall be limited to 2^{o} or 0.035 radian in areas subject to mine subsidence or slippage.

Unless otherwise directed by the Superintendent, the Contractor shall lay pipes on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface.

Detectable identification tape shall be laid along the line of non-metallic mains within 150 mm of the finished surface (Refer SEQ-WAT-1200-2).

(k) Trench stops

Where a pipe is laid on bedding at a grade of 5% to 14%, the Contractor shall construct trench stops consisting of bags filled with clay, or sand or cement stabilised sand and sealed (Refer SEQ-WAT-1209-1):

(i) at the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 100 mm deep to suit the width of bag shall be excavated into the bottom of the trench across its full width and into both sidewalls and extend to within 300 mm below finished surface level; and

(ii) the bags shall be placed around and above the pipe, as in (i) above, to give close contact with the pipe and to fill the entire space between the excavated recess and the pipe. Bags shall not be placed onto sand bedding.

The distance between trench stops shall be determined by the following formula:

$D = \frac{100}{G}$, whereby

D = Distance between stops in m

G = Grade of pipe expressed in %.

(l) Concrete bulkheads

Where a pipe is installed at a grade of 15% to 29%, the Contractor shall construct concrete bulkheads. Where a pipe is installed at a grade 30% to 50%, the Contractor shall construct concrete bulkheads integral with concrete encasement. Where a pipe is to be installed at a grade of 50% or more the Contractor shall provide a site-specific design. Bulkheads shall be

of 25 MPa concrete complying with Section SC6.4.18 Concrete works, 150 mm minimum thickness as follows (Refer SEQ-WAT-1209-1 and WSA 03 – 2011, Part 2, Section 15.10):

(i) Where concrete bedding or encasement to pipe is required, the 150 mm thick bulkhead shall be cast integral with the concrete bedding or encasement across the width of trench and shall be keyed into both sidewalls a minimum of 150 mm. The bulkhead shall extend to 300 mm below finished surface level or such other level as directed by the Superintendent.

(ii) Where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150 mm for the full width of trench.

(iii) A 75 mm nominal diameter drain hole shall be provided in the concrete bulkhead immediately above the top of the encasement bedding or foundation and crushed rock or gravel shall be placed in and at the upstream end of the drain hole to act as a filter. The gravel shall be 10 to 20 mm in size within 150 mm in all directions upstream and above the invert of the drain hole beyond which another 150 mm thick surround of gravel 2 to 10 mm in size shall be placed.

The distance between concrete bulkheads shall be determined by the following formula:

Concrete bulkhead (grade of 15% to 29%)

$$D = \frac{L}{G}$$

Concrete encasement (continuous) and concrete bulkhead (grade of 30 per cent to 50 per cent)

$$D = \frac{100}{G}$$ whereby

L = 80 x Pipe length in m = 450 m maximum

If L > 100 m use intermediate trench stops at spacing < 100/G

D = Distance between bulkheads in m

G = Grade of pipe expressed in %

(m) Valve and hydrant chambers

The Contractor shall construct around each valve and hydrant a chamber of the type and to the details shown on the design drawings (WSA 03 – 2011, Part 2, Section 15.13).

The concrete shall comply with Section SC6.4.18 Concrete works.

Valve chamber covers shall be painted with white pavement marking paint while hydrant chamber covers shall be painted with yellow pavement marking paint.

Where the type of valve chamber is such that the body, or part of the body, of the valve is to be backfilled before the valve chamber is constructed, the Contractor shall either wrap the valve using a tape consisting of synthetic fibre open weave cloth impregnated with saturated hydro-carbons, applied in accordance with the valve manufacturer's written instructions, or apply at least one coat of corrosion preventing material to the valve body after the valve has been installed but before backfilling. The coating material shall be compatible with the coating material which has been applied to the valve prior to delivery.

(n) Chamber covers and frames

Covers and frames shall not be warped or twisted. Surfaces shall be finished such that there are no abrupt irregularities and gradual irregularities shall not exceed 3 mm. Unformed

surfaces shall be finished to produce a surface that is dense, uniform, and free from blemishes. Exposed edges shall have a minimum 4 mm radius.

Tolerances for the dimensions on the COVER shall be 3 mm + NIL. Tolerances for the dimensions on the FRAME shall be - 3 mm + 3 mm.

Covers shall be seated as shown on the design drawings or as directed by the Superintendent.

Covers shall be finished flush with the surface in road pavements, footpaths, and other paved surfaces. Elsewhere, covers shall be finished 25 mm above the surface of the ground, or such other level as directed by the Superintendent, in a manner designed to avoid as far as possible, the entry of surface water.

Cast iron covers and frames shall be manufactured in accordance with AS 3996 and shall be installed and filled with concrete, as necessary, in accordance with the manufacturer's written requirements.

The Contractor shall take care to avoid lateral movement, cracking and subsidence when installing plastic covers and frames.

(o) Service connections

Not applicable

(p) Thrust and anchor blocks

Thrust and anchor blocks shall be constructed where shown on the design drawings to the dimensions depicted therein or as otherwise directed by the Superintendent. The blocks shall be provided at valves, flexibly jointed bends, tees, enlargers and reducers or any other point where unbalanced forces resulting from internal pressures will occur (Refer SEQ-WAT-1205-1, SEQ-WAT-1206-1 and SEQ-WAT-1207-1 and WSA 03 – 2011, Part 2, Section 15.7).

The Contractor shall provide permanent thrust blocks of 20 MPa concrete, complying with Section SC6.4.18 Concrete works, such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over the bearing area not less than that directed by the Superintendent.

The Contractor shall provide permanent anchor blocks of 20 MPa concrete, complying with Section SC6.4.18 Concrete works, of a volume not less than that directed by the Superintendent.

The Contractor shall provide temporary anchorages adequate to restrain the pipe when under test.

The Contractor shall obtain the consent of Council for the type and use of restrained joints, as an alternative to thrust blocks, in the case of congested service corridors and urgent commissioning.

(q) Concrete encasement

The use of Concrete encasement shall not be permitted unless otherwise approved by Council.

(r) Wrapping of pipelines

Where shown on the design drawings, the Contractor shall enclose a pipeline or a section thereof, in lay flat polyethylene sleeving (WSA 03 – 2011, Part 2, Section 15.11).

The materials to be used shall be high impact resistance polyethylene sleeving, of minimum thickness 0.2 mm polyethylene film approved by the Superintendent and 50 mm wide plastic

adhesive tape.

The width of the sleeving when flat shall be in accordance with the manufacturer's written recommendations for the size and type of the pipeline which is to be encased. Precautions shall be taken so that exposure to direct sunlight does not exceed 48 hours.

For dual trenching, pipelines shall be identified by colour sleeving, blue stripe for potable water and lilac for recycled water, or an appropriate identification tape.

Application of the polyethylene sleeving and plastic adhesive tape shall be in accordance with the pipe manufacturer's written instructions or as directed by the Superintendent. The Contractor shall take due care not to damage the sleeving during its application or during the backfilling of the trench. Each pipe shall be encased in a length of sleeving overlapped for a minimum of 250 mm at each field joint, and the ends of each length of sleeving shall be held in position with at least three circumferential turns of adhesive tape. As the polyethylene sleeving material covering the pipe will be loose, excess material shall be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of strips of plastic tape at approximately 1 metre intervals. Bends, tapers, and similar fittings shall be covered by polyethylene sleeving as specified for the pipes. The Contractor shall hand wrap valves, hydrants and irregular shaped fittings and joints using flat polyethylene sheets secured with plastic adhesive tape, or other suitable material, to provide an adequate seal. The flat polyethylene sheets may be obtained by splitting suitable lengths of sleeving.

The Contractor shall rectify any damage done to the polyethylene sleeving before, during or after backfilling of the trench.

(s) Corrosion protection of steel bolts and nuts

The Contractor shall wrap all galvanised steel bolts and nuts, used for installation below ground, of flanges, bolted gland joints, mechanical joints, tapping bands, using a tape, approved by the Superintendent, consisting of synthetic fibre open weave cloth impregnated with saturated hydrocarbons applied in accordance with the manufacturer’s recommendations or as directed by the Superintendent. Bolts and nuts shall be dry, clean, and free from rust immediately before wrapping.

(5) Pipeline testing and restoration

(a) Testing of pipeline

The hydrostatic pressure testing shall be conducted in accordance with Section 6 and Appendix M of AS/NZS 2566.2.

The Contractor shall pressure test mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. Pipelines shall be tested in sections approved by the Superintendent as soon as practicable after each section has been laid, jointed, and backfilled provided that:

(i) if so specified, or if the Contractor so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Superintendent; and

(ii) the pressure testing shall not be commenced earlier than seven days after the last concrete thrust or anchor block in the section has been cast.

For the purpose of this clause, “a section” shall be defined as a length of pipeline which can be effectively isolated for testing, e.g. by means of main stop valves.

Pressure testing shall not be carried out during wet weather unless otherwise approved by the Superintendent.

During pressure testing, all field joints, which have not been backfilled, shall be clean, dry, and accessible for inspection.

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

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

The hydrostatic test pressure, which shall be applied to each section of the pipeline, shall be 1200 kPa.

The Contractor shall maintain the specified test pressure as long as required by the Superintendent while the Contractor examines the whole section. In any case, the specified test pressure shall be maintained for not less than 4 hours. For the purpose of determining the actual leakage losses, the Contractor shall carefully measure and record the quantity of water added in order to maintain the pressure during the period of testing.

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

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

(ii) there is no visible leakage;

(iii) the measured leakage rate for pipes other than PE does not exceed the permissible leakage rate as determined by the following formula:

Q1 = 0.14DLH

where

Q1 = permissible leakage rate (litres per hour) D = nominal diameter of pipe (m)

L = length of section tested (km)

H = average test head (m); and

(iv) for PE Pipes:

V2≤ 0.55V1 + 0.14DLH

where

V1 = water volume (litres) added between Hour 2 and Hour 3 to maintain test pressure

V2 = water volume (litres) added between Hour 4 and Hour 5 to maintain test pressure

D = nominal diameter of pipe (m)

L = length of section tested (km)

H = average test head (m).

Any failure, defect, or visible leakage which is detected during the pressure testing of the pipeline or during the defects-liability period shall be made good by the Contractor at the Contractor's expense. This constitutes a hold point.

Unless directed by the Superintendent, the maximum test length shall be 1000 m.

(b) Connection to existing pipelines

Connections to existing pipes carrying water shall be made at such times as will cause the least interference with the supply. The Contractor shall make arrangements with Council or other Authority concerned for the timing of the work including the need to isolate the existing mains and notification of affected dwelling occupants. The Superintendent shall be given 5 working days' notice of such arrangements (WSA 03 – 2011, Part 2, Section 22.).

(c) Disinfection and flushing of pipelines

The Contractor shall disinfect all water mains after satisfactory testing in accordance with this sub-section (WSA 03 – 2011, Part 2, Section 20). The Contractor shall adopt procedures for the disinfection of the mains with the concurrence of Council. All test results submitted are required to be NATA certified.

After disinfection and testing is completed, the Contractor shall flush all water mains to ensure that the disinfected water used in the process do not enter sections of the system already in service. Flushing and disposal of disinfected water shall be in accordance with WSA 03 – 2011, Part 2, Section 20.2.

(d) Bacteriological testing

(i) General

Disinfection of a water main may be required to ensure suitable water quality parameters are maintained. When disinfection of a main is required, bacteriological testing of the disinfected water must be undertaken.

Disinfection may also be required where there is a likelihood of contamination. A bacteriological test must also be undertaken on all new disinfected mains following satisfactory completion of swabbing/flushing and pressure testing of the water main.

(ii) Test procedure

Water mains shall be tested as follows:

1. scour past the sampling point;
2. engage a NATA registered laboratory to collect representative water samples from the test section of the water main; and
3. dispose of testing water in accordance with the relevant environmental Regulator and/or WaterAgency requirements.

(iii) Satisfactory bacteriological test

The water main will be deemed compliant if:

1. the test results fall within the water quality parameter limits specified below; or
2. the water quality parameter test results in the test section of water main are no worse than the water quality parameter test results measured by testing an influent sample of existing mains water, provided that the influent sample was collected by the NATA registered laboratory at the same time as water sample from the test section of water main was collected.

Table SC6.4.11.4 – Water Quality Parameter Limits

Water Quality Parameter	Unit	Acceptable Range
pH	-	6.8–8.5*
Chlorine (free)	mg/L	0.5–2.0
Total Coliform count	cfu/100mL	0
Faecal Coliform count or E.Coli count	cfu/100mL	0
Heterotrophic Plate count	cfu/mL	0–10

* for cement mortar lined mains an upper level pH of 9.2 is acceptable

For failed tests, the water main shall be swabbed, flushed and/or disinfected and then re-tested. This shall be undertaken until all test results are satisfactory.

(e) Backfill and compaction

After laying and jointing of a pipeline has been completed the Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to the commencement of trench backfilling. The Superintendent's approval to the laid and jointed pipes is required prior to the release of the hold point. Backfill shall not be placed until the Superintendent has given approval.

Material for the side support and overlay of the pipe shall comply with the requirements for Clause SC6.4.11.3 (4)(i) Pipe bedding. The material shall be compacted in layers of not more than 150 mm to a Density Index of 70 as determined in accordance with AS 1289.5.6.1 and with reference to WSA 03 – 2011, Part 2, Section 16.3.

The Contractor shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150 mm thick as follows: (WSA 03 – 2011, Part 2, Section 17).

(i) Where the trench is within a roadway, proposed roadway, or footpath area, the remainder of the trench shall be backfilled (WSA 03 – 2011, Part 2, Section 17):

1. with a non-cohesive granular material, with a grading falling generally within the limits detailed herein for pipe bedding and compacted to Density Index of 70 when determined in accordance with AS 1289.5.6.1 for cohesionless materials:
    a) below 0.3 m of the subgrade road surface; and
    b) in the road reserve, up to top of overlay zone;
2. with selected material and compacted to 100% of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1, to top of subgrade level of the road surface, but excluding the pavement layers;
3. with selected material and compacted to 95% of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1, to finish surface level of the areas of trench outside of roadways; and
4. with road base and sub-base material as per existing or proposed pavement layers and compacted to 100% of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1.

(ii) Elsewhere, unless stated otherwise, the remainder of the trench shall be backfilled with ordinary excavated backfill material. Where suitable material is not available, granular material may be used for the full depth of backfilling. The material shall be compacted to a density Index of 70 when determined in accordance with AS 1289.5.6.1 for

cohesionless materials or 98% of the standard maximum dry density of the material when determined in accordance with AS 1289.5.7.1 for cohesive materials.

The Contractor shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.

The Contractor shall carry out compaction tests 75 mm to 100 mm below the level being tested.

Where a roadway is to be sited over existing infrastructure, excavation of trench material down to overlay zone and subsequent backfilling with appropriate select material to the underside of sub-base to the compaction requirements stated above.

The Contractor may compact backfill by trench flooding only where:

1. the ground and backfill material is cohesionless sand;
2. water for flooding has been sourced at the site;
3. the process will not create mud which would be moved off site by vehicles or construction plant.The process is closely monitored to ensure adequate volumes are added to sufficiently compact the materials to achieve the compaction requirements as specified in WSA 03 – 2011, Part 2 – Table 19.1; and
4. additives are not used.

(f) Valve and hydrant marking

The Contractor shall clearly mark the position of each stop valve, scour valve, air valve and hydrant on completion of backfilling in a manner and position in accordance with SEQ-WAT-1300-2 and/or shall be consistent with the method(s) in use by Council.

Where, in the opinion of the Superintendent, a valve or hydrant is at too great a distance from any existing wall, fence, kerb face, or post, the Contractor shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting. The distance to the valve or hydrant in metres, to an accuracy of 0.1 m, shall be permanently marked on the plate with legible numbers a minimum 80 mm high. Wooden posts are not to be used where there is evidence, by rotting or termite activity, that the integrity of the posts will be affected.

The post shall conform to the following requirements:

(i) the post shall be of sufficient length to be set firmly in place under saturated ground conditions;

(ii) when installed, the post shall project 1000 mm above the ground, provided that where tall grass or crops are likely to obscure the post, its height above the ground shall be increased to 1500 mm; and

(iii) the post shall be painted with 2 coats of white enamel for exterior use.

The Contractor shall fix marking plates as soon as practicable after each valve or hydrant is installed. However, the Contractor shall temporarily cover marking plates for hydrants using masking tape or other approved cover which the Contractor shall remove on satisfactory completion of the pressure testing of the pipeline.

For hydrants, the Contractor shall affix blue two-way reflective raised pavement markers to the road pavement in accordance with SEQ-WAT-1300-1.

(g) Restoration of surfaces

The Contractor shall clean pavements, lawns and other improved areas and leave them in the same order as they were at the commencement of the Works. The Contractor shall restore any fencing removed during construction and shall restore lawns with turf cut and set aside from the original surface and with turf imported from a source approved by the Superintendent (WSA 03 – 2011, Part 2, Section 23). The restoration works shall be done progressively and as soon as possible after the section of works is completed.

The Contractor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the defects-liability period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the defects-liability period. The Contractor shall maintain pavements with crushed igneous rock, gravel or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement.

The Contractor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the defects-liability period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the defects-liability period. The Contractor shall maintain pavements with crushed igneous rock, gravel, asphaltic concrete, or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement. Final restoration may include, if required by the Superintendent, the removal of temporary restoration.

In other than roadways, the Contractor shall place the backfill sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the defects-liability period in order that the surface of the completed trench may then conform to the adjacent surface.

Surplus material shall be removed and disposed of to areas arranged by the Contractor. Where dry weather conditions have persisted after the original backfilling, including during the defects-liability period, the Contractor shall take all necessary steps to consolidate the trench before removing surplus materials from the site.

In locations where, in the opinion of the Superintendent, surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench to the satisfaction of the Superintendent in such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Contractor shall maintain the backfill and adjacent ground until the expiry of the defects-liability period.

Where, within public or private property, the reasonable convenience of persons will require such, the Contractor shall level trenches at the time of backfilling or otherwise as directed by the Superintendent. The Contractor shall make good any subsequent settlement, as required by placing additional fill.

The Contractor shall immediately restore any damaged or disturbed private property and services.

Should the Contractor elect to tunnel under paving, kerb and channel or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces, and payment shall be made for the restoration of the surfaces as though they had been removed and replaced. The Contractor shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until

the end of the defects-liability period.

The Contractor shall provide notice to affected property owners of any pending works.

(6) Pump stations

(a) Pumps

Pump construction materials for centrifugal end suction pumps shall comply with the following:

Description	Material
Pump	
Casing and suction bend	Cast iron AS1830 Gr T200
Wear rings	Cast iron AS1830 Gr T200
Impeller	316 Stainless steel AS/NZS 3678
	Gunmetal AS 1565-905C
Impeller nut	316 Stainless steel AS 5200.053
Shaft	Phosphor bronze AS 1565-9060/316
Shaft sleeve	Phosphor bronze AS 1565-9060
Neck bush, lantern ring	Cast Iron AS 1830 Gr T200
Gland	316 Stainless steel AS 2837
Gland studs	316 Stainless steel AS 2837
Gland nuts	316 Stainless steel AS 2837
Fixing nuts and bolts handhold	316 Stainless steel AS/NZS 3678
Covers	316 Stainless steel AS 2837
	316 Stainless steel AS 2837
Fitted bolts and nuts, casing and dowels	316 Stainless steel AS/NZS 3678
Forcing screws	Cast iron AS 1830 Gr T200/ Fabricated steel
Water thrower and drip tray	
Pump set base plate	
Motor	
Motor frame and end shield	Cast iron/ mild steel
Motor terminal box	Cast iron/ mild steel
Motor fan cover	Mild steel
Motor fan	Metal
Holding Down Bolts	316 Stainless steel AS 2837
Mechanical Seals	
Seal faces	Tungsten carbide or equal

Springs	Nickel chrome steel
Secondary seal	Fluoro carbon or nitrite rubber

The Contractor shall provide a written warranty from the Manufacturer of the equipment. This action constitutes a hold point. The Superintendent's approval of the warranty is required prior to the release of the hold point.

The Manufacturer's warranty shall require the Manufacturer to accept liability for any defect in materials or workmanship which becomes apparent at any time within two years after the date of delivery of any piece of equipment used in Work under the Contract.

All nuts and bolts shall be manufactured in accordance with AS/NZS 1111 and AS/NZS 1112 150 metric series and fitted with washers beneath bolts heads and nuts.

Requirements are:

(i) all bolts, nuts and washers shall be stainless steel to AS/NZS 3678 and AS 2837, minimum grade 316. All bolts, nuts and washers are to be of the same grade and supplied passivated;

(ii) all threads are to be rolled;

(iii) all bolt heads and nuts shall be hexagonal;

(iv) all bolts, studs, set screws and nuts for bolting flanges and other pressure containing purposes shall conform to AS 2528;

(v) all nuts and bolts subjected to vibration shall be fitted with lock washers or lock nuts;

(vi) all concrete anchor bolts, nuts, locking nuts and large series washers required for the bolting down of pump set discharge bends shall be provided. These anchor bolts shall be as recommended by the equipment designer with a minimum diameter of 16 mm; and

(vii) concrete anchor bolts shall be chemical masonry anchor type, set to their full depth, suitable for the required duty.

Bolts on all flanges will protrude no more than 10 mm past the nut when tightened.

The Contractor shall apply sufficient anti-seize/anti-galling material to the threads of all stainless-steel fasteners. The material shall be Polytetrafluoroethylene (PTFE), either tape to AS 1272, dipped or sprayed, or molybdenum disulphide.

(b) Pressure gauges

The Contractor shall install one diaphragm protected, glycerine oil filled, direct mounting, bottom connection pressure gauge complying with AS 1349 per centrifugal pump installation. Cases shall be fabricated from stainless steel complying with AS/NZS 3678 or bronze. The protective diaphragm shall be suitable for dismantling for cleaning without affecting the accuracy of the gauge.

The gauge face shall be 100 mm in diameter and calibrated in metres head of water. The gauge shall accurately indicate the pump operating head and the pump no flow head.

Each gauge shall be supplied with the nominally sized metric equivalent of three of the following bronze fittings: gate valve, union, nipple and reducing nipple.

Gauges and fittings shall be screwed into the pipe wall of ductile iron pipes, or pipe fittings, 150 mm and larger. In pipework less than 150 mm, gauges and fittings shall be screwed into a tapping band. Where shown on the design drawings, the Contractor shall install a ball valve to allow removal of the gauge.

The pressure gauge range for single or parallel pumps duty shall be 0 to 1.7 times the closed valve head of the pumps.

(c) Electrical compliance

The Works shall be in accordance with the requirements specified in Clause SC6.4.11.6 Water and sewerage electrical and mechanical, except where this section or the design drawings indicate otherwise. The technical requirements detailed on the design drawings shall take precedence over the requirements of this section should clauses be in disagreement.

Except where Clause SC6.4.11.6 Water and sewerage electrical and mechanical requires a higher standard, works shall be carried out in accordance with AS/NZS 3000, the service rules of the supply authority and all relevant statutory authorities.

The Contractor shall supply the Superintendent a proof of compliance with a standard or specified test. Such proof shall comprise a test certificate from an approved independent testing authority.

The Contractor shall submit all designs and material to each Authority having jurisdiction for approval. The Contractor shall arrange for each Authority having jurisdiction to inspect the works. The Superintendent shall be advised a minimum of 7 working days in advance of the date of any inspection by an Authority. The Superintendent shall advise at the time of notification by the Contractor whether the option to attend the inspections is to be exercised.

(d) Switchgear and control gear assembly (SCA)

The Contractor shall supply and install the SCA designed and assembled by a manufacturer approved by the Superintendent.

The SCA shall be of outdoor, stationary, free standing, metal enclosed, cubicle type series with a minimum degree of protection of IP56D as specified in AS 60529.

All equipment shall be securely mounted on suitable mounting panels and comprise individual compartments. A hot dipped galvanised steel channel base shall be provided.

Starter contactors shall have the appropriate rating for the proposed pumps to AC3.

All necessary terminals with terminal and cable numbers shall be supplied and installed in accordance with the design drawings.

The Contractor shall liaise with the electricity supply authority to supply pad locks for the metering equipment, at the Contractor’s expense. The Council shall supply pad locks for use on the SCA at no cost to the Contractor.

The electrical characteristics of the SCA shall be:

(i) Main Circuit: 415/240 V, 50 Hz, 3-phase, 4-wire;

(ii) Motor Control Circuit: 240 V, 50 Hz;

(iii) Common Control Circuit: 240 & 24 V, A.C;

(iv) Prospective short circuit current: 14 kA for 1 second;

(v) Peak Factor: 2.2;

(vi) Power Factor Correction (Determined in consultation with Council); and

(vii) Earthing (M.E.N. system).

All cables shall enter the SCA from below.

The Contractor shall supply data from the switchgear supplier confirming Type “2” coordination between contactors, motor protection relays and corresponding circuit breakers, to the Superintendent.

Refer to standard specification TCC24 clause 18 for starter selection requirements and functional requirements for the project.

The Contractor shall carry out factory tests in the presence of the Superintendent's Representative and in accordance with the requirements stipulated in Clause SC6.4.11.6 Water and Sewerage Electrical and Mechanical and the results shall comprise all routine Tests specified in AS 3439.

Inspections and functional tests shall be in accordance with TCC24 clause 21.

The Contractor shall ensure, after approval has been given by the Superintendent, that any relays, programmable logic controllers, and fittings likely to be adversely affected during delivery shall be adequately protected or shall be removed and packed separately in protected containers. Where equipment has been removed, cover plates shall be provided.

The Contractor shall be responsible for any damage that may occur during transit and unloading at site.

The Contractor shall ensure that spare parts, tools etc., are packed separately from the main plant and shall be marked “Spare Parts”, “Tools” etc., as applicable.

The Contractor shall supply spare parts in accordance with the schedule supplied by the Superintendent.

The Contractor shall supply and install control equipment that is compatible with the existing equipment.

(e) Electrical installation

The Contractor shall liaise with the Supply Authority for the electricity supply to the pump station site.

The Contractor shall be responsible for all facilities required by the Supply Authority for revenue metering equipment and the payment of all associated connection, inspection fees and capacity charges.

The Contractor shall supply and install all cabling including consumer mains, motor, control and instrumentation cables, conduits, and electrical pits.

The Contractor shall install all wiring in HD-PVC underground conduits laid in accordance with the Supply Authority’s requirements, with a minimum 500 mm below the finished ground level in non-trafficable areas and 600 mm below the finished ground level in trafficable areas. The trench and backfill material shall be free of rocks and other foreign matter likely to damage the conduits.

The Contractor shall run electrical marker tape 150 mm below the finished ground level directly above the conduits for the entire length of the conduits. Marker tape shall be orange in colour, 150 mm wide and stamped with the words “DANGER – ELECTRIC CABLES BELOW” or similar.

The Contractor shall route all underground cabling with the approval of the Superintendent. Brass marking plates shall be positioned on a concrete surround clearly showing the direction of the incoming consumer mains. Wording and markings shall read “DANGER –

ELECTRICAL CABLES BELOW". The Superintendent's approval of the route of all underground cabling is required prior to the release of the hold point.

The Contractor shall determine the points of attachment on site and the Contractor shall supply and install any consumer's connection poles for the consumer mains required by the Supply Authority.

The consumer mains shall be generally run underground and commence at the point of attachment on a steel consumers pole (if applicable), installed near the property boundary and run-in conduit to the switchboard.

No aerial conductors are to be installed over structures, access road or vehicle manoeuvring areas.

The minimum size of the consumers' mains shall be sized to satisfy the following requirements:

(i) current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30% minimum;

(ii) be sized for a voltage drop less than 1.5% to the maximum demand as calculated;

(iii) be single core PVC/PVC cables. XLPE insulated cable may also be used;

(iv) comply with the requirements of the Supply Authority; and

(v) AS/NZS 3000 and AS/NZS 3008.

In addition to the requirements of the Supply Authority and as specified in Clause SC6.4.11.6 Water and sewerage electrical and mechanical, the main earthing conductor shall be run in conduit to the main earthing electrode. The main earthing connection shall be contained in an earthing electrode connection box similar to ALM type ERB-1 up to 50 mm^2 cable and a Type 4 pit for larger cable.

Earth electrode shall be bonded and suitably labelled with an engraved brass label.

Surge diverters shall be earthed in accordance with manufacturer's instructions.

The Contractor shall bond the pump station metallic pipework to the main earth. Refer also to TCC24 clause 28.1 for installation instruction requirements.

Metering equipment and installation shall comply with the Queensland Electricity Connections and Metering Manual.

The Contractor shall gland cables entering the outdoor SCA compartment using non-ferrous metallic or plastic glands with neoprene compression seals and connect the on-flow switch and pump motor cables to the appropriate terminals. Cables shall not be jointed.

The Contractor shall seal, at the completion of commissioning tests, all conduits into the outdoor SCA with a non-setting sealing compound to prevent the ingress of vermin.

(f) Testing and commissioning of pump station

The Contractor shall test and/or inspect all materials, equipment, installation, and workmanship to prove compliance with this section's requirements. The submission to the Superintendent of satisfactory test results constitutes a hold point. The approval of the Superintendent is required prior to the release of the hold point.

Tests and inspections shall comply with relevant Australian Standards.

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

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

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

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

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

(i) initial charges of lubricant in addition to any special lubricant requirements for initial flushing or treatment of the system or for “running in”;

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

(iii) electrical and instrument installation tests, including motor insulation tests and checking instruments against certified instruments and correcting as necessary;

(iv) tests of the correct functioning of automatic and manual control and protection equipment, including simulating danger conditions, mal-operations or failures, to check that all instruments and controls function correctly. These tests shall also include adjusting instrument set points and alarm settings and proving correct operation of alarms; and

(v) equipment and system operating tests. The Contractor shall certify compliance of each item and submit a signed copy to the Superintendent prior to commissioning.

The Contractor shall carry out pre commissioning tests to the satisfaction of the Superintendent and shall record the results of the tests on the appropriate Pre-commissioning Record Sheet.

Refer to TCC24 clause 28.1.11 for electrical test documentation requirements.

The Contractor shall furnish the Superintendent with one signed copy of each completed Pre-commissioning Record Sheet countersigned by the Superintendent's Representative who witnessed the test.

Commissioning is the running of the plant and equipment to ensure flow through the pumping system, carrying out any necessary testing and adjustments until it is ready and suitable for normal starting and running under service conditions.

The Contractor shall give the Superintendent 5 working days’ notice of the Contractor’s intention to undertake commissioning and supply to the Superintendent the copies of each of the pre-commissioning record sheets and three copies of the operational and maintenance manuals at the time that notice of commissioning is given.

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

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

The Contractor shall provide continuous supervision by personnel experienced in the operation of the equipment and shall have qualified personnel in attendance to carry out all

necessary adjustments and/or remedial work during the commissioning tests.

The Contractor shall prepare schedules, test record sheets and programmes for approval by the Superintendent prior to each stage of the overall commissioning.

The Contractor shall carry out final testing and commissioning (min 1 day duration) of the electrical services in conjunction with the mechanical equipment (e.g. pump, etc.) including setting and adjustment of equipment in accordance with the requirements in Clause SC6.4.11.6 Water and sewerage electrical and mechanical electrical and mechanical.

The Contractor shall arrange for all testing, commissioning, and any adjustments to be carried out by qualified personnel.

(g) Practical completion of pump station

The Contractor shall fulfil the following requirements before the Certificate of Practical Completion is issued:

(i) receipt by the Superintendent of a certificate of approval from the relevant statutory authorities;

(ii) pump station is in working order as demonstrated by the testing and commissioning;

(iii) approval by the Superintendent of Operating and Maintenance Manuals; and

(iv) receipt by the Superintendent of As-built drawings of the pump station.

(h) Telemetry

The Contractor shall make provision for equipment to link the pump station to the existing telemetry network to be provided by Council at the Contractor's expense. Refer to TCC24 clause 17.1, 28.2, Appendix B2 and Appendix C.

The pump station shall operate automatically by control signals from the telemetry system. In addition, either one or any combination of pumps may operate at any one time by control signals from the telemetry system.

(i) Operation and maintenance manuals

(i) Manuals shall contain the following information:

1. contractor's name, address, and telephone number;
2. client's contract number, job name; and
3. pump station general arrangement drawing showing pumps, motors, valves, pipework, switchboard, and electrical installation.

(ii) Manuals for pumps shall contain the following information:

1. manufacturer;
2. type and model number;
3. serial number;
4. dimensioned general arrangement drawing of pump and motor;
5. sectional arrangement drawing with parts and list; and
6. dimensioned sectional arrangements detailing:
    a) maximum and minimum shaft/bearing clearance (radial);
    b) maximum and minimum impeller/bowl clearance (radial);

c) maximum and minimum impeller/bowl clearance (axial);

d) impeller/bowl wear rings;

e) motor/pump coupling - type, make and model number; and

f) mechanical seals where applicable.

(iii) Manual for motors shall contain the following information:

1. manufacturer;
2. type and model number;
3. serial number;
4. dimensioned general arrangement drawing;
5. sectional arrangement drawing for submersible motor power cabling where applicable;
6. gland sealing arrangement drawing for submersible motor power cabling where applicable;
7. cables where applicable; and
8. terminal block arrangement drawing where applicable.

(iv) Manuals for electrical equipment shall comply with TCC24 clause 23 and requirements for electrical drawings are described in TCC24 clause 22.

(v) Manuals for valves shall contain a dimensioned sectional arrangement drawing with parts and material list for all valves.

(vi) Manuals shall contain the following test curves:

1. pump witnessed test curves;
2. motor test curves; and
3. motor torque/speed/efficiency characteristic curves.

(vii) The operating and maintenance manual shall include:

1. safe working procedures: for switching and isolating the supply and distribution system;
2. description of operation;
3. maintenance procedures: recommended maintenance periods and procedures;
4. tools: particulars of maintenance equipment and tools provided, with instructions for their use.
5. equipment: a technical description of the equipment supplied, with diagrams and illustrations where appropriate;
6. dismantling: where necessary, procedures for dismantling and reassembling equipment; and
7. spare parts: a list of the spare parts provided.

(j) Trouble shooting instructions shall be included for pumps, motors, valves and SCA.

(k) Procedures for dismantling pumps, motors, and valves

Step by step procedures for dismantling and reassembly of pumps, motors, and valves using

any special tools shall be detailed together with step-by-step procedures for replacement of wearing parts such as bearing, seals, wear rings, etc.

(7) Construction compliance

(a) Work-as-executed details and operation and maintenance manual

The Contractor shall submit to the Superintendent work-as-executed drawings showing the actual location and alignment of pipelines, and all pump station details together with operating and maintenance manuals.

Details shall include the size, type, levels of pipelines, valve and hydrant chamber types and cover details, easement requirements for maintenance, pump details, switchboard equipment details and station structural details.

The Contractor shall ensure that a Registered Surveyor certifies the plans showing location and alignment.

The Contractor shall provide records, for Council's Asset Register, to the Superintendent at the time of practical completion of the Contract. The records are to be in a form consistent for inputting into the Asset Register as directed by the Superintendent.

SC6.4.11.4 Sewerage planning and design guidelines

(1) Introduction

(a) Scope

The work to be undertaken in Clause SC6.4.11.4 includes the design of a sewerage system either, as a stand- alone project of as part of a development.

(i) Inclusions

Clause SC6.4.11.4 covers the design of sewerage infrastructure elements as per the scope of the *CTM Water Alliance Design and Construction Code*.

(ii) Exclusions

Clause SC6.4.11.4 does not cover requirements for sewage treatment plant design considerations. Bulk sewerage infrastructure will be planned and designed by Council in conjunction with experienced specialist consultants.

(b) Documents

(i) Reference and source documents

Reference and source documents that must be read in conjunction with the section are as follow:

Section SC6.4.3 Standard drawings

Editor's Note - Standard drawings other than water and sewerage (such as road crossings) that also contain information on water and sewerage infrastructure shall also be referred to.
Cairns, Townsville Mackay (*CTM) Water Alliance Design and Construction Code*

Public Health Regulation 2005

Workplace Health and Safety Queensland *Safe Design of Structures – Code of Practice*.

(ii) Document precedence

The order of precedence of documents shall be:

1. This section;

2. Cairns, Townsville, Mackay (*CTM) Water Alliance Design and Construction Code*; and

3. Section SC6.4.3 Standard drawings.

(2) Sewage collection system planning

(a) Scope

Sewage collection system planning covers the requirements of the sewage collection system from service connection to treatment facility. This includes collection sewers, trunk sewers, pump stations, and pressure mains.

(b) Hydraulic loading assessment

(i) General

Refer to Item 11 of the *CTM Water Alliance Design and Construction Code*.

Hydraulic loading shall be determined for all catchments being assessed. Loadings shall be determined in terms of equivalent persons (EP) and developed into flows using the unit loading factors and peaking factors detailed in the following sections.

(ii) Equivalent population estimations

The ultimate equivalent population (EP) used to determine design flows shall be determined from the following:

1. designated value of EP per hectare for each zone type provided in Part 4 of the Townsville City Plan;

2. the location of various zone types as specified in the Townsville City Plan;

3. an assessment of the ultimate population, including the expected peak occupancy ratesand the quantity of undeveloped land for each zone type listed in the Townsville City Plan; and

4. estimation of contributing loads for “Special Purpose” zonings (university, refineries, hospitals, etc.) shall be determined by analysis of historic consumption, and consultationwith the institution regarding future development.

Where staging of the works is necessary, the planner is to consider the expected growth rate for the area to develop loadings for intermediate planning horizons. This shall be based on the Townsville City Council Growth Model which is available from the Infrastructure Planning Unit. This model is based on population projection information available from the Planning Information Forecasting Unit (PIFU), Queensland Government Statistician's Office.

(iii) Design flows

Design sewage flow shall be calculated in accordance with *CTM Water Alliance Design andConstruction Code* Table 10.

(c) Network planning

(i) Purpose

Network planning is to be undertaken to meet the objectives of the *CTM Water Alliance Design and Construction Code* Part A.

Clause (ii) below, details the circumstances under which a network plan should be prepared.

(ii) Network modelling

A sewer network model is required for code and impact assessable material change of use (MCU) and reconfiguring a lot (RAL) applications where:

1. the proposed land use results in an increase in load greater than what is presently allowedfor in the planning scheme; or
2. the development requires trunk infrastructure identified in Council's plans for trunk infrastructure to be constructed ahead of its planned date, or out of sequence identified inmaster planning; or
3. the development requires the construction of new trunk infrastructure not already identified on council's plans for trunk infrastructure; or
4. existing sewer infrastructure is required to be relocated as part of the development, and such relocation may impact the hydraulics or operational functionality of the system. End ofline works are excluded from this requirement.

Council also requires the development of a network model for:

a) the preparation of infrastructure master plans; and

b) Network modelling shall be undertaken in accordance with the *CTM Water Alliance Design and Construction Code* Section 12.

(iii) Levels of assessment

Depending on the type of works in question, simplified or detailed modelling may be required todemonstrate compliance with these guidelines. Simplified or detailed assessments are defined below:

1. Simplified assessment

   An assessment that demonstrates network capacity through manual calculations, or through the use of simplified network models (schematic style models); and

2. Detailed assessment
   An assessment involving the preparation of detailed network models based on proposed design and/or development layouts.

Water and sewer network modelling guidelines outline the process to be followed to obtain Council advice as to what level of assessment is required.

(i) Timeframes

Master Planning and associated whole of life cost analysis shall be undertaken in accordance with timeframes as indicated in the *CTM Water Alliance Design and Construction Code*. In particular, the reporting years shall coincide with the census collection years viz. 2026, 2031, 2036, and ultimate design scenario.

Council may request that master planning consider provision to adjacent developments to enable an efficient trunk network.

(d) Sewerage systems

(i) General

Refer to Section 13 of the *CTM Water Alliance Design and Construction Code*.

Where possible the sewer system shall be designed to use gravity to convey the sewage.

Proposals for systems including pumping stations and rising mains require Council's written approval, including requirements for current electrical and telemetry standards, overflow and emergency arrangements, and compliance with Council's current Licence

conditions.

As such Council may opt for sewage pumping stations and pressure mains to transport wastewater into an adjacent catchment or direct to the WWTP and will be at the approval of Council.

(ii) Alternative sewer systems

Alternative sewer systems (e.g. common effluent drains, vacuum sewerage, pressure sewer systems, etc.) will only be considered with an analysis showing the benefits of such systems using a triple bottom line approach and require Council's written approval.

Alternative sewer systems shall be designed in accordance with the *CTM Water Alliance Design and Construction Code Section 13.*

(iii) Sewers

Sewer layouts, pipe sizing and grading shall be determined in accordance with the *CTM Water Alliance Design and Construction Code Part C* and associated references.

(iv) Sewage pump stations and pressure mains

Sewage pump stations are to be provided where gravity systems cannot be utilised, or sewers become uneconomically deep (usually > 5m).

Sewage pump stations are to be provided where approved in writing by Council.

Pump stations shall be planned and designed to optimise construction, operation, and maintenance costs for the total life cycle of the infrastructure and equipment. This shall include the pump station along with the discharge pressure main.

(v) Pump station and pressure main planning shall be undertaken in accordance with the *CTM Water Alliance Design and Construction Code Section 13.3.*

(3) Sewer network modelling

(a) Scope

A sewer network model is required where listed under the requirements of Clause SC6.4.11.4 (2)(c)(ii) above.

(b) Model requirements – simplified assessment

A simplified assessment involves the use of manual calculations to demonstrate compliance with design standards. A simplified assessment must include:

(i) assessment of design loads in accordance with *CTM WaterAlliance Design and Construction Code;*

(ii) necessary, hydraulic calculations based on fixed boundary conditions for Peak Wet Weather Flow loading;

(iii) calculations can be undertaken manually, using spreadsheets or using network modelling software. Where modelling software is used, the model files shall be provided to council as part of the submission; and

(iv) a brief report covering the requirements of Clause SC6.4.11.4 (3)(d) below. Sketches of results are to be provided where they make it easier to interpret results.

(c) Model requirements – detailed assessment

(i) Format

The current network modelling software must be used to undertake detailed assessments

of sewer networks. This will enable models to be incorporated into Council's existing network models. A map of the available sewer network model areas is provided in Attachment B.

Models shall be set up such that all scenarios, design horizons and options considered for the study are incorporated into a single model file.

(ii) Scenario planning

A scenario must be developed by the modeller prior to commencing modelling such that each scenario required for analysis is identified and that differences between scenarios are clearly understood.

The modeller must utilise parent and child scenarios and alternatives such that common information for each scenario is inherited to child scenarios, and that unique changes are clearly identifiable. A "parent" scenario should be applied for each design horizon or stage and ultimate development. The following provides an example of a model scenario structure.

1000- Existing Average Dry Weather Flow

1100- Existing ADWF Overflow Storage Assessment

1200- Existing Peak Wet Weather Flow

2000- Ultimate Average Dry Weather Flow

1100- Ultimate ADWF Overflow Storage Assessment

1200- Ultimate Peak Wet Weather Flow

1210- Ultimate PWWF Infrastructure Option 1

1220- Ultimate PWWF Infrastructure Option 2 (Preferred)

(iii) Technical specification

Hydraulic modelling shall be undertaken in accordance with Section 12 of *CTM Water Alliance Design and Construction Code.*

(iv) Sewage flow calculations

Design loads are to be calculated in accordance with the *CTM WaterAlliance Design and Construction Code.*

Loads must be applied to the model as an Average Dry Weather Flow (ADWF) base demand. A peaking factor multiplier applied as a fixed pattern on the load must be used to generate Peak Wet Weather Flow (PWWF).

Where a maintenance hole represents demands generated from different land uses, separate demand entries must be applied to the node to enable quick identification of the source of the demand.

(d) Reporting requirements

A sewer network modelling report must be prepared to document the process, assumptions and analysis employed through modelling to develop the infrastructure design and/or master plan.

The following provides details of sections to be incorporated into the modelling report. The modeller may provide further information as needed to justify decisions made through the modelling and design process.

(i) Introduction

1. development locality, lot/plan description, application number (if applicable);
2. objectives of study – design/master plan; and
3. brief methodology – describe level of modelling undertaken (simplified/detailed), software used, reference to model overview in appendix.

(ii) Sewage flow/loading assessment:

1. population assessment based on land use categories, site plan showing layout and land use;
2. load assessment showing calculation of ADWF and PWWF flows; and
3. summary table showing total load, with breakdown for each pump station catchment or network sub catchment, average dry weather flow (L/s), (kL/d), peak wet weather flow (L/s), (kL/d).

Where an existing Council model is being updated, a table comparing previous catchment loads to updated catchment loads must be provided.

(iii) Modelling assessment

1. scenarios analysed, including description or reference to design standards applied;
2. modelling assumptions;
3. existing network description, including proposed connection points;
4. modelling assessment;
5. existing system capacity;
6. existing system + ultimate development;
7. augmentations, new infrastructure options analysis including; and
8. assessment of options at interim stages as specified in the *CTM Water Alliance Code* and shall coincide with the census collection years viz. 2026, 2031, 2036, etc., and ultimate design scenario.

(iv) Summary

Preferred option, justification, capital works program.

(v) RPEQ Certification statement in accordance with Section SC6.4.2 Development application guidelines.

(vi) Appendix

1. model overview to be included in appendix (covering scenario structure, options and clearly outlining which scenario represents the design solution);
2. tabulated results of the manhole, gravity and rising main outputs:

Maintenance holes	Element ID Diameter Node Top and Invert Elevations Design Load

Pipes - gravity and rising mains	Element ID Pipe diameter/material and class, invert levels Grade Upstream maintenance hole, Downstream maintenance hole Pipe flow depth as percentage of diameter PWWF(gravity mains) Flow velocity at PWWF (rising mains) Flow velocity under single pump operation (risingmains)
Pump Stations	Element ID

3. pump stations system resistance curve/s with pump curve/s overlaid. Pump curve/s may be duty point however the designer shall consider the capability of pumps on the market to meet such a duty (i.e. it needs to be physically achievable).

(4) Gravity sewer design

(a) Scope

Clause SC6.4.11.4 (4) covers the design of gravity sewers.

(b) Sewer layout

Sewers shall comply with the requirements of the *CTM Water Alliance Design and Construction Code* and associated references.

(c) Sewers

Sewer Loading, Sizing, and grading. Refer to *CTM Water Alliance Design and Construction Code* Table 10.

(d) Reference and source documents (Restoration)

Reference and source documents that must be read in conjunction with this section are as follow:

For restoration under roadways refer to SEQ-WAT-1204-1.

Refer to *CTM Water Alliance Design and Construction Code* for construction specification.

For state-controlled roads restoration should be designed and constructed in accordance with DTMR standards and requirements.

(5) Sewage pump station design

(a) Scope

This section covers the design of sewage pump stations within the sewerage collection system, and also incorporates the requirements for the sizing of sewage pressure mains.

(b) Pump station design

(i) Pump station types

Refer to Section 13.3 of *CTM Water Alliance Design and Construction Code*.

(ii) Importance level

Where a building is required, buildings shall be designed for Importance Level 3 (minimum) in accordance with the *Building Code of Australia* Table B1.2a.

(c) Pump system design

(i) Design loading

Design loading for the pump station shall be determined in accordance with the *CTM Water Alliance Design and Construction Code Table 10*.

(ii) Design flow

The design flow for the pump station shall be determined in accordance with the *CTM Water Alliance Design and Construction Code Table 10* for both dry weather and wet weather (peak flow) conditions.

(iii) Pump and pressure main sizing

Pump and pressure main sizing shall be performed in accordance with the *CTM Water Alliance Design and Construction Code* Table 10 and Section 13.3.1.

(iv) Pressure main velocity

Refer to *CTM Water Alliance Design and Construction Code* Table 10.

(v) Pressure main hydraulic models

Refer to *CTM Water Alliance Design and Construction Code* Section 12.

(d) Pump station design certification

Concrete pump station shall be designed and certified by a suitably qualified and experienced RPEQ engineer.

FRP pump stations designed and manufactured outside of Queensland shall be certified by a suitably qualified engineer experienced in the design of FRP pump stations;

(e) Pump well sizing

Pump well sizing shall be performed in accordance with *CTM Water Alliance Design and Construction Code*.

(f) Overflow containment

Systems shall be designed in accordance with the *CTM Water Alliance Design and Construction Code* Table 10 and WSA 04 – 2005 Item 5.6.

(g) Vehicular access

(i) Access road

Access requirements shall be in accordance with *CTM Water Alliance Design and Construction Code* with the following additional requirements:

1. sealed asphalt access road;
2. provide access during 1% AEP flood event;
3. minimum road width of 4 m;
4. on-site turn-around for maintenance vehicle; and
5. parking area provided adjacent to all equipment to be lifted for a crane truck maintenance vehicle. Parking is only required for a single vehicle.

Design of access is to be approved by Council.

(ii) Maintenance vehicle reconfiguration

Allowance shall be made for maintenance vehicles that are 10 t (8.8 m long) crane trucks Medium Rigid Vehicles (AS 2890.2 *Parking facilities - Off street commercial vehicle* facilities) with mounted crane positioned centrally on the rear end of the vehicle.

(h) Townsville water and waste sewage pump station equipment schedule (TCC SPS equip schedule)

An equipment schedule is to be prepared for each new pump station and existing equipment schedules are to be revised for any project modifying or upgrading a pump station. The document is referenced by Tag number and lists, in summary, critical design and performance data for mechanical, electrical, radio and telemetry, and instrumentation and control equipment. The schedule is a required document in all O&M manuals.

The schedule is the cross-reference document between the tag number and the actual equipment item delivered. The schedule is a useful tool when selecting equipment as it contains relevant process parameters for each equipment item. The sample Equipment Schedule to be used and can be provided on request.

(6) Pressure main design

(a) Pressure main sizing

Refer to *CTM Water Alliance Design and Construction Code* Table 10.

(b) Services and alignment

Refer to *CTM Water Alliance Design and Construction Code* and associated references for minimum clearance requirements from other services.

(c) Restoration

Refer to *CTM Water Alliance Design and Construction Code* and associated references for restoration requirements.

For restoration under roadways refer to SEQ-WAT-1204-1.

SC6.4.11.5 Sewerage system construction

(1) Introduction

(a) Scope

This section is for the construction of the following:

(i) gravitation sewers up to DN600 nominal size;

(ii) common effluent sewers, both gravity and pressurised;

(iii) vacuum sewerage systems;

(iv) rising mains up to DN600 nominal size;

(v) standard appurtenances such as maintenance holes, maintenance shafts and property connection sewers; and

(vi) small pump stations, usually limited to single wells with submersible pumps.

This section excludes the construction activities for:

(i) treatment plants;

(ii) headworks;

(iii) dosing plant;

(iv) larger pump stations; and

(v) works controlled by others, including overflow management

The Contractor shall carry out the work, and supply materials meeting the requirements of the reference documents and, in particular, in accordance with the requirements of the Water Services Association of Australia publications WSA 02-2014*, Gravity Sewerage Code of Australia*, WSA 07 – 2005*, Sewerage Pumping Station Code of Australia*, and WSA 07-2011*, Pressure Sewerage Code of Australia*, except as otherwise specified herein.

Sewerage works should be designed in accordance with Clause SC6.4.11.4 above in conjunction with the Department of Energy and Water, *Planning Guidelines for Water and Sewerage*.

For the purposes of this section, “access chambers” are referred to as “maintenance holes”.

(b) Reference and source documents

Reference and source documents to be read and applied in conjunction with this section are as follow:

Editor’s Note - Documents referenced in this section are listed below whilst being cited in the text in the abbreviated form or code indicated. The Contractor shall possess, or have access to, the documents required to comply with this section.

(i) References to the *Sewerage Code of Australia* are made where there are parallel sections or equivalent clauses to those in this section. Where not called up as part of this section, these references are identified by edition, part and section numbers and enclosed in brackets thus (WSA Edition, Part, Section). The latest edition of the documents shall apply.

1. SC6.4 Development manual planning scheme policy sections:

   Section SC6.4.3 Standard drawings

   Section SC6.4.6 Road works and traffic control, control of traffic section

   Section SC6.4.18 Concrete works

   Editor’s Note - Where any standard drawing used in conjunction with this section includes technical requirements that conflict with this section, the requirements of this section shall take precedence.

2. Australian standards:

   Editor’s Note - References in this section or on the design drawings to Australian Standards are noted by their prefix AS or AS/NZS. Where not otherwise specified in this section or the design drawings, the Contractor shall use the latest Australian Standard, including amendments and supplements, available within two weeks of close of tenders.

AS/NZS 1111	*ISO metric hexagon commercial bolts and screws (Set)*
AS/NZS 1112	*ISO metric hexagon nuts (Set)*
AS/NZS 1260	*PVC-U pipes and fittings for drain, waste and vent applications*
AS 681	*Elastomeric Seals – Material requirements for pipe joint seals used in water and drainage applications*
AS 1289.5.4.1	*Methods of testing soils for engineering purposes – Method 5.4.1: Soil compaction and density tests - Compaction control test – Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.7.1	*Methods of testing soils for engineering purposes – Method 5.7.1:*

	Soil compaction and density tests- Compaction control test – Hilf density ratio and Hilf moisture variation (Rapid Method)
AS 1349	*Bourdon tube pressure and vacuum gauges*
AS 1444	*Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties*
AS/NZS 3678	*Structural steel – hot rolled plates, floorplates and slabs*
AS/NZS 1477	*PVC pipes and fittings for pressure applications*
AS 1565	*Copper and copper alloys – Ingots and castings*
AS 1579	*Arc welded steel pipes and fittings for water and wastewater*
AS/NZS 1594	*Hot-rolled steel flat products*
AS 1627.4	*Metal finishing – Preparation and pre-treatment of surfaces - Part 4: Abrasive blast cleaning of steel*
AS 1646	*Elastomeric seals for waterworks purposes*
AS 1657	*Fixed Platforms, walkways, stairways and ladders – Design, construction and installation*
AS 1741	*Vitrified clay pipes and fittings with flexible joints – sewer quality*
AS 1830	*Grey cast iron*
AS 60529	*Degrees of protection provided by enclosures (IP Code)*
AS/NZS 2032	*Installation of PVC pipe systems.*
AS/NZS 2033	*Design and installation of polyolefin pipe systems*
AS 2129	*Flanges for pipes, valves and fittings*
AS/NZS 2280	*Ductile iron pipes and fittings*
AS 2528	*Bolts, studbolts and nuts for flanges and other high and low temperature applications*
AS/NZS 2566.1	*Buried flexible pipelines – Part 1: Structural design*
AS/NZS 2566.2	*Buried flexible pipelines – Part 2: Installation*
AS 2738	*Copper and copper alloys – compositions and designations of refinery products, wrought products, ignots and castings.*
AS/NZS 3000	*Electrical installations (known as the Australian/New Zealand Wiring Rules)*
AS/NZS 3008	*Electrical installations –Selection of cables (Set)*
AS 3439	*Low voltage switchgear and control gear assemblies (Set)*
AS 3518	*Acrylonitrile butadine styrene (ABS) compounds pipes and fittings for pressure applications*
AS 3571.1	*Plastics piping systems - Glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin - Part 1: Pressure and non-pressure drainage and sewerage which may not be relevant to this section*

AS 3571.2	*Plastics piping systems — Glass reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin - Part 2: Pressure and non-pressure water supply*
AS 1628	*Water supply – Mettalic gate, globe and non-return valves*
AS/NZS 2638.1	*Gate valves for waterworks purposes – Part 1: Metal seated*
AS/NZS 2638.2	*Gate valves for waterworks purposes – Part 2: Resilient seated*
AS 4794	*Non-return valves for waterworks purposes – swing check and tilting disc*
AS 3681	*Application of polyethylene sleeving for ductile iron pipelines and fittings*
AS/NZS 3690	*Installation of ABS pipe systems*
AS 3972	*General purpose and blended cements*
AS 3996	*Access covers and grates*
AS/NZS 4058	*Precast concrete pipes (pressure and non-pressure)*
AS 4060	*Loads on buried vitrified clay pipes*
AS/NZS 4087	*Metallic Flanges for waterworks purposes*
AS/NZS 4129	*Fittings for polyethylene (PE) pipes for pressure applications*
AS/NZS 4130	*Polyethylene (PE) pipes for pressure applications*
AS 4198	*Precast concrete access and maintenance chambers for sewerage applications*

Editor's Note - Read "maintenance hole" for "access chamber"

AS 4321	*Fusion-bonded medium-density polyethylene coating and lining for pipes andfittings*
AS/NZS 4680	*Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*
AS/NZS 4765	*Modified PVC (PVC-M) pipes for pressure applications*
AS 4794	*Non return valves – Swing check and tilting disc*

3. Other:

Department of Energy and Water Supply	*Planning Guidelines for Water Supply and Sewerage*, April 2010 Chapter 6 Amended March 2014

Water Services Association of Australia (WSAA):

WSA 02-2002	*Gravity Sewerage Code of Australia*
WSA 04-2005	*Sewerage Pumping Station Code of Australia*
WSA 05-2013	*Conduit Inspection Reporting Code*
WSA 07-2007	*Pressure Sewerage Code of Australia*

British Standard:

BS 410	*Specification for test sieves*
International Erosion Control Association (IECA)	*Best Practice Erosion and*

Sediment Control.

ISO 3310 *Test sieves – Technical requirements and testing (set)*

(2) Materials

(a) General

The Contractor shall comply with the requirements of the manufacturer's recommendations regarding the handling, transport and storage of materials and as further specified in this section.

Prior to the delivery of products and materials, the Contractor is expected to obtain relevant product or material certification from the manufacturer which shall be presented to the Superintendent if requested.

The Contractor shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits.

All gravity reticulation pipes shall be rubber ring (elastomeric), complying with AS 1646, jointed to the type, size and class as shown on the design drawings.

If the Contractor proposes to use alternative products and materials other than the products and materials authorised by Council, the design drawings and this section, an approval from the Council is required prior to delivery and use of alternative products or materials.

(b) PVC pipes

Unplasticised and modified PVC (uPVC and PVC-M) pipe and fittings

Unplasticised PVC (uPVC) pipes and fittings for gravity systems shall comply with AS/NZS 1260, shall be suitable for rubber rings (elastomeric) joints and shall be of the class and size as shown on the design drawings (WSA 02- 2014, Part 2, Section 13.).

Unplasticised PVC (uPVC) pipes and fittings for rising mains and suction pipes shall comply with AS/NZS 1477 and AS/NZS 4765, shall be suitable for rubber ring (elastomeric) joints and shall be of the class and size as shown on the design drawings. Modified PVC (PVC-M) pipes and fittings shall comply with AS/NZS 4765, shall be suitable for rubber ring (elastomeric) joints and shall be of the class and size as shown on the design drawings.

PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS/NZS 2032 and AS/NZS 2566.1.

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

(c) Polyethylene (PE) pipes and fittings

Polyethylene pipe shall comply with AS/NZS 4129 and AS/NZS 4130 and shall be of the class and size shown on the design drawings and installed in accordance with AS/NZS 2033 (WSA 02-2014, Part 2, Section 13.).

Jointing shall be by butt thermal fusion or by electrofusion couplings, or with compression fittings.

The Contractor shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown on the design drawings.

(d) Glass reinforced plastic (GRP) pipes and fittings

Glass filament reinforced thermosetting plastics (GRP) pipes shall comply with AS 3571.1 and shall be of the class and size as shown on the design drawings and installed in accordance with AS/NZS 2566.1 (WSA 02- 2014, Part 2, Section 13.).

Pipes and fittings are to be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultraviolet light and damage. The Contractor shall take account of the time for storage and type of cover.

(e) Ductile iron (DI) pipes and fittings

Ductile iron (DI) pipes and fittings shall comply with AS/NZS 2280 and shall be of the class, size, and lining, as shown on the design drawings, and installed in accordance with AS/NZS 2566.1. Jointing shall be with rubber rings (elastomeric) to the class and type as shown on the design drawings and in accordance with WSA 02- 2014, Part 2, Section 13.

Flanges shall be to the table shown on the design drawings. Bolts and nuts for flanged joints shall be galvanised, or stainless steel as for the pumps specified herein, unless shown otherwise on the design drawings.

All pipework shall be sleeved externally with polyethylene sleeving in accordance with the requirements of AS 3681 unless specified otherwise to be coated and lined. All fittings shall be thermal bonded polymeric coated, in accordance with AS/NZS 4158, or wrapped. The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

(f) Steel pipeline

Steel pipelines and fittings shall comply with AS 1579 and AS/NZS 1594 and shall be of the class, size, lining and coating as shown on the design drawings or as specified in WSA 02-2014, Part 2, Section 13.

The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

The jointing system shall be rubber ring (elastomeric) unless shown otherwise on the design drawings.

(g) Vitrified clay

Vitrified clay (VC) pipes and fittings shall comply with AS 1741 and shall be of the class of pipe, complying with the loading requirements of AS 4060, and size as shown on the design drawings and suitable for rubber ring (elastomeric) joints (WSA 02-2002, Part 2, Section10).

(h) Precast maintenance holes (MH)

Precast maintenance hole components shall comply with AS/NZS 1477 for PVC, AS/NZS 2033 for PE, AS 3518 for ABS, AS 3571.1 for GRP and AS 4198 for concrete (WSA 02-2014, Part 2, Section 17.2).

If approved by the Council, precast systems, complying with the drawings, may be used in lieu of cast in-situ systems (WSA 02-2014, Part 2, Section 17.2.2). Precast system components shall not be delivered to the site before satisfactory documentary evidence has been submitted to the Superintendent that quality tests have been carried out.

(i) Preformed Maintenance Shafts (MS) and Terminal Maintenance Shafts (TMS Including Covers

Preformed maintenance shaft and terminal maintenance shaft components shall comply with AS/NZS 1477 for PVC, AS/NZS 2033 for PE, AS 3518 for ABS, AS 3571.1 for GRP and AS

4198 for concrete (WSA 02-2014, Part 2, Section 17).

(j) Maintenance hole covers and frames

Cast iron maintenance hole covers and frames shall comply with AS 3996 and shall be of a type that is flush top cast cover, identifiable as SEWER, size, opening and class as shown on the design drawings. Covers and frames shall not be delivered to the site before satisfactory documentary evidence has been submitted to the Superintendent that quality tests have been carried out.

(k) Steelwork

Structural steelwork, including ladders, brackets and covers, complying with AS 1657, shall be abrasive blast cleaned to AS 1627.4, Class 2.5 and hot dip galvanised to AS/NZS 4680.

(3) Pipeline construction

(a) General

The Contractor, employees, or subcontractors, engaged in excavations, including tunnelling, are to be accredited for the work. Proof of accreditation must be provided to the Superintendent prior to the release of the hold point (WSA 02-2014, Part 2, Section 16.).

The Contractor shall not change the pipeline alignment without the prior concurrence of Council. The Contractor shall provide full details, of any proposed changes to the pipeline alignment, to the Superintendent for submission to Council. The Superintendent shall obtain the decision of Council prior to the release of the hold point.

(b) Location

The location of the sewers, maintenance holes, rising mains, and pump stations, sizes and grades of sewers and rising mains, the types of maintenance holes and maintenance hole covers, and the classes of pipes shall be as shown on the design drawings. The Contractor shall commence laying of pipelines at the lower end of the line unless directed otherwise by the Superintendent. The Contractor shall lay pipelines to grades and locations shown on the design drawings unless directed otherwise by the Superintendent (WSA 02-2014, Part 2, Section 16.).

(c) Cover over pipelines

The minimum depth of cover to be provided over pipelines in accordance with SEQ-SEW-1200-2.

Location	Minimum Cover (mm)
Private property non vehicular new developments	600
Private property non vehicular existing developments	450
Private residential property subject to vehicular loading	750
Footpaths, sealed roads (non arterial)	900
Unsealed roads	1200
Arterial roads	1200

Lesser covers may be permitted where special protection of the pipelines has been shown on the design drawings or directed by the Superintendent (WSA 02-2014, Part 1, Section 5.6.3.).

(d) Crossings

Where a pipeline crosses a main or state road, creek or involves features shown on the design drawings, under the control of any Authority, the Contractor shall carry out the work in accordance with the requirements of that Authority. The Contractor shall provide written notification to the Authority of the intention to carry out the work and pay the appropriate fees. The Contractor shall obtain the written approval from the Authority prior to commencement of work. Such written approval shall be supplied to the Superintendent if requested.

Where shown on the design drawings, the Contractor shall use trenchless methods for the installation of the sewer mains. The installation of the sewer main by open trenching shall not be permitted over the lengths designated for trenchless installation (WSA 02-2014, Part 2, Section 14.12).

The Contractor shall address, in its method statement for trenchless conduit installation, the following:

(i) general description of method and sequence of operation;

(ii) size, depth and position of temporary pits required;

(iii) use of specialist subcontractors;

(iv) specialist equipment to be used; and

(v) grout type and method of injection.

The encasement pipe shall be as detailed on the design drawings. The encasement pipe shall extend 1.0 m behind the back of the kerb on either side of the carriageway.

The carrier pipe shall be positioned on support cradles and the carrier pipe shall be centrally located within the encasement pipe.

After installation and pressure testing of the carrier pipe, the Contractor shall fill the annular space between the carrier pipe and the encasement pipe with suitable grout or cementitious grout filler.

Where the carrier pipe is ductile iron cement lined (DICL), any length of pipe which is enclosed within the encasement pipe need not be wrapped in polyethylene tubing.

(e) Earthworks

The Contractor shall carry out all excavations for structures and pipelines to the lines, grades, and forms shown on the design drawings, or as directed by the Superintendent, within the specified tolerances.

Prior to commencement of excavation, the Contractor shall be responsible in obtaining approval from the appropriate Authorities and shall comply with all requirements of the approval including having regard for drainage, dewatering, silt control, noise abatement, proximity to existing buildings and generally for the amenity of adjacent owners.

The Contractor shall leave a clear space of 600 mm minimum between the edge of any excavation and the inner toe of stockpiles. No excavated materials shall be stockpiled against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be stockpiled separately and utilised to restore the surface after backfilling.

At the completion of work each day, the Contractor shall install safety fencing to statutory requirements along the edges of open excavations to isolate them from the public. The Contractor shall provide fenced walkways and vehicular crossways across trenches to

maintain access at all times from carriageway to individual properties or within individual properties and advise beforehand all affected residents. All such installations shall be of adequate size and strength and shall be illuminated to prevent accidents.

The Contractor shall locate, protect, and repair, as necessary, all services affected by the Works at the Contractor's expense. The Contractor shall give notice of any interference to the works caused by an existing service and submit a proposed work method statement.

The Contractor shall carry out erosion and sedimentation control at all construction sites in accordance with *Best Practice Erosion and Sediment Control*.

The Contractor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open.

(f) Minimum trench width for pipelines

The minimum clear width of trench inside internal faces of timbering or sheet piling, if used to a height of 150 mm above the top of the pipe shall be in accordance with SEQ-SEW-1200-2.

Table SC6.4.11.5 – This table has been deleted. The information is captured in the relevant SEQ drawings.

Where the design drawings provide for a trench to be excavated across a paved surface, the width of the trench shall be kept to a minimum. Bitumen and concrete surfaces shall be carefully cut, by saw-cutting, or other means approved by the Superintendent, provide a neat straight line free from broken ragged edges (WSA 02-2014, Part 2, Section 14.7).

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

(g) Maximum trench width

For gravitation sewers or rising mains of pipe materials other than PVC or PE, no restriction shall be placed on the maximum width of trench due to the structural strength of the pipe provided the depth to invert of the pipe does not exceed the depths shown in column (ii) of Table SC6.4.11.6.

The Superintendent may, however, restrict the width of trench due to local conditions. The Superintendent shall not restrict the width of trench to less than as shown in column (iii) of Table SC6.4.11.6.

Where the depth to invert exceeds that shown in column (ii) of Table SC6.4.11.6 – Maximum trench widths, the maximum width of trench (outside timbering or sheet piling, if used) to a height of 150 mm above the top of the pipe shall be as shown in column (iii) of Table SC6.4.11.6.

Table SC6.4.11.6 – Maximum Trench Widths.

Nominal size of pipe (mm) (i)	Maximum depth to invert, unlimited width trench (m) (ii)	Maximum trench width, depths greater than in column (ii) (mm) (iii)
150	8.0	750
225	6.5	825
300	5.5	900
375	4.5	975
400	4.5	975
450	4.5	1050
525	4.0	1125
600	4.0	1200

For gravitation sewers or rising mains of PVC/PE pipe the maximum width of trench from the trench base to a height of 150 mm above the top of the pipe shall be the outside diameter of the pipe barrel plus 400 mm.

However, in timbered or travelling box excavated trenches, the width of trench when measured to the outside of the support used may be increased to a maximum of 580 mm plus the outside diameter of the pipe barrel.

The Contractor shall supply a method statement of any special construction control, where shown on the design drawings, to the Superintendent's approval.

(h) Excavation depth

The Contractor shall excavate trenches to a minimum of 100 mm below the underside of the pipe barrel and socket or coupling except for rising mains to be laid on other than rock foundations or as otherwise shown on the design drawings (Refer SEQ-SEW-1201-1, SEQ-SEW-1202-1 and SEQ-SEW-1203-1).

The excavation shall be carried out such as to ensure solid and uniform support for each pipe over the whole length of the barrel with chases provided for joints and wrapping.

(i) Support of excavation

The Contractor shall adequately support all excavations to statutory requirements as the works proceed. When withdrawing supports, the Contractor shall exercise every precaution against slips or falls.

The Contractor shall ensure that timber is left in place where its removal may endanger structures in the vicinity of the excavation.

(j) Pipe bedding

When excavation of the trench has been completed the Contractor shall obtain the Superintendent's approval prior to commencing pipe laying, jointing, and bedding. The Superintendent's approval of the excavated trench is required prior to the release of the hold point, or where sewers are to be located in water charged ground (present or predicted to occur) will require specialist geotechnical analysis and design. The Contractor shall inform the Superintendent immediately upon encountering ground water and await further direction.

Crusher screenings may only be used for pipe bedding where sand or other non- cohesive material is not readily available locally or where the Contractor can demonstrate that its use will not impede repair operations.

Pipes for gravitation sewers (excluding PVC/PE pipes), shall be bedded on sand or other

non-cohesive material. Pipe bedding shall consist of a non-cohesive granular material, having a minimum thickness of 75 mm below the barrel and socket of the pipe, and its grading shall generally fall within the following limits shown in Table SC6.4.11.7.

Table SC6.4.11.7 – Grading of Bedding Material for Pipes other than PVC and PE

Sieve size aperture width (ISO 3310)	Equivalent BS sieve size (BS410)	Percentage passing
22.4 mm	1 inch	100
6.7 mm	¼ inch	90 - 100
425 µm	No. 36	40 - 90
75 µm	No. 200	0 - 10

Pipes for rising mains (excluding PVC/PE pipes) may be laid directly on other than rock foundation. The Contractor shall provide non-cohesive granular bedding, having a minimum thickness of 100 mm below the barrel (Refer SEQ-SEW-1201-1) and socket of the pipe, where rock or other hard material occurs in the bottom of the trench or where specified or directed by the Superintendent. The bedding material shall be either loose clean sand and /or medium dense clean sand or as directed by the Superintendent.

For PVC/PE pipes, irrespective of foundation, the material to be used for pipe bedding (underlay a minimum of 100 mm below the underside of the pipe barrel (Refer SEQ-SEW-1201-1) and socket, side support and overlay to a depth of 150 mm above the top of the pipe) as shown in Figure 5.1 in AS 2032 shall be in sand or other non-cohesive granular material, either crushed, natural or blended, and its grading shall fall within limits shown in Table SC6.4.11.8 below. Grading of bedding material for PVC and PE Pipes, except that where the materials cannot be reasonably sourced from within the vicinity, the Contractor may use materials satisfying the classification in the second paragraph above, provided also that the material meets the requirements for passing sieve sizes 9.5 mm and 6.7 mm as shown in Table SC6.4.11.8 below.

Table SC6.4.11.8 – Grading of Bedding Material for PVC and PE Pipes

Sieve size aperture width (ISO 3310)	Equivalent BS sieve size (BS410)	Percentage passing
9.5mm	3/8 inch	100
6.7mm	¼ inch	90 - 100
425µm	No. 36	40 - 90
150µm	No. 100	0 - 10

The Contractor shall bed all gravitation sewers laid on grades of 15 per cent to 50 per cent on 20 Mpa concrete complying with Section SC6.4.18 Concrete works. Such concrete bedding shall have a thickness of at least 75 mm below the underside of the barrel and socket of the pipe and shall extend to a level above the bottom of the pipe of one quarter of the external diameter of the pipe and a width across the trench not less than the minimum width shown in the relevant SEQ drawings.

The Contractor shall encase all gravitation pipelines and rising mains, laid on grades steeper than 50 per cent, in concrete as detailed on the design drawings.

(k) Laying and jointing of pipes

Unless detailed otherwise, the Contractor shall install pipes in accordance with AS 2032, AS/NZS 2033, AS/NZS 2566.1 or AS/NZS 3690 as appropriate (WSA 02-2014, Part 2, Section 16).

Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Contractor and, if required by the Superintendent, the Contractor shall suspend each one in a sling to enable the Superintendent to inspect it. If directed by the Superintendent, the Contractor shall oil valves and repack valve glands.

The Contractor shall ensure that the interior of the pipeline is clean and free from obstructions. Plugs shall be used to prevent foreign matter entering sections of pipeline which are left uncompleted overnight.

The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. The Contractor shall remove any temporary supports prior to completion of backfilling.

Except where solvent cement joints are needed to make up or install fittings, joints in pipelines shall be flexible, rubber ring (elastomeric) joints (either roll-on rubber ring (elastomeric) or skid type) or, where shown on the design drawings, mechanical joints (either fixed flange or bolted gland type).

For pipes with roll-on rubber ring (elastomeric) joints, spigots and sockets shall be clean and dry. The Contractor, after making the joint, shall check that the rubber ring (elastomeric) has rolled in evenly, and, if not, the Contractor shall withdraw the pipe and remake the joint.

For pipes with skid type rubber ring (elastomeric) joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. The Contractor shall make the joint such that the witness mark shall, at no point, be more than 1 mm from the end of the socket.

Pipes may be cut as needed, or directed by the Superintendent, to suit closing lengths, to remove damaged pipe or fittings or to remove sockets (if necessary) when jointing a socketed fitting.

For field cuts, a mechanical pipe cutter shall be used, except that PVC/PE pipes may be cut using a power saw or a fine-toothed handsaw and mitre box. For field cuts of ductile iron or steel, the Contractor shall ensure that fire-fighting equipment, in working order, is on the site prior to the field cuts being made. If the Contractor proposes to use a petrol-engine pipe cutter in an excavation, the Contractor shall ensure that a safe atmosphere is maintained in the excavation at all times.

The Contractor shall prepare the ends of any pipes cut in the field to the manufacturer’s written instructions, or as directed by the Superintendent.

Where pipes are cut in the field, the Contractor shall make a witness mark on the pipe at the length specified by the manufacturer from the end of the pipe. The Contractor shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the Contractor shall refer to the socket manufacturer for the correct marking depth.

Where PVC pipes are to be joined to pipes of another material, the joints shall be made as follows:

(i) Jointing PVC/PE to VC Pipes

For jointing PVC/PE spigot to VC socket or PVC/PE socket to VC spigot, the Contractor shall use a PVC/PE adaptor. The joints in both instances shall be made using a ring conforming to AS1646.

(ii) Jointing PVC/PE to Ductile Iron Pipes

For jointing PVC/PE to ductile iron, the Contractor shall use a rubber ring (elastomeric) joint with an adaptor coupling.

The Contractor shall conform with the relevant statutory and Work, Health and Safety requirements when cutting and disposing of asbestos cement pipes.

Gravitation pipelines shall be constructed to the following tolerances:

(iii) the maximum horizontal deviations to either side from the design axis of a pipeline shall be 20 mm for all sizes of pipes (WSA 02-2014, Part 2, Section 22.1) ; and

(iv) the invert level shall not deviate from the design grade line by more than 10 mm (WSA 02-2014, Part 2, Section 22.2).

Flexibly jointed pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The Contractor shall comply with the manufacturer's written recommendations in respect of maximum deflection for each joint provided that no joint shall be deflected to such an extent as to impair its effectiveness.

The maximum angle of deflection between adjacent pipes shall be limited to 2º or 0.035 radian in areas subject to subsidence or slippage.

Unless otherwise directed by the Superintendent, the Contractor shall lay pipes for rising mains on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface.

Detectable identification tape to AS/NZS 2648.1 shall be laid along the line of the rising main within 150 mm of the finished surface or as otherwise directed by the Superintendent (Refer WSA 02-2014, Part 2, Section 16.11.2 and SEQ-SEW-1200-2).

(l) Connections to maintenance holes and structures

The Contractor shall connect pipelines to maintenance holes, structures, or embedded concrete by means of 600 mm long pipes such that two flexible joints are provided, the first joint being at or within 150 mm of the face of the structure. The Contractor shall not core any connections into wall sections of precast or cast in-situ manholes <150 mm from any joint to the closest edge of core. Where flexible joints cannot be made with cut pipes, the Contractor shall select pipes from the various lengths provided in order to make the second joint within 300 mm of the position shown on the drawings (Refer SEQ-SEW-1300-1 and SEQ-SEW-1300-2).

The Contractor may vary slightly the positions of maintenance holes shown on the design drawings, subject to final approval by the Superintendent immediately prior to construction, to suit changes, such as erection of structures, growth of flora and installation of services. The positioning of a maintenance hole shall be such as to comply with occupational health and safety requirements for access by maintenance staff, providing a proper working area around the top and access into the hole. Once the final position of a maintenance hole has been established, construction shall be subject to the following requirements:

(i) for deviations from the design levels of maintenance holes as shown on the design drawings or as directed by the Superintendent during construction, the following tolerances shall apply (WSA 02-2014, Part 2, Section 22):

1. where the difference in levels between the inlet pipe and the outlet pipe in a maintenance hole is 100 mm or less:

   Pipe Tolerance

   Inlet - nil; + 10 mm

   Outlet - 10 mm; + nil; and

2. where the difference in levels, as above, is greater than 100 mm:

   Pipe Tolerance

   Inlet - 10 mm; + 10 mm

   Outlet - 10 mm; + 10 mm; and

3. allowable lateral deviations from the final design position of maintenance holes shall be +/- 300 mm.

(m) Junctions and property connection sewers

The Contractor shall provide junctions for dead ends and property connection sewers or risers to properties to serve existing and future dwellings in accordance with this section and the design drawings. Such junctions shall be inserted along pipelines in locations shown on the design drawings or directed by the Superintendent, with the service connection, where not shown on the design drawings, provided at a depth no deeper than 1.5 m provided the property still has service to the sewer, as follows:

(i) for existing dwellings, at the most practical point not outside the property boundary to facilitate the connection, considering existing sewage outlets. Separate connections shall be provided for dual occupancies; and

(ii) for vacant blocks, at the most practical point not outside the property boundary to facilitate the connection, considering topography and likely positioning of sewage outlets.

Where the sewer is intended to serve a large block and/or where the sewer line is located more than 75 m from the premises, the Contractor shall extend the property connection sewer onto that block such that the maximum horizontal measurement in a straight line between the sewer connection point and the premises on the block is not more than 75 m.

Concrete support shall be provided for the full trench width in accordance with SEQ-SEW-1106-2 and Section SC6.4.18 Concrete works.

Except where concrete encasement is ordered by the Superintendent, the Contractor shall sand compact backfill around risers to the top of the socket or coupling on the highest branch off the riser, for the full width of trench and for a minimum distance of 500 mm upstream and downstream of the riser. Compaction density shall be as for the requirements for the trench pipeline.

All property connection sewers and junctions shall have a minimum diameter of 150 mm and have a screwed access cap. Property connection sewers shall have a maximum length of 10 m.

(n) Marking of junctions and property connection sewers

The Contractor shall clearly mark the position of each riser, junction, or end of a property connection sewer on completion of backfilling. The marking shall be made by one of the following methods, but the location of the mark or peg shall be consistent with the method(s) in use by Council and to the approval of the Superintendent (WSA 02-2014, Part 2, Section 16.9).

Where the position of a riser, junction or the end of a property connection sewer is at a substantial boundary fence or structure located on the boundary, a neatly stencilled letter "J" 50 mm high shall be painted thereon. An underground identification tape, as specified hereafter, shall finish flush with the existing ground surface as close to the boundary fence or structure as possible.

Elsewhere, the Contractor shall drive into the ground, a peg, 75 mm x 50 mm x 600 mm long at that position and left flush with the surface of the surrounding ground. The Contractor shall connect the peg to an underground identification tape as specified hereafter.

The Contractor shall tie the identification tape to the junction or end of the property connection sewer, hold the tape in a vertical position during backfilling operations and finish tape flush with finished ground level.

The identification tape shall be 75 mm wide fawn coloured polyethylene tape with the inscription "Caution - buried sewer line", printed in heavy black letters every 200 mm.

(o) Trench stops

Where a sewer or rising main is laid on bedding at a grade of 5 per cent to 14 per cent, the Contractor shall construct, as below, trench stops consisting of bags filled with clay, or sand or cement stabilised sand and sealed. Reference shall be made to SEQ-SEW-1206-1 and SEQ-SEW-1207-1.

(i) At the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 100 mm deep to suit the width of bag shall be excavated into the bottom of the trench across its full width and into both sidewalls and extend to within 300 mm below finished surface level.

(ii) The bags shall be placed around and above the pipe, as in Clause (i) above, so as to give close contact with the pipe and to fill the entire space between the excavated recess and the pipe. Bags shall not be placed onto sand bedding.

The distance between trench stops shall be determined by the following formula:

$D = \frac{100}{G}$ whereby

D = Distance between stops in m

G = Grade of pipe expressed in per centum.

(p) Concrete bulkheads

Where a gravitation sewer or rising main is installed at a grade of 15 per cent to 29 per cent, the Contractor shall construct concrete bulkheads. Where a gravitation sewer or rising main is installed at a grade 30 percent to 50 percent, the Contractor shall construct concrete bulkheads integral with concrete encasement. Where any sewer line is to be installed with a grade exceeding 50 per cent, the contractor must provide a site-specific design to incorporate all aspects of the site conditions including soil conditions. Bulkheads shall be of 20 Mpa concrete complying with Section SC6.4.18 Concrete works, 150 mm minimum thickness as follows: (Refer SEQ-SEW-1206-1, WSA 02-2014, Part 1, Section 9.10 and WSA

02-2014, Part 2, Section 16.6).

(i) where concrete bedding or encasement to pipe is required, the 150 mm thick bulkhead shall be cast integral with the concrete bedding or encasement across the width of trench and shall be keyed into both sidewalls a minimum of 150 mm. The bulkhead shall extend to 150 mm below finished surface level or such other level as directed by the Superintendent;

(ii) where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150 mm for the full width of trench; and

(iii) a 75 mm nominal diameter drain hole shall be provided in the concrete bulkhead immediately above the top of the encasement bedding or foundation and crushed rock or gravel shall be placed in and at the upstream end of the drain hole to act as a filter. The gravel shall be 10 to 20 mm in size within 150 mm in all directions upstream and above the invert of the drain hole beyond which another 150 mm thick surround of gravel 2 to 10 mm in size shall be placed.

The distance between concrete bulkheads shall be determined by the following formula: (WSA 02-2014, Part 1, Section 9.10.)

Concrete bulkhead

$$S = \frac{L_P}{G}$$

Concrete encasement (continuous) and concrete bulkhead S = 100/G, whereby

LP = 80 X Pipe length, m = 450 m max

if LP > 100 m use intermediate trench stops at spacing < 100/G S = Distance between bulkheads in m

G = Grade of pipe expressed in per centum.

(q) Thrust and anchor blocks for rising main

The Contractor shall construct thrust and anchor blocks, where shown on the design drawings to the dimensions depicted therein or as otherwise directed by the Superintendent where it is deemed that the allowable bearing pressure of the ground and the design pressure on the pipeline are different to the actual pressures on site. The blocks shall be provided at valves, flexibly jointed bends, tees, enlargers, and reducers or any other point where unbalanced forces resulting from internal pressures will occur.

The Contractor shall provide permanent thrust blocks of 20 Mpa concrete, complying with Section SC6.4.18 Concrete works, such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over the bearing area not less than that directed by the Superintendent.

The Contractor shall provide permanent anchor blocks of 20 Mpa concrete, complying with Section SC6.4.18 Concrete works, of a volume and dimension not less than that directed by the Superintendent.

The Contractor shall provide temporary anchorages adequate to restrain the pipe when under test. The cost of providing such anchorages shall be deemed to be included in the rates tendered for laying and jointing rising mains.

The Contractor shall obtain the consent of Townsville Water and Waste for the type and use of restrained joints, as an alternative to thrust blocks, in the case of congested service corridors and urgent commissioning.

(r) Rising main fittings

The Contractor shall install rising mains, air release valves, and inspection pipes, where shown on the design drawings or directed by the Superintendent. All rising mains shall be topped with an appropriate identification tape.

The Contractor shall provide marking plates bearing the letters “DAV” for double air valves, “SCOUR” for scour pipes and “SRM” for sewage rising main at changes of direction and at such chainages that the location of the main is marked, at least once each 100 metres, as specified hereinafter. In urban areas, the kerb adjacent to each fitting is to be painted with 2 coats of non-slip paint coloured black.

Where, in the opinion of the Superintendent, a valve or fitting is at too great a distance from any existing wall, fence or post to which the notice plate could be conveniently fixed, the Contractor shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting. The distance to the fitting in metres, to an accuracy of 0.1 m, shall be permanently marked on the plate with legible numbers a minimum 80 mm high. Wooden posts are not to be used where there is evidence, by rotting or termite activity, that the integrity of the posts will be affected.

The post shall conform to the following requirements:

(i) the post shall be of sufficient length to be set firmly in place under saturated ground conditions;

(ii) when installed, the post shall project 1000 mm above the ground, provided that where tall grass or crops are likely to obscure the post, or, where directed by the Superintendent, its height above the ground shall be increased to 1500 mm; and

(iii) the post shall be painted with 2 coats of white enamel for exterior use.

The Contractor shall encase in concrete, pipes in gravity sewers or rising mains, as shown on the design drawings, with less than the specified cover above the top of the pipe barrel, or where directed by the Superintendent. Concrete shall be 20 Mpa complying with Section SC6.4.18 Concrete works and have the following minimum dimensions (WSA 02-2014, Part 1, Section 9.7 and SEQ-SEW-1207-1):

(i) for trenches in other than rock: 150 mm minimum under, on both sides and on top of the pipe barrel; and

(ii) for trenches in rock: 100 mm minimum under the pipe barrel, 150 mm on top of the pipe barrel and for the full width of trench excavated.

In trenches of other than rock or fissured rock, a contraction joint consisting of a layer of bituminous felt 12 mm thick shall be formed in the concrete encasement at the face of each socket or at one face of each coupling.

Reinforcement in concrete encasement shall be as shown on the design drawings.

(s) Wrapping of pipelines

Where shown on the design drawings or directed by the Superintendent, the Contractor shall enclose a pipeline or a section thereof, in lay flat polyethylene sleeving (WSA 02-2014, Part 2, Section 16.10).

The materials to be used shall be high impact resistance polyethylene sleeving of minimum thickness 0.2 mm polyethylene film, approved by the Superintendent, and 50 mm wide plastic adhesive tape.

The width of the sleeving when flat shall be in accordance with the pipe manufacturer's written recommendations for the size and type of the pipeline which is to be encased. Precautions shall be taken so that exposure to direct sunlight does not exceed 48 hours.

Where necessary to distinguish pipes within close proximity, pipelines shall be identified by colour sleeving or an appropriate identification tape.

Application of the polyethylene sleeving and plastic adhesive tape shall be in accordance with the pipe manufacturer's written instructions or as directed by the Superintendent. The Contractor shall take due care not to damage the sleeving during its application or during the backfilling of the trench. Each pipe shall be encased in a length of sleeving overlapped for a minimum of 250 mm at each field joint, and the ends of each length of sleeving shall be held in position with at least three circumferential turns of adhesive tape. As the polyethylene sleeve material covering the pipe will be loose, excess material shall be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of strips of plastic tape at approximately 1 metre intervals. Bends, tapers, and similar fittings shall be covered by polyethylene sleeving as specified for the pipes. The Contractor shall hand wrap valves, hydrants and irregular shaped fittings and joints using flat polyethylene sheets secured with plastic adhesive tape, or other suitable material, to provide an adequate seal. The flat polyethylene sheets may be obtained by splitting suitable lengths of sleeving.

The Contractor shall rectify any damage done to the polyethylene tubing before, during or after backfilling of the trench. The Contractor shall present the wrapped pipeline for inspection by the Superintendent prior to commencing backfilling operations.

(t) Corrosion protection of steel bolts and nuts

The Contractor shall wrap all galvanised steel bolts and nuts, used for installation below ground, of flanges, bolted gland joints, mechanical joints, tapping bands using a tape, approved by the Superintendent consisting of synthetic fibre open weave cloth impregnated with saturated hydrocarbons applied in accordance with the manufacturer's recommendations. Bolts and nuts shall be dry, clean, and free from rust immediately before wrapping.

(u) Cast in-situ maintenance holes

For all maintenance holes concrete work, the Contractor shall comply with Section SC6.4.18 Concrete works in relation to the supply and placement of concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection except as specified below (Refer WSA 02-2014, Part 2, Section 17.2.3 and SEQ-SEW-1301-5 and SEQ-SEW-1309-1).

Cement used in all concrete shall be Type SR to AS 3972. The Contractor may use fly ash additive to a maximum 20 per cent. Cement used shall be no older than 3 months since manufacture.

The minimum cement content shall be 360 kg/m^3 of concrete and the water/cement ratio of the mix shall not be greater than 0.50 by mass.

(v) Covers and frames

Covers and frames shall not be warped or twisted. Surfaces shall be finished such that there are no abrupt irregularities and gradual irregularities shall not exceed 3 mm. Unformed surfaces shall be finished to produce a surface that is dense, uniform, and free from blemishes. Exposed edges shall have a minimum 4 mm radius.

Tolerances for the dimensions on the COVER shall be – 3 mm + NIL. Tolerances for the dimensions on the FRAME shall be -3 mm +3mm.

Maintenance hole covers shall be seated on a layer of bitumen impregnated fibre board, having a cross section of 25 x 25 mm. Alternatively another seating material of a cross section and composition approved by the Superintendent may be used.

Maintenance hole covers shall be finished flush with the surface in roadways, footpaths, and paved surfaces of any type. Elsewhere, covers shall be finished 25 mm above the surface of the ground where not shown otherwise on the design drawings, or such other level as directed by the Superintendent, in a manner designed to avoid as far as possible, the entry of surface water. Covers shall finish 150 mm above finished surface levels in new subdivisions.

In locations, where shown on the design drawings or directed by the Superintendent, the Contractor shall install a cast iron cover and frame. Where it is evident, or otherwise shown on the design drawings, the Contractor shall install bolt down frames and covers in areas subjected to flooding. Cast iron covers and frames shall be manufactured in accordance with AS 3996, and shall be installed and filled with concrete, as necessary, in accordance with the manufacturer's written requirements.

(w) Preformed maintenance hole and maintenance shaft systems

The Contractor shall supply components that make a watertight system and have a satisfactory surface finish.

Generally, preformed maintenance holes shall be made up in accordance with the design drawings, with components consisting of a base section, shaft sections, converter, cover, and frame. Make-up Rings (1 only) of 100-150 mm may be used between converter section and cover to make up height differentials. The wall thickness of any reinforced component below the frame shall not be less than 84 mm.

Preformed maintenance shafts shall be made with section lengths that once constructed comprise the least number of joints as required to satisfy height parameters and unit joint/wall penetration coring clearances.

The installation of all preformed components shall be in accordance with the manufacturers' recommended procedures and requirements.

Backfill for all preformed maintenance holes and maintenance shafts shall be placed and compacted evenly around the maintenance hole to the required finished surface level according to location requirements. If necessary, the Contractor shall import and compact non-cohesive granular material.

(x) Bedding and backfilling compaction requirements

After laying and jointing of a pipeline has been completed the Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to commencement of trench backfilling (WSA 02-2014, Part 2, Section 19). Backfill shall not be placed until the Superintendent has given approval.

Material for the bedding, side support and overlay of the pipe shall be as for pipe bedding specified in Clause SC6.4.11.5 (3)(j) Pipe bedding above. The material shall be compacted in layers of not more than 150 mm to a Density Index of 70 for the material used when determined in accordance with AS 1289.5.6.1.

The Contractor shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150 mm thick as follows:

(i) Where the trench is within a roadway, proposed roadway, the remainder of the trench shall be:

1. backfilled with a non-cohesive granular material, with a grading falling generally within the limits shown in Table SC6.4.11.7 and compacted to Density Index of 70 when determined in accordance with AS 1289.5.6.1:

    a) below 0.3 m of the subgrade road surface; and

    b) in the road reserve, up to top of overlay zone;

2. backfilled with selected material and compacted to 100 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1, to top of subgrade level of the road surface, but excluding the pavement layers;

3. backfilled with selected material and compacted to 95 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1, to finish surface level of the areas of trench outside of roadways; and

4. backfilled with road base and sub-base material as per existing or proposed pavement layers and compacted to 100 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1.

(ii) Elsewhere, unless stated otherwise, the remainder of the trench shall be backfilled with ordinary excavated backfill material. Where suitable material is not available, granular material may be used for the full depth of backfilling. The material shall be compacted to a density Index of 70 when determined in accordance with AS 1289.5.6.1 for cohesionless materials or 98 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1 for cohesive materials.

The Contractor shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.

The Contractor is to submit to the Superintendent for approval any proposal for construction of embankments in conformance with the drawings, including the method of placement and compaction and any limitations to the placement/compaction over the top of any pipeline.

Where a roadway is to be sited over existing infrastructure, excavation of trench material down to overlay zone and subsequent backfilling with appropriate select material to the underside of sub-base to the compaction requirements stated above must be undertaken by the contractor.

The Contractor may compact backfill by trench flooding only where:

1. the ground and backfill material is cohesionless sand;

2. water for flooding has been sourced at the site;

3. the process will not create mud which would be moved off site by vehicles or constructionplant; and

4. additives are not used.

The contractor shall carry out compaction tests to the full depth of zone being tested and present NATA certified test results to the Superintendent.

(4) Pipeline testing and restoration

(a) General

The Contractor shall subject all sewers and maintenance holes to an initial test as soon as practicable after construction and backfilling is completed (WSA 02-2014, Part 2, Section 21).

All lines shall be clear and free from soil, slurry, liquids and other foreign substances at the time of initial and acceptance testing.

Where a vacuum system has been specified, the Contractor shall test the system in accordance with the testing schedule as shown on the design drawings.

(b) Initial test of gravitational sewers

The Contractor shall make the initial testing of gravitation sewers with compressed air. Before the initial test is performed, all pipe laying on the section shall be completed, and backfill shall be compacted to at least the level of the top of overlay section of trench filling. The Superintendent shall advise at the time of notification by the Contractor whether the option to inspect the initial testing is required.

The initial test shall not be carried out before risers and/or property connection sewers are constructed.

Where the Superintendent approves the construction of pipelines in other than full lengths between maintenance holes, each length of pipeline shall be tested before backfilling together with the downstream portion of the maintenance hole length under construction.

The Contractor shall rectify any fault detected and obtain a satisfactory test before the remainder of backfill is placed.

(c) Initial test of maintenance holes

The Contractor shall test each maintenance hole for leakage, as soon as practicable after the maintenance hole is constructed and the maintenance hole cover surround fitted.

Maintenance holes may be tested in conjunction with both upstream and downstream sections of mains using the low-pressure vacuum method for the initial testing only in accordance with WSA 02-2014, Part 2, Section 21.4.2.2. It is advised that a pressure relief valve be installed in line with a maximum setting release of 50 kPa.

Alternatively, the Contractor may request to test manholes initially using hydrostatic means. The test shall be made by plugging all pipe openings in the walls and by filling the maintenance hole with water to the lowest point on the top of the maintenance hole cover surround. The plugs shall be positioned in the pipes as near as practicable to the internal face of the maintenance hole. The Contractor shall provide details of the alternative method proposed, for approval by the Superintendent, prior to its use.

(d) Ovality test and CCTV inspection

The Contractor shall carry out deflection (ovality) testing in conformance with WSA 02-2014 Part 2, Section 21.6.2 upon completion of placement and compaction of trench and embankment fill. Submit proposal for deflection testing to the Superintendent for acceptance. Carry out a CCTV inspection of the sewer system and maintenance structures to WSA 05-2013 Attachment E and WSA 02-2014 Part 2, Section 21.7 and Clause SC6.4.14.5 Conduit assessment.

The Contractor shall undertake ovality testing as follows:

(i) all sewers to DN 300 shall be tested to determine any excessive ovality using either a proving tool approved by the council or by CCTV light ring and approved measurement software. Ovality testing shall be undertaken after all earthworks on the subdivision are complete and no sooner than 14 days after backfilling of trenches has been completed. Sewer pipes having excessive ovality shall be replaced and the line retested (WSA 02-2014, Part 2, Section 21.6.2 & WSA 05-2013);

(ii) the proving tool shall be rigid and non-adjustable having an effective length of not less than its nominal diameter. The minimum diameter at any point along the length shall be as specified in WSA 02-2014, Appendix K;

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

(iv) Maximum Allowable Deflection = 3% of Mean Outside Diameter; and

(v) the testing shall require a “prover” to be pulled through each section of the pipeline by hand winching to demonstrate that the maximum allowable deflection is not exceeded.

(e) Acceptance test of gravitational sewers and maintenance holes

Acceptance testing shall be carried out before the issue of the Certificate of Practical Completion. Sewers or maintenance holes failing any test, shall be repaired and the test repeated. The process of testing, repair of defects and retesting shall continue until a satisfactory test is obtained. (WSA 02-2014, Part 2, Section 21.) The Contractor shall make the acceptance test on all components in the section of the sewer in the same manner and to the same methods as the initial test. The Contractor shall submit to the Superintendent satisfactory test results from the acceptance testing.

The Superintendent may permit hydrostatic testing as an alternative to air testing for acceptance of gravitation pipelines and maintenance holes after approval from council.

Where the project contains a combination of precast and cast in-situ maintenance holes, then each group must be regarded as a separate population and testing frequencies shall be in accordance with WSA 02-2014, Part 2, Table 21.5.

The Superintendent may reject any pipeline or maintenance hole in which there is visible or detectable leakage.

(f) Testing with compressed air

The Contractor shall supply and keep all necessary equipment in a condition acceptable to the Superintendent.

All test gauges must have a current calibration certificate and have a range that is suitable to be able to read decimal increments. The minimum diameter of readable face shall be 100 mm.

Sewer lines may be tested by either vacuum (negative pressure) or by positive pressure. The use of inline manhole through connectors can be utilised for ease of testing multiple lines. Manholes and sewer lines shall be tested separately.

Compressed air shall be supplied by a compressor of the rotary vane type capable of supplying at least 1 m^3/minute at 35 kPa. The air shall be fed through a pressure reducing valve capable of reducing pressure from that supplied to 28 kPa ± 4 kPa. The air shall then pass through an airtight line fitted with a pressure gauge reading from 0 to 50 kPa, a pressure relief valve that shall be set to blow off at 28 kPa ± 4 kPa and a gate valve to the pipeline to be tested.

The method of setting up and carrying out the test shall be as specified in WSA 02-2014, Part 2, Section 21.4.2.

(g) Allowable pressure drop

The time taken for the pressure to drop from 25 kPa to 18 kPa shall be greater than that specified in WSA 02- 2014, Part 2, Table 21.3.

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

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

(h) Hydrostatic testing

The Contractor shall not carry out hydrostatic testing unless prior approved by the superintendent.

The pipeline under test, and the pipe or hose with container, shall be filled with water until the free surface is level with the top of the container, when that container is suspended in accordance with the requirements set out below.

The test container shall be suspended at a level such that the test head applied to the pipeline is as follows:

(i) for initial test:

1. when no property connection sewers or risers are constructed – a minimum head of 2 metres above the pipe invert at the upstream end of the line under test; or
2. where property connection sewers and/or risers are constructed – a minimum head of 2 metres above the highest invert in the line under test, including its risers and property connection sewers;

(ii) for acceptance test, a minimum head of 2 metres above the highest invert in the line under test, including its risers and property connection sewers, or above the free-standing level of ground-water in the vicinity whichever is the higher; and

(iii) such other lesser head as the Superintendent, at the Superintendent's discretion, may direct.

The Contractor shall determine, at the Contractor's expense, the free-standing level of groundwater, by a method acceptable to the Superintendent.

After allowing an interval for absorption, to be determined by the Superintendent, any fall of the free water surface shall be made good by adding extra water to the container. The Contractor shall measure the fall in water level during the ten minutes thereafter.

The pipeline will be regarded as satisfactory if there are no visible leaks, and if the fall in water level is not more than 25 mm for each standard test length of the pipeline under test including property connection sewers and/or risers.

A standard test length in metres is defined as 1370 m divided by the effective diameter of the pipeline in millimetres. Where the pipeline under test is all of the same size, the effective diameter shall be the nominal size of that pipeline. Where the pipeline under test has property connection sewers and/or risers of smaller nominal size than the main sewer line, then the effective diameter shall be calculated as the product of the length and the nominal size of the larger pipe added to the product of the length and the nominal size of the smaller pipe; this sum shall be divided by the total length of pipeline under test; the result shall be

the effective diameter.

(i) Visual inspection and measurement of infiltration

Whenever, in the case of acceptance testing, the pipeline is subjected to a significant head of groundwater (I.e., 1500 mm or more above the soffit of the sewer main provided that groundwater is at least 150 mm above any property connection sewer included in the test), the tests previously prescribed may be dispensed with in favour of visual inspection and measurement of infiltration upon request to the Superintendent.

In such circumstances, the Contractor shall propose full details of the method by which the infiltration is to be measured (WSA 02-2014, Part 2, Section 21.5).

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

Rate of Infiltration

$Q.I. = 0.65 (L^1d^1h^1 + L^2d^2h^2 + \quad L^nd^nh^n) + Ha$

Where:

Q.I. = rate of infiltration in litres/hour L = length of pipe in metres

d = nominal size of pipe in metres

h = average head of groundwater over the invert level of the pipe in the section under test

Ha = head of groundwater above the invert level of the outlet pipe of the maintenance hole when the maintenance hole is included in the infiltration test.

The Contractor shall determine the head of groundwater, by a method approved by the Superintendent.

(j) Testing of rising mains

The Contractor shall pressure test rising mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. Acceptance testing shall be carried out before the issue of the Certificate of Practical Completion. Rising mains failing any test, shall be repaired and the test repeated. The process of testing, repair of defects and retesting shall continue until a satisfactory test is obtained (WSA 07-2007, Part 3, Section 21). The Contractor shall submit to the Superintendent satisfactory test results from the acceptance testing.

Pipelines shall be tested in sections approved by the Superintendent as soon as practicable after each section has been laid, jointed, and backfilled, provided that:

(i) if so specified or if the Contractor so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Superintendent; and

(ii) the pressure testing shall not be commenced earlier than 7 days after the last concrete thrust or anchor block in the section has been cast.

For the purpose of this clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing e.g. by means of main stop valves. A maximum length of 1000 m can be tested in one continuous section unless otherwise approved by the Superintendent.

Pressure testing shall not be carried out during wet weather unless otherwise approved by the Superintendent.

During pressure testing, all field joints which have not been backfilled shall be clean, dry, and accessible.

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

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

The hydrostatic test pressure which shall be applied to each section of the pipeline shall be equivalent to 1.25 times the maximum operating pressure of the pipeline but do not exceed 1.25 times the maximum operating pressure rating of the lowest rated pipe/fitting. The test procedure shall be in accordance with WSA 07-2007*,* Part 3, Section 21.4.

The Contractor shall maintain the specified test pressure for as long as required by the Superintendent, while the Contractor examines the whole section. In any case, the specified test pressure shall be maintained for not less than 4 hours. For the purpose of determining the actual leakage losses, the Contractor shall carefully measure and record the quantity of water added in order to maintain the pressure during the period of testing.

The pressure testing (pipes other than PE) of a section shall be considered to be satisfactory if:

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

(ii) there is no visible leakage; and

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

Q1 = (0.14xDxLxH)

where

Q1 = permissible leakage rate (litres per hour)

D = nominal internal diameter of pipe (m)

L = length of section tested (km) H = average test head (m)

Any failure, defect, visible leakage and/or excessive leakage rate, which is detected during the pressure testing of the pipeline or during the defects liability period shall be rectified by the Contractor at the Contractor’s expense.

For PE rising mains, testing shall be in accordance with WSA 07-2007, Part 3, Section 21.5.

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

(k) Connection to existing sewers

The Contractor must request approval (request for private works quotation) for connection to existing sewers from Townsville Water and Waste. Works shall be either performed by Council or delegated to the Contractor at the discretion of Council. Approval must only be requested upon satisfactory completion of all backfilling and testing. All necessary works required in completing connections to “live” maintenance holes (that is, accesses to sewer system that is currently in service), including all works undertaken by Council at “live” maintenance holes in delivering the works shall be the responsibility of the Contractor (WSA 02-2014, Part 2, Section 23).

(l) Restoration of surfaces

The Contractor shall clean pavements, lawns, and other improved areas and leave them in the same order as they were at the commencement of the Works. The Contractor shall restore any fencing removed during construction and shall restore lawns with turf cut and set aside from the original surface and with imported turf from a source approved by the Superintendent. (WSA 02-2014, Part 2, Section 24.) The restoration works shall be done progressively and as soon as possible after the section of works is completed.

The Contractor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the defects-liability period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the defects-liability period. The Contractor shall maintain pavements with crushed igneous rock, gravel or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement.

Immediately the backfilling of a trench excavated through a pavement has been completed, the Contractor shall temporarily restore the pavement. Where the trench crosses bitumen or concrete pavement, the surface is to be protected from deterioration. A pre-mixed asphaltic material may be used for such temporary restoration.

The Contractor shall maintain the temporary restoration until final restoration is carried out. Final restoration of the pavement shall be carried out in accordance with SEQ-SEW-1205-1 to restore the pavement and its sub-base to no less than the original condition. Final restoration may include, if required by the Superintendent, the removal of temporary restoration.

In other than roadways, the Contractor shall place the backfill sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the defects-liability period in order that the surface of the completed trench may then conform with the adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the Contractor. Where dry weather conditions have persisted after the original backfilling, including during the defects-liability period, the Contractor shall take all necessary steps to consolidate the trench before removing surplus materials from the site.

In locations where, in the opinion of the Superintendent, surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench to the satisfaction of the Superintendent in such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Contractor shall maintain the backfill and adjacent ground until the expiry of the defects-liability period.

Where, within public or private property, the reasonable convenience of persons will require such, the Superintendent may order the Contractor to level trenches at the time of backfilling. The Contractor shall make good any subsequent settlement, as required by placing additional fill.

The Contractor shall immediately restore any damaged or disturbed private property and services.

Should the Contractor elect to tunnel under paving, kerb and channel or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces. The Contractor shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the defects-liability period.

The Contractor shall provide notice to affected property owners of any pending works.

(5) Pump stations

(a) General

Provide only products and materials authorised by Council, the drawings, and the Planning Scheme Policy. The Contractor shall submit for approval any alternative or not authorised products and materials.

The Contractor must conform to manufacturer's recommendations for handling, transport, and storage of materials and in a manner to prevent damage or deterioration or excessive distortion. Inspect all products and materials at the time of delivery and reject products and materials not in conformance with Council requirements and the manufacturers' recommendations. Maintain protective crating or packaging until immediately before use.

Damaged or defective materials are not to be installed or used, including coatings and linings, outside the manufacturer's recommended limits.

(b) Certification of FRP manufacture pump station

The manufacture of the FRP pump station shall be certified by a suitably qualified independent engineer experienced in the manufacture of FRP pump stations.

(c) Pumps

Pump construction materials for centrifugal end suction pumps shall comply with the following:

Description	Material
Pump	
Casing and suction bend	Cast iron AS1830 Gr T200
Wear rings	Cast iron AS1830 Gr T200
Impeller	316 Stainless steel AS/NZS 3678
Impeller nut	Gunmetal AS 1565-905C
Shaft	316 Stainless steel AS 2837
Shaft sleeve	Phosphor bronze AS 1565-9060/316
Neck bush, lantern ring	Phosphor bronze AS 1565-9060
Gland	Cast Iron AS1830 Gr T200

Gland studs	316 Stainless steel AS 2837
Gland nuts	316 Stainless steel AS 2837
Fixing nuts and bolts handhold	316 Stainless steel AS 2837
Covers	316 Stainless steel AS/NZS 3678
Fitted bolts and nuts, casing and dowels	316 Stainless steel AS 2837
Forcing screws	316 Stainless steel AS 2837
Water thrower and drip tray	316 Stainless steel AS/NZS 3678
Pump set base plate	Cast iron AS1830 Gr T200/ Fabricated steel
Motor	
Motor frame and end shield	Cast iron/ mild steel
Motor terminal box	Cast iron/ mild steel
Motor fan cover	Mild steel
Motor fan	Metal
Holding Down Bolts	316 Stainless steel AS 2837
Mechanical Seals	
Seal faces	Tungsten carbide or equal
Springs	Nickel chrome steel
Secondary seal	Fluoro carbon or nitrite rubber

The Contractor shall provide a written warranty from the manufacturer of the equipment. This action constitutes a hold point. The Superintendent's approval of the warranty is required prior to the release of the hold point.

The manufacturer's warranty shall require the manufacturer to accept liability for any defect in materials or workmanship which becomes apparent at any time within 2 years after the date of delivery of any piece of equipment used in work under the contract.

All nuts and bolts shall be manufactured in accordance with AS/NZS 1111 and AS/NZS 1112, 150 metric series and fitted with washers beneath bolts heads and nuts. Requirements are:

(i) all bolts, nuts and washers shall be stainless steel to AS/NZS 3678and AS 2837, minimum grade 316. All bolts, nuts and washers are to be of the same grade and supplied passivated;

(ii) all threads are to be rolled;

(iii) all bolt heads and nuts shall be hexagonal;

(iv) all bolts, studs, set screws and nuts for bolting flanges and other pressure containing purposes shall conform to AS 2528;

(v) all nuts and bolts subjected to vibration shall be fitted with lock washers or lock nuts;

(vi) all concrete anchor bolts, nuts, locking nuts and large series washers required for the bolting down of pump set discharge bends shall be provided. These anchor bolts shall be as recommended by the equipment designer with a minimum diameter of 16 mm;

and

(vii) concrete anchor bolts shall be chemical masonry anchor type, set to their full depth, suitable for the required duty.

Bolts on all flanges will protrude no more than 10 mm past the nut when tightened.

The Contractor shall apply sufficient anti-seize/anti-galling material to the threads of all stainless-steel fasteners. The material shall be Polytetrafluroethylene (PTFE), either tape to AS 1272, dipped or sprayed, or molybdenum disulphide.

(d) Preformed pump stations and package pump stations

Preformed components or systems, complying with the design drawings, if any, otherwise complying with AS 3518, AS 3571.1 or AS 4198 may be used in lieu of in-situ construction provided:

(i) preformed concrete wall units are to be manufactured to AS 4058 except as modified as for the requirements for precast maintenance hole units;

(ii) joints shall be internal flush; and

(iii) the Contractor shall supply components that make a watertight system and have a satisfactory surface finish.

Package pump stations may be supplied and installed provided:

(i) the proposed packaged system has been appraised and recommended by Water Services Association of Australia (WSAA);

(ii) all components comply with the requirements of this section; and

(iii) the units are at least equivalent to the requirements of this section and the design drawings.

(e) Electrical compliance

The Works shall be in accordance with the requirements contained in Clause SC6.4.11.6 Water and sewerage electrical and mechanical below, except where this section or the design drawings indicate otherwise. The technical requirements detailed on the design drawings shall take precedence over the requirements of this section should clauses be in disagreement.

Except where Clause SC6.4.11.6 Water and sewerage electrical and mechanical requires a higher standard, works shall be carried out in accordance with AS 3000, the Service Rules of the Supply Authority and all relevant statutory authorities.

The Contractor shall supply proof of compliance with a standard or specified test. Such proof shall comprise a test certificate from an approved independent testing authority.

The Contractor shall submit all designs and material, to each Authority having jurisdiction for approval. The Contractor shall arrange for each Authority having jurisdiction to inspect the Works. The Superintendent shall be advised a minimum of 7 working days in advance of the date of any inspection by an Authority. The Superintendent shall advise at the time of notification by the Contractor whether the option to attend the inspections is to be exercised.

(f) Switchgear and Control Gear Assembly (SCA) controls

The Contractor shall supply and install the SCA designed and assembled by a manufacturer approved by the Superintendent.

The SCA shall be of outdoor, stationary, free standing, metal-enclosed, cubicle type series with a minimum degree of protection of IP56D as specified in AS 60529.

All equipment shall be securely mounted on suitable mounting panels and comprise individual compartments. A hot dipped galvanised steel channel base shall be provided.

The Contractor shall provide an effective barrier to prevent gases from the wet well entering the SCA.

Starter contactors shall have appropriate ratings for the proposed pumps to AC3.

All necessary terminals with terminal and cable numbers shall be supplied and installed in accordance with the design drawings.

The Contractor shall liaise with the electricity supply authority to supply padlocks for the metering equipment, at the Contractor's expense. The Council shall supply padlocks for use on the SCA at no cost to the Contractor.

The electrical characteristics of the SCA shall be:

Main Circuit: 415/240 V, 50 Hz, 3-phase, 4-wire. Motor Control Circuit: 240 V, 50 Hz.

Common Control Circuit: 240 & 24 V, A.C.

Prospective short circuit current:14kA for 1 second. Peak Factor: 2.2

Power Factor Correction (determined in consultation with the Superintendent) Earthing (M.E.N. system) Characteristics.

All cables shall enter the SCA from below.

The Contractor shall supply data from the switchgear supplier confirming Type "2" co-ordination between contactors, motor protection relays and corresponding circuit breakers, to the Superintendent.

Refer to Council's Standard Specification TCC24 clause 18 for starter selection requirements and functional specification for the project.

The Contractor shall carry out of factory tests in the presence of the Superintendent's Representative and in accordance with Clause SC6.4.11.6 Water and sewerage electrical and mechanical and the results shall comprise all routine Tests specified in AS 3439. The Superintendent shall be given 7 days' notice of the proposed date of such tests.

Inspections and functional tests shall be in accordance with TCC24 clause 21.

The Contractor shall pack the equipment for transport after satisfactory final factory inspection and tests, and after approval has been given by the Superintendent. The Contractor shall ensure that any relays, programmable logic controllers, and fittings likely to be adversely affected during delivery shall be adequately protected or shall be removed and packed separately in protected containers. Where equipment has been removed, cover plates shall be provided.

The Contractor shall be responsible for any damage that may occur during transit and unloading at site.

The Contractor shall ensure that spare parts, tools etc., are packed separately from the main plant and shall be marked "Spare Parts", "Tools" etc., as applicable.

The Contractor shall supply spare parts in accordance with the schedule supplied by the Superintendent.

Automatic control of the pump station pumping equipment shall be by way of hydrostatic level sensor providing single pump duty operation unless shown otherwise on the drawings. The level sensor will be compatible with those in use in the system. A float switch shall be used to provide a HIGH (overflow) level alarm. Refer to TCC24 clauses18.2, 18.2, 19.1 and 19.2.

The following wet well levels shall be used in the automatic control of the pump operation system:

(i) STOP level;

(ii) Duty Start level;

(iii) Standby Start level; and

(iv) High level.

Pump operation requirements are described in TCC24 clause 18.

The Contractor shall supply and install control equipment that is compatible with the existing equipment.

(g) Electrical installation

The Contractor shall liaise with the Supply Authority for the electricity supply to the pump station site.

The Contractor shall be responsible for all facilities required by the Supply Authority for revenue metering equipment and the payment of all associated connection, inspection fees and capacity charges.

The Contractor shall supply and install all cabling including consumer mains, motor, control and instrumentation cables, conduits, and electrical pits.

The Contractor shall install all wiring in HD-PVC underground conduits laid in accordance with the Supply Authority's requirements, with a minimum 500 mm below the finished ground level in non-trafficable areas and 600 mm below the finished ground level in trafficable areas. The trench and backfill material shall be free of rocks and other foreign matter likely to damage the conduits.

The Contractor shall run electrical marker tape 150 mm below the finished ground level directly above the conduits for the entire length of the conduits. Marker tape shall be orange in colour, 150 mm wide and stamped with the words "DANGER – ELECTRIC CABLES BELOW" or similar.

The Contractor shall route all underground cabling with the approval of the Superintendent. Brass marking plates shall be positioned on a concrete surround clearly showing the direction of the incoming consumer mains. Wording and markings shall read "DANGER – ELECTRICAL CABLES BELOW". The Superintendent's approval of the route of all underground cabling is required prior to the release of the hold point.

The Contractor shall determine the points of attachment on site and the Contractor shall supply and install any consumer's connection poles for the consumer mains required by the Supply Authority.

The consumer mains shall be generally run underground and commence at the point of attachment on a steel consumers pole or Ergon pillar (if applicable), installed near the property boundary and run-in conduit to the switchboard.

No aerial conductors are to be installed over structures, access road or vehicle manoeuvring areas.

The minimum size of the consumers mains shall be sized to satisfy the following:

(i) current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30 percent minimum;

(ii) be sized for a voltage drop less than 1.5 percent to the maximum demand as calculated;

(iii) be single core PVC/PVC cables. XLPE insulated cable may also be used;

(iv) comply with the requirements of the Supply Authority; and

(v) AS 3000 and AS 3008.

In addition to the requirements of the Supply Authority and Clause SC6.4.11.6 Water and sewerage electrical and mechanical, the Contractor shall run the main earthing conductor in conduit to the main earthing electrode. The main earthing connection shall be contained in an earthing electrode connection box similar to ALM type ERB-1 up to 50 mm2 cable and a Type 4 pit for larger cable.

Earth electrode shall be bonded and suitably labelled with an engraved brass label.

Surge diverters shall be earthed in accordance with manufacturer's instructions.

The Contractor shall bond the pump station metallic pipework to the main earth.

Refer also to TCC24 clause 28.1 for installation instruction requirements.

Metering equipment and installation shall comply with the *Queensland Electricity Connections and Metering Manual*.

The Contractor shall gland cables entering the outdoor SCA compartment using non-ferrous metallic or plastic glands with neoprene compression seals and connect the on-flow switch and pump motor cables to the appropriate terminals. Cables shall not be jointed.

The Contractor shall seal, at the completion of commissioning tests, all conduits into the outdoor switchgear and control gear assembly with a non-setting sealing compound to prevent the ingress of vermin.

(h) Pressure gauges

The Contractor shall install one diaphragm protected, glycerine oil filled, direct mounting, bottom connection pressure gauge complying with AS 1349 per centrifugal pump installation. Cases shall be fabricated from stainless steel complying with AS/NZS 3678 or bronze. The protective diaphragm shall be suitable for dismantling for cleaning without affecting the accuracy of the gauge.

The gauge face shall be 100 mm in diameter and calibrated in metres head of water. The gauge shall accurately indicate the pump operating head and the pump no flow head.

Each gauge shall be supplied with the nominally sized metric equivalent of three of the following bronze fittings: gate valve, union, nipple and reducing nipple.

Gauges and fittings shall be screwed into the pipe wall of ductile iron pipes, or pipe fittings, 150 mm and larger. In pipework less than 150 mm, gauges and fittings shall be screwed into a tapping band. On rising mains, where shown on the design drawings, the Contractor shall install a ball valve to allow removal of the gauge.

The pressure gauge range for single or parallel pumps duty shall be 0 to 1.7 times the closed valve head of the pumps.

(i) Valves

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

The Contractor shall ensure that valves are installed to facilitate maintenance. The Contractor shall take into account the manufacturer's recommendations, the requirements shown on the design drawings, the type of connection, and lubrication of connecting bolts.

Flanges shall comply with AS 2129 to the class shown on the design drawings.

Unless shown otherwise on the design drawings, all valves shall be anti-clockwise closing.

The Contractor shall size "Tee" Key valve operators and hand wheels to operate the valves under all operating conditions throughout their full range with no greater than 180 Newtons applied to the ends of the key bar or the rim of the wheel.

Hand wheels shall display an embossed or engraved arrow, together with "open" and/or "close" corresponding to the valve operation.

One "Tee" key operator per pump station, of suitable length for operating the respective valve from the surface level, shall be provided for each size of valve installed in each pump station.

Non-return valves shall be of the swing check type to AS 3578 of cast iron or steel body, cover and disc with bronze body and disc seat rings. The leaf shall swing clear and provide an unobstructed waterway.

The body cover shall be located and sized to allow the valve flap to be removed and the seat to be inspected without removing the valve.

Each non-return valve shall have an extended spindle, minimum grade 316 stainless steel, fitted with an adjustable counterweight.

The knife gate valve shall be constructed in accordance with the following:

(i) the design shall include an enclosed bonnet;

(ii) the spindle shall be of the non-rising type;

(iii) valves shall be anti-clockwise closing;

(iv) the gland around the spindle shall be adjustable or formed by a double O-ring;

(v) flange jointing shall be rubber O-rings; and

(vi) seating shall be achieved by flexible seats which shall be designed in a manner that will allow easy replacement. The material of the seat is to be nominated.

All assembly bolts and nuts shall be fitted with fibre or nylon isolating washers to prevent bimetallic corrosion where required.

Each valve spindle shall be fitted with a cast steel or forged steel spindle guard secured to the valve spindle with a gun metal set screw or a handwheel secured to the spindle with gun metal set screw and washer.

Valves shall be drilled and threaded, where required, in accordance with AS 2129.

(j) Testing and commissioning of pump station

The Contractor shall test and/or inspect all materials, equipment, installation, and workmanship to prove compliance with the section requirements. The submission to the Superintendent of satisfactory test results constitutes a hold point. The approval of the Superintendent is required prior to the release of the hold point.

Tests and inspections shall comply with relevant Australian Standards.

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

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

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

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

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

(i) initial charges of lubricant in addition to any special lubricant requirements for initial flushing or treatment of the system or for “running in”;

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

(iii) electrical and instrument installation tests, including motor insulation tests and checking instruments against certified instruments and correcting as necessary;

(iv) tests of the correct functioning of automatic and manual control and protection equipment, including simulating danger conditions, mal-operations or failures, to check that all instruments and controls function correctly. These tests shall also include adjusting instrument set points and alarm settings and proving correct operation of alarms; and

(v) equipment and system operating tests. The Contractor shall certify compliance of each item and submit a signed copy to the Superintendent prior to commissioning.

The Contractor shall carry out pre commissioning tests to the satisfaction of the Superintendent and shall record the results of the tests on the appropriate Pre commissioning Record Sheet.

Refer to TCC24 Clause 28.1.11 for electrical test documentation requirements.

The Contractor shall furnish the Superintendent with one signed copy of each completed Pre commissioning Record Sheet countersigned by the Superintendent's Representative who witnessed the test.

Commissioning is the running of the plant and equipment to ensure flow through the pumping system, carrying out any necessary testing and adjustments until it is ready and suitable for normal starting and running under service conditions.

The Contractor shall give the Superintendent 5 working days' notice of the Contractor's intention to undertake commissioning and supply to the Superintendent the copies of each of the pre commissioning record sheets and three copies of the operational and maintenance manuals at the time that notice of commissioning is given.

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

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

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

The Contractor shall prepare, schedules, test record sheets and programmes for approval by the Superintendent prior to each stage of the overall commissioning.

The Contractor shall carry out final testing and commissioning (min 1 day duration) of the electrical services in conjunction with the mechanical equipment (e.g. pump, etc) including setting and adjustment of equipment in accordance with these water and sewerage planning design guidelines.

The Contractor shall arrange for all testing, commissioning, and any adjustments.

(k) Practical completion of pump station

The Contractor shall fulfill the following requirements before the Certificate of Practical Completion:

(i) receipt by the Superintendent of a certificate of approval from the relevant statutory authorities;

(ii) pump station is in working order as demonstrated by the testing and commissioning;

(iii) approval by the Superintendent of operating and maintenance manuals; and

(iv) receipt by the Superintendent of as-built drawings of the pump station.

(l) Telemetry

The Contractor shall make provision for equipment to link the pump station to the existing telemetry network to be provided by Council at the Contractor's expense. Refer to TCC24 clause 17.1, 28.2, Appendix B2 and Appendix C.

The pump station shall be capable of being operated automatically by control signals from the existing or proposed telemetry system. In addition, either one or any combination of pumps may operate at any one time by control signals from the telemetry system.

(m) Operation and maintenance manuals

(i) Manuals shall contain the following information:

1. contractor's name, address, and telephone number;
2. client's contract number, job name; and
3. pump station general arrangement drawing showing pumps, motors, valves, pipework, switchboard and, electrical installation.

(ii) Manuals for pumps shall contain the following information:

1. manufacturer;
2. type and model number;

3. serial number;
4. dimensioned general arrangement drawing of pump and motor;
5. sectional arrangement drawing with parts and list; and
6. dimensioned sectional arrangements detailing:
    a) maximum and minimum shaft/bearing clearance (radial);
    b) maximum and minimum impeller/bowl clearance (radial);
    c) maximum and minimum impeller/bowl clearance (axial);
    d) impeller/bowl wear rings;
    e) motor/pump coupling – type, make and model number; and
    f) mechanical seals where applicable.

(iii) Manual for motors shall contain the following information:

1. manufacturer;
2. type and model number;
3. serial number;
4. dimensioned general arrangement drawing;
5. sectional arrangement drawing for submersible motor power cabling where applicable;
6. gland sealing arrangement drawing for submersible motor power cabling where applicable;
7. cables where applicable; and
8. terminal block arrangement drawing where applicable.

(iv) Manuals for electrical equipment shall comply with TCC24 clause 23 and requirements for electrical drawings are described in TCC24 clause 22.

(v) Manuals for valves shall contain a dimensioned sectional arrangement drawing with parts and material list for all valves.

(vi) Manuals shall contain the following test curves:

1. pump witnessed test curves;
2. motor test curves; and
3. motor torque/speed/efficiency characteristic curves.

(vii) The operating and maintenance manual shall include:

1. safe working procedures - for switching and isolating the supply and distribution system;
2. comprehensive description of operation, including flow charts detailing each operational activity (e.g. manual pump operation, routine test procedures) ;
3. maintenance procedures - recommended maintenance periods and procedures;
4. tools - particulars of maintenance equipment and tools provided, with instructions for their use;

5. equipment - a technical description of the equipment supplied, with diagrams and illustrations where appropriate;

6. dismantling - where necessary, procedures for dismantling and reassembling equipment; and

7. spare parts - a list of the spare parts provided.

Trouble shooting instructions shall be included for pumps, motors, valves and SCA.

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

(6) Construction compliance

(a) As constructed details and operation and maintenance manuals

The Contractor shall submit as-constructed drawings showing the actual location and alignment of pipelines, maintenance holes and junctions, all pump station details together with operating and maintenance manuals in accordance with Section SC6.4.24, Clause SC6.4.24.3 (3)(a).

Details shall include the size, type, levels, grade of pipelines, maintenance hole, and maintenance shaft location, types and cover details, easement requirements for maintenance, pump details, switchboard equipment details and station structural details. The Contractor shall record on as-constructed drawings the area of side fill which should not be disturbed in future without special precautionary measures where side fill construction is part of the structural integrity of a constructed pipeline of a diameter more than 225 mm.

The Contractor shall ensure that a registered surveyor certifies the plans showing location and alignment.

The Contractor shall provide records, for Council's Asset Register, to the Superintendent at the time of practical completion of the Contract. The records are to be in a form consistent for inputting into the Asset Register as directed by the Superintendent.

(b) Video records

Unless advised otherwise by the Superintendent, the Contractor shall provide a video recording of the internal condition of all mains. The video recording shall be undertaken at the time of practical completion of the Contract.

SC6.4.11.6 Water and sewerage electrical and mechanical

(1) Introduction

(a) Scope

Clause SC6.4.11.6 addresses the electrical and mechanical design considerations applicable generally to water and sewerage pump stations but can extend to treatment plants.

(b) Treatment plants

New treatment plants and plant upgrades are typically undertaken as one-off projects and performed by experienced treatment plant designers/consultants with the necessary qualifications, specialist skills and experience to carry out the planning, assessment, design, and delivery processes for the project.

Generally, Council will prepare a detailed design brief and requirements for the engagement of specialist consultants suitable to carry out the electrical aspects of the project including issues of supply, transformers, HV, plant and motor control and monitoring.

(c) Legislative requirements

Electrical designs and works shall consider relevant legislative requirements including:

(i) *Electrical Safety Act 2002* including associated regulations and Codes of Practice;

(ii) *Electricity Act 1994* and associated regulations;

(iii) *Electricity National Scheme (Queensland) Act 1997;*

(iv) *Building Act 1975* and associated regulations; and

(v) *National Electricity Rules.*

(d) Reference and source documents

Reference and source documents that must be read in conjunction with this section are as follow:

TCC 24 *Townsville City Council Standard Specification for Electrical Switchboards*

Townsville City Council Standard Specification for Standby Generators

WSA 02 – 2002 *Sewerage Code of Australia*

WSA 03 - 2011 *Water Code of Australia*

WSA 04 - 2005 *Sewerage Pump Station Code of Australia*

(e) Standards:

In general, the following standards, codes and manuals are applicable to the design and documentation of typical pumping stations.

(i) Workmanship and Design.

Standard	**Name**
Australian Standards	All relevant Australian Standards
IEC and British Standards	Relevant International Electrotechnical Commission (IEC) and British Standards where no Australian Standard exist.
BCA	Building Code of Australia
NER	National Electricity Rules
ECMM	Queensland Electrical Connection and Metering Manual

(ii) Preparation of Electrical Drawings

Standard	**Name**
AS 1100	Technical Drawings
AS 1102	Graphical Symbols for Electro-technology
AS 3702	Item Designation in Electro-technology
TCC24	Townsville City Council Standard Specification for Electrical Switchboards

(2) Electrical supply requirements

(a) General

(i) Provision for power supply

Energy Queensland is the electrical distribution entity responsible for the connection of power supplies to all Council infrastructure assets.

The designer shall where possible, commence discussions with the electrical distribution entity at an early stage as part of the overall planning process for the proposed construction of new water and sewerage infrastructure or for the augmentation of existing water and sewerage infrastructure. Early involvement of the distribution entity shall be sought in order to resolve network considerations and availability to meet the anticipated electrical loads. Budget costs where possible shall be obtained from the distribution entity for any required upgrading of the existing power supply network and provided to Council for inclusion in project budgets, however the current distribution entity's policy is that no cost estimates are provided unless the full application process is completed with a detailed design. This shall be considered in the design program.

The designer shall obtain plans of existing infrastructure in the vicinity from the Dial Before You Dig service of the existing and proposed electricity supply network in the vicinity of the proposed infrastructure. The location of the existing network will have a bearing on the proposed locations of the infrastructure, and electrical "point of supply". The optimum location for the electrical "point of supply" should be as near as practicable to either the largest electrical loads or the proposed location of the electrical main switchboard and/or motor control centre.

The designer shall seek advice from suitably experienced people where information from the distribution entity is not forthcoming as to potential electrical supply issues.

Electrical power supply connections shall comply with the requirements of the *Queensland Electrical Connection and Metering Manual* available from their web site.

(ii) Energy retailer

The energy retailer may not necessarily be the energy supplier to the infrastructure asset. As the Queensland electricity market is a contestable market, Council may decide to obtain electrical energy from another energy retailer. The designer shall consult with Council to determine current Council commercial agreements in regard to energy retailer contracts to be applied to the new infrastructure.

(iii) Clearances

The location of water and sewerage structures such as treatment plant and pump station buildings shall be such that minimum clearances are maintained from overhead and underground electrical cables. These clearance distances are contained within the *Electrical Safety Act 2002* and AS/NZS 3000 *Electrical installations (Australian and New Zealand Wiring Rules)* and are dependent upon variables including the voltage of the overhead power lines. Guidance shall be sought from the distribution entity regarding the voltages of overhead power lines to ensure adequate clearance distances are maintained. The supply authority normally prohibits the construction of structures beneath overhead power lines. The designer shall also consider clearance distances for cranage during construction maintenance and demolition of these structures.

(iv) Ownership of HV infrastructure

Council's preference is for ownership and on-going maintenance of high voltage transformers and switchgear to remain with the distribution entity.

Where the designer seeks to have Council retains ownership and on-going maintenance of the high voltage supply assets, a detailed financial breakdown of the cost of ownership including initial capital cost and on-going maintenance costs shall be undertaken.

(v) Connection of power supply

It is Council's practice that costs associated with the connection of the required power supply to each location (including the distribution entity capital contribution) is normally included in the contract price by the Contractor performing the works. Tender documentation shall state this requirement.

All forms required to be submitted for the connection of the power supply shall be completed by the Contractor and forwarded to Council for signature. Submission of the forms shall be by the Contractor. However, circumstances may arise where the arrangements for power connection may be excluded from the contract and undertaken by Council directly with the distribution entity, including:

1. requirements for a capital contribution by the distribution entity; and
2. extended application timeframes within Energy Queensland and design program requirements where costs may not be known at the time of tendering the works.

(b) Submission of application to distribution entity

The designer shall be responsible for the calculation of the electrical loads for the proposed infrastructure or the additional electrical loads where existing infrastructure is proposed for augmentation. These shall be submitted with the application in the format required by the distribution entity.

(c) Fault levels

In order to determine the applicable fault level for the installation, particularly for HV connections, advice will be required from the distribution entity as to the applicable fault levels at the site connection. This information can then be used during the design process to calculate the fault levels throughout the site and to enable equipment selection.

In practice, this information, particularly for LV connections, is generally not forth coming from the distribution entity within typical project design time frames. To enable design progression, suitable experienced designers shall by site inspection determine as far as possible the existing LV network's configuration and based on anticipated works determine the most likely fault level for the site.

Suitable allowance for future augmentation of the proposed infrastructure shall be taken into account when calculating the prospective fault levels. The designer shall seek advice from Council to determine any proposed future upgrading at the facility.

(d) Retail energy metering

All retailer energy metering shall be designed, installed, and connected in accordance with the relevant retailer requirements.

Metering locations shall be accessible to the retailer's meter reading personnel during normal working hours. Typically for new installations, the metering panel is not located within a building or locked compound. Where old facilities are being refurbished, the designer shall relocate the meters to an accessible location.

Phone line connections etc. should be provided at each metering location in accordance with the requirements of the distribution entity. Where the installation of GSM modems for remote downloading of energy readings is required, the location of the meter panel shall be such that adequate mobile telephone coverage is achieved.

(e) Energy tariff

(i) Tariff selection

Should it be determined that the site will be connected as a regulated energy tariff connection rather than as a contestable site then:

1. the designer shall provide a detailed analysis of energy consumption at the site, taking account of equipment run times and hours of operation. The analysis shall provide indicative comparison; and
2. submit details of the energy consumption along with monthly metering charges and all other additional costs payable by Council and seek Council approval prior to the installation and connection of energy meeting.

(ii) Energy cost minimisation

The electrical design shall encompass all energy cost savings applicable due to off peak electrical consumption. Where pumps and other large electric motors are installed, control systems shall be configured to only operate pumps within high energy cost periods to maintain minimum levels in reservoirs and pump stations where possible. Major pumping shall occur during periods of off-peak low energy costs. These tariff control measures shall be provided with manual override facilities both locally and as part of any SCADA based control system.

Other constraints particularly in the sewerage network (e.g. pump station storage, or peak flows into sewerage treatment plants) may prevent the use of “off peak”, for example the storage then delivery of large quantities of raw sewerage to biological treatment plant processes.

Retailer energy charges are in Queensland presently based on real energy measurement with regulated limits on the amount of reactive power that may be produced or consumed at each site.

Some other states in Australia also charge for reactive power consumption, the rate for reactive power is generally higher than real power providing ability to determine a return on investment for power factor correction devices (other than by simple regulatory compliance).

Given potential for Queensland to alter present charging strategies in regard to reactive power, design consideration should be given to provision of space for future ability to retrofit power factor correction equipment to the site. This provision may include space, switchgear, and busbar extension, and so on as required.

(3) Emergency power supply

(a) General

(i) Generator requirements

Each water and sewerage site shall have provision for either the permanent connection of a standby diesel generating set, or as a minimum be provided with facilities for the connection of a portable generating set as required by TCC24.

A formal risk assessment of the criticality of a particular infrastructure asset shall be made by the designer in order to assess whether the standby generating set shall be permanently located and connected, or provision made for connection of a portable generating set.

For sewerage pump stations the following general guidelines apply for the provision of standbygenerating sets:

1. where a sewerage pump station has inter-area overflow capabilities, the installation of a manual transfer switching arrangement and plug-in type connection socket as a minimum is required; and
2. where the sewerage pump station does not have inter-area overflow capability, a permanently connected standby generating set with automatic changeover facilities mounted within the electrical switchboard is required.

For water pump stations, it is not normal practice to provide permanent standby generators as water is normally continued to be supplied by gravity from reservoirs during power failures. The exception is where supply to consumers will fail during power outages. In such cases permanent generators are required.

Standby generating sets shall be sized to ensure that the largest pump load combination required at the site can be successfully started and run. Manual transfer switching arrangements shall also be sized for the largest electrical pump load combination required at the site.

Generators shall be fitted with protective circuit breakers on the supply cables.

Technical requirements for the generator are provided in the council's *Standard Specification for Standby Generators*. Site Location

The generator set shall be located on the site to allow for easy and safe access for servicing and maintenance (including removal from the site where necessary). This may require a suitable hardstand area.

Access shall allow all panels on the generating set to be easily opened without hindering access to the electrical switchboard or pump station.

Vandal proofing shall be to TCC24 minimum requirements.

(ii) Fuel storage requirements and alarms

The generator set shall have a fuel capacity for a minimum of 24 hours operation based on 100% of the rated load of the generating set.

The designer shall also take into account the reliability of fuel supplies to specific locations after severe storm and cyclone events which may prevent access to the sites for re-fuelling. Where the designer determines unacceptable risk to the supply of fuel to a critical site, additional fuel storage shall be provided to Council's satisfaction.

Remote locations (e.g. Magnetic Island, rural areas) shall be considered as special cases and the availability of fuel supplies at the site after severe weather events shall be a consideration in resolving the quantity of fuel stored on-site.

A low fuel alarm from fuel storage tanks shall be connected to the telemetry and SCADA systems.The alarm shall operate when the fuel level in the tank has fallen to a level which only provides two hours of remaining operation of the standby generating set at full load.

(iii) Environmental considerations – generating sets

Fuel containmentThe generating set shall be located within a bunded area which provides drainage to a low point. A lockable draw off valve shall be provided for discharge of liquid from the bunded area. Alternatively, suitable fuel containment and drip trays shall be provided within the emergency generator set base frame.

Noise- The generator shall be fitted with sound attenuation systems to meet the environmentalrequirements for allowable noise emissions.

(iv) Battery charging

Each generating set shall have a battery charger powered from a dedicated circuit from the main site switchboard or distribution board.

(b) Indoor standby generating sets

Where the electrical main switchboard and/or motor control centre are contained within a building structure, the standby generating set shall also be located within the same building structure.

The generating set shall be contained within a fire rated sound attenuated room that provides adequate airflow for cooling purposes. Airflow requirements shall be based upon the individual generating set manufacturer's recommendations.

Bulk fuel storage shall be located externally to the building. The bulk fuel storage shall have a lockable fuel cap.

A smaller day storage tank may be provided within the room. Automatic transfer of fuel between the external bulk fuel storage tank and the smaller day tank shall be provided.

The location of the refuelling point and ability to access safely shall be considered for each site such that it allows accessibility for the delivery of fuel by the selected method.

(c) External standby generating sets

Where the electrical switchboard is either plinth or pole mounted externally, the generating set shall also be located externally provided requirements such as noise attenuation can be met.

Permanently connected standby diesel generating sets shall be fully enclosed and sound attenuated. Generating set enclosures shall offer easy access to all maintainable parts for maintenance personnel.

Externally installed generator installations shall be vandal resistant. No glass or plastic panels are to be provided on the generator exterior housing. All covers (including radiator and fuel caps) are to be pad- lockable. No controls (e.g. emergency stop) are to be external or accessible without opening a locked door or cover.

There should be no exposed "hot" parts, such as exhausts. It should not be possible to drop items down the exhaust pipe.

Surface treatment of the generator and acoustic enclosure and other exposed parts shall be selected for the environment at the site, and to provide a 15-year minimum design life.

(4) Determining electrical site loads

(a) General

The designer shall determine the site loading in accordance with AS/NZS 3000 *Electrical installations* requirements, and with consideration of the proposed pump/equipment operation combinations and sequencing. Load calculations shall be approved by Council

prior to being forwarded to the electrical distribution entity.

The designer shall be responsible for the early submission of electrical load calculations to the electrical distribution entity to minimise delays with electrical connection works.

The designer shall ensure that the calculated motor drive sizing can be achieved by a recognised pump manufacturer selected from Council's preferred equipment lists.

The electrical load calculations shall take into account Council's planned future augmentation of the infrastructure. Where no future augmentation is planned, the electrical loads shall be calculated on the anticipated connected loads plus 25% extra.

(b) Pump stations

Electrical load calculations shall be based on the method of operation of the pumps to be supplied and installed e.g., Duty-Duty, Duty-Standby, Duty1-Duty2-Standby, etc. The proposed method of operation shall also be discussed with the distribution entity to determine any potential network issues with the proposed arrangements. The design for motor starting shall meet the requirements of the distribution entity and TCC24.

(5) Electricity point of supply

The preferred method for the connection to the point of supply shall be by underground cabling.

The final location for the point of supply shall be agreed between the distribution entity and Council and shall be compatible with access to the site. Parts of the overall area serviced by Council are prone to flooding. All electrical infrastructure susceptible to flood damage shall be located above the design inundation levels adopted for the proposed site. Flood inundation level information is available from Council to assist in the location of electrical infrastructure above predicted inundation levels.

The point of supply within residential locations shall be via a galvanised steel property pole or underground URD pillar. Where galvanised steel property poles are used, the pole location shall be such that the final consumer's mains cabling length is kept to a minimum. No aerial cables are permitted to cross over infrastructure or vehicle working areas.

All connectivity at points of supply shall be accessible for maintenance purposes.

(6) Cabling

(a) Consumer's mains cabling

The consumer's mains cabling shall be sized by the designer in accordance with the calculated electrical load at the site and the requirements of AS/NZS 3000 *Electrical Installations*.

Cabling shall generally be Cu PVC/PVC/XLPE installed underground in HD uPVC conduits run between the nominated point of supply and the site electrical Main Switchboard.

Where external cabling enters a building, the cabling may be installed on cable ladder or cable tray with mechanical protection as required under AS/NZS 3000.

Where underground HD uPVC electrical conduits are installed, the designer shall provide for spare conduits, generally in the ratio of one spare conduit of the same diameter of the conduit installed for each conduit containing electrical cables.

(b) Sub-mains cabling

Sub-mains cabling shall be sized by the designer in accordance with the calculated electrical load at the particular location and the requirements of AS/NZS 3000.

Cabling shall consist of single or multi-core copper PVC/PVC or PVC/XLPE conductors generally installed underground where run external of structures in suitably sized cable ducts, or within cable trays where run internally of building structures.

(c) Power and control cables

Power and control cables shall be circular type cabling to facilitate ease of waterproofing cable entries. Consideration shall be given to use of flexible type cabling to pumps to facilitate ease of removal and installation.

Power cables shall be a minimum of 2.5 mm^2. Control cables shall be a minimum of 1.5 mm^2. A minimum of two spare cores shall be provided for all control cables following installation. Only one control voltage shall be contained within any control cable.

Where the designer has deemed a higher risk of further mechanical damage, Steel Wired Armoured (SWA) cabling or other protection method shall be provided.

(d) Variable frequency drive cables

Cables run to motors driven by VFDs shall be flexible type cabling to facilitate ease of termination and removal from pumping equipment. Cabling type, length and installation method shall be selected to meet the applicable Electromagnetic Compliance (EMC) requirements. Typically, a screened cable would be used with screen continuous from the motor terminal box to the VFD terminals.

(e) Instrumentation cables

Instrumentation wiring and cabling required to carry signals to the PLC or process instrumentation shall be selected to suit the intended application.

Generally, overall screened cables shall be used for digital signal while overall and individually screened pairs shall be used for analogue signals. Analogue and digital signals shall not be provided within the same cable.

Cables shall generally be Dekoron or approved equivalent of minimum conductor size of 0.75 mm^2. Adequate separation shall be provided between instrumentation cables and other cabling to ensure non-interference from AC power and control cables. As a minimum, cable trays shall have adequate partitions and instrumentation cabling not in trays shall be run in separate conduits.

Provision of surge suppressing transient barriers shall be provided for all instrumentation cabling run external of buildings.

(f) Control systems networks

Control system networks shall be designed to suit specific application by a control system specialist.

(g) Pump power cable connection

Power cable termination for pump units shall be determined in consultation with Council. The following applies:

(i) typical all electrical equipment shall be hardwired; and

(ii) remote sites or high maintenance sites shall be connected by decontactor style plug and socket connections.

Where plug-in connections are used, the designer shall ensure that cableways from the plug to the motor are sized to permit plugs to be withdrawn with all other cables in place.

(h) Lighting and power sub-circuits

Cabling for lighting and power circuits shall be sized in accordance with the requirements of AS/NZS 3000 *Electrical installations*.

Generally, sub-circuit cabling shall be circular multiple stranded 0.6/1kV Copper PVC/PVC insulated and sheathed conductors where not enclosed in ducting and single insulated where enclosed by ducting.

The following minimum cable cross sectional areas shall apply:

Lighting sub circuit cabling	1.5 mm²
Power sub circuit cabling	2.5 mm²

(i) Cable identification

All cables shall have an identification number engraved on a non-corrodible metallic tag secured by a non-corrodible metallic tie. Tags shall be fitted to both ends of every cable.

(7) Wiring enclosures

(a) General

Cables shall be installed within wiring enclosures to provide the required degree of mechanical protection in accordance with AS/NZS 3013 *Electrical installations - Classification of the fire and mechanical performance of wiring system elements*. The wiring enclosures shall typically consist of cable ladder or conduits.

Wiring System Classification (AS 3013)	Conduit Type
WSX1	Light Duty uPVC or equivalent
WSX2	Heavy Duty uPVC or equivalent
WSX3	Metallic Rigid Conduit or equivalent

(b) Cable ladder

Cable ladders shall typically be a heavy-duty aluminium type conforming to NEMA20B. In wet or corrosive areas stainless steel ladders may be required. Cable ladders shall be the primary method of support for surface run cables. Ladder support systems shall be designed such that loadings on ladders shall not cause deflection in excess of 1:200 of span length. Typically supports for horizontal ladders shall not exceed 3000 mm spacing and for vertical ladders, 1500 mm. In no case shall manufactures guidelines be exceeded. Ladders installed external to buildings shall be fitted with covers – horizontal ladders shall have peaked covers; vertical ladders shall have flat covers. Cables on ladders shall not be exposed to direct sunlight. It may be necessary to fit covers to the underside of some ladders. Bends, Tees and other fittings shall be of the same manufacture as the cable ladder. All fixings shall be stainless steel. Cables shall be secured in ladders utilising ties or clamps. Where external to a building, the ties/clamps shall be a non-corrodible metallic type.

(c) Conduit

Conduits shall have a minimum diameter of 20 mm and shall be run as directly as practical with a minimum number of bends or sets. Surface run conduits are to be as inconspicuous as possible and shall be run parallel to walls, floors, and ceilings wherever practical. Conduit fittings shall be of the same manufacture and be compatible with the conduit. Elbows and Tee type fittings shall not be used. Long radius bends/sets or suitably sized junction boxes shall be used. Metallic conduits installed in wet or corrosive environments shall be stainless steel or aluminium. Corrugated PVC conduit shall not be acceptable.

Underground conduits shall typically be installed to a Category A system as classified in AS 3000. The depth of burial shall be selected to suit the site environment. Sand shall be used as a bedding material – the type and grade selected to provide the required thermal properties for the installation.

Underground cable systems shall use cable pits at each change of direction and every 50 m on straight runs. The pits, lids and method of installation shall be suitable for the maximum wheel loads that may occur in the area in which they are installed. Typically, “plastic” pits shall never be used where they might be subject to vehicle traffic. The pits shall be sized to suit the number of conduit entries and size/type of cables to be installed. Ensure that cable manufacturer’s minimum bending radius is never compromised. All conduit entries shall be bell mouthed.

Underground cable routes shall be identified at each end, each change of direction, each pit entry and every 30 m along straight runs by a non-corrodible metallic plates with direction arrows, set in a concrete block.

(d) Flexible conduits

Flexible conduit shall be used to make the final connection to an item of plant. The flexible conduit shall typically be a PVC sheathed metallic liquid tight type, though in certain environments other materials may be more suitable, e.g. in wet, chemical, or hazardous area environments. The flexible conduit shall be terminated with correct fittings from the same manufacturer as the conduit. The length of flexible conduit shall be kept to the minimum required to make a final termination to an item of plant. Corrugated PVC conduit shall not be acceptable.

(8) Switchboard design guidelines

(a) General

The following applies:

(i) Electrical switchboards including motor control centres, distribution boards, etc. shall be constructed in accordance with the requirements of the TCC specification TCC24 and accompanying standard drawings.

(ii) These typical drawings shall be adapted to suit the application and the proposed switchboard general arrangement.

(iii) The switchboard main switch shall be rated for 125% of the current rating of the consumer mains cabling.

(iv) Generator control and/or connectivity shall be included.

(v) Switchboard design shall include shrouding of live terminals to prevent inadvertent contact.

(vi) Sections of switchboards required to be accessed by non-electrical personnel shall be physically segregated from other sections of the switchboard and be supplied by extra low voltage 24V DC power supplies. Where this requirement is not achievable, lockable hinged escutcheons shall be provided to prevent access to electrical equipment by unauthorised persons.

(vii) Where the electrical energy metering is included in the overall switchboard design, a separate compartment with padlockable access door shall be provided where required by the energy retailer.

(viii) Switchboards located adjacent to sewerage pump stations shall be mounted on a concrete plinth to the side of the well.

(ix) Sufficient concrete hardstand area shall be provided for maintenance personnel servicing the switchboard. Switchboards shall be located such that the access doors do not open towards an access road or the actual pump well, and

(x) Galvanised steel bollards filled with concrete shall be erected in the vicinity of external electrical switchboards to minimise accidental vehicular damage to the switchboard and to protect maintenance personnel.

(b) Design documentation

The following list contains the minimum design documentation required for switchboard and electrical design to be submitted to Council for approval:

(i) Detailed electrical drawings including but not limited to the following:

1. power single line diagrams;
2. control circuit drawings;
3. PLC control and network drawings;
4. switchboard general arrangement drawings; and
5. layout drawings.

(ii) Detailed electrical calculations including but not limited to the following:

1. electrical maximum demand calculations;
2. fault level calculations;
3. cable calculations; and
4. earth fault loop impedance.

(iii) Detailed electrical schedules including but not limited to the following:

1. cable schedules;
2. I/O schedules;
3. single line diagrams;
4. electrical equipment lists; and
5. technical data sheets.

(c) Switchboard construction

Switchboard construction and equipment shall be in accordance with TCC24 specification, including:

(i) construction from 316 grade brushed stainless steel (the use of zinc anneal switchboard enclosures may be considered in internal locations with air-conditioned switch room);

(ii) all switchboard hardware, including, but not limited to, hinges, locking devices etc. shall also be manufactured from 316 grade stainless steel;

(iii) padlockable, vandal resistant swing handle type locking mechanisms are preferred for enclosures to suit the standard keying system. The overall number of lockable compartments shall be kept to a minimum; and

(iv) ventilation/cooling requirements to ensure internal temperatures do not exceed manufacturer's recommendations for any equipment contained in the switchboard.

External switchboards shall be painted colours that provide reflection of direct sunlight to minimise heat build-up within the switchboards and shall be orientated to minimise risks of direct sunlight affecting internal electronic components.

Externally mounted switchboards and control panels shall be provided with sunhoods to minimise heat build-up within the control panels and to provide cover to maintenance personnel when working on the switchboards in rain.

1. separate compartments to locate electronic soft starters > 22kW;
2. separate compartments for PLC and telemetry hardware, with associated cabling terminated on suitably rated terminal strips; and
3. VFD equipment in external boards may require suitable mechanical refrigeration/cooling systems to extend equipment life.

Motor starters, motor protection, and switchboard instrumentation shall be in accordance with the requirements of TCC specification TCC 24.

Major main switchboards and distribution boards shall include arc detection and VESDA protection.

(d) Electrical switchrooms

Dedicated electrical switchrooms shall be provided for large scale pump stations, treatment plants or where required to suit equipment types or the application.

Switchrooms shall conform to the requirements of AS/NZS 3000, the Building Code of Australia (BCA), and Council's operational requirements. Emergency lighting and fire extinguishers shall be provided at each Main Switchboard located within a dedicated switchroom as a minimum.

(e) Lightning and surge protection measures

Transient and surge protection devices shall be provided as recommended by the relevant Australian Standards including:

(i) AS 1768 *Lightning protection; and*

(ii) AS 4070 Recommended practices for protection of low voltage electrical installations and equipment in MEN systems from transient over voltages.

(9) Monitoring/control guidelines

(a) Design outputs

Control loop and P and ID drawings shall be provided for all major infrastructure including treatment plants and large pump stations.

Functional specifications shall be produced for proposed PLC and SCADA based control systems. Integration works are to be approved by Council.

For design and construct works, control loop and P and ID drawings shall be provided as part of the evaluation phase.

(b) Monitoring/control methodology - pump stations

Pump stations shall generally be controlled as per TCC24 including local automatic / local manual and system control mechanisms.

All pump stations are to be remotely monitored by the telemetry and SCADA system.

(c) Monitoring methodology - reservoirs

Reservoir level monitoring shall be performed using submersible pressure transducers or external differential pressure transmitters.

Where flow to the reservoir is controlled by a pump or control valves, the pressure transducer shall be used for pump and/or valve control.

(d) Monitoring/control methodology - treatment plants

Treatment plants shall be controlled by PLC and SCADA based control systems, utilising optical fibre communication cabling.

Systems shall be to Council's current requirements, and systems for plant augmentations shall be compatible with existing systems. SCADA system shall be Citect or ClearSCADA (Council to confirm). PLC equipment shall be Siemens S7 series.

A functional specification for the monitoring/control of treatment plant systems including design and redundancy is to be included in the detailed design brief for each project.

(e) Float switches

Encapsulated float switches are to be provided in sewerage pump stations to indicate high level alarms. The installation of float switches must allow for the float to be accessed from the top of the pump well without the need to enter the well.

(10) Field equipment installation, wiring and terminations

(a) General

Field equipment installation, wiring and terminations shall generally encompass all electrical works external to the switchboards and motor control centres, including but not limited to the installation of field cabling and cable support systems, local control stations, marshalling boxes, motor and equipment isolation and field instrumentation.

Important considerations include:

(i) preferred method of support and environmental conditions - includes consideration of flood levels, UV, and damage by insects or vermin;

(ii) segregation of cabling - separation of differing cable types;

(iii) cable carrier capacity - capacity for present and planned expansion;

(iv) cable bend limitations;

(v) cable labelling requirements; and

(vi) cable mechanical protection.

(b) Field instrumentation and installation

(i) General

Field instrumentation shall be supplied and installed in accordance with the process requirements and the manufacturers' recommendations. The location and height of each instrument shall be shown on the relevant "Layout" drawings.

Field instruments shall be located as close to their primary connection to ensure instrument accessibility while still facilitating ease of access for operation, inspection, and maintenance.

An optimum working and/or viewing height for each instrument shall be 1500 mm above grade or finished surface level.

No LCD screens for instrumentation or other plastic components that may be susceptible to damage from UV radiation shall be exposed to direct sunlight and potential vandalism shall be considered when locating equipment.

Where process instrumentation is installed on process pipework, suitable isolation devices shall be provided to allow for instrument removal.

All power supplies to instrumentation shall be surge protected and filtered.

(ii) Installation

Instrument enclosures suitable for the prevailing environment and any potential hazardous classification of the area shall be provided for all field instrumentation and shall be installed in safe accessible locations.

Transmitters shall be enclosed in their own weatherproof enclosure and in addition, those mounted outdoors shall be shaded by 316 stainless steel covers with sides, drip hood and back as a minimum. All brackets and mounting bolts etc. for sensors and transmitters shall be 316 grade stainless steel.

Instrumentation shall not be supported from handrails or from steel work or plant which may be subject to vibration. All brackets and supports shall be constructed of 316 grade stainless steel and be constructed so that vibration from wind, operation of surrounding equipment, etc. is negligible.

(iii) Specific instrument requirements

Pressure transmitters where installed shall be fitted with valve manifold blocks.

Hydrostatic type level sensors shall be installed such that they are not affected by turbulence by the use of either stainless steel weighted cables or stilling tubes.

Impulse lines shall be fitted with valves and strainers. Lines shall be constructed of either copper or stainless steel and be provided with draining facilities for cleaning and maintenance. Cables shall be identified by an engraved metallic tag with stainless steel fixings.

(c) Labelling of equipment

Equipment labels in the form of "traffolyte" labels shall be provided at each field mounted instrument to identify the instrument and at each local isolator or stop/start station to identify the item of plant that the isolator or control stations controls. Labels shall be fixed to equipment with stainless steel screws.

(11) Radio telemetry and SCADA system

(a) General

Council operates a telemetry system to monitor and/or control sewage pump stations, water supply pump stations, and reservoirs. The system is based on Schneider Scadapack Hardware Controls (previously Serck/Hunter Watertech) PDS and Enet hardware connected by narrow band analogue and digital UHF radio networks. Human/machine interface is provided by various SCADA software.

Automated and manual alarm dial outs are provided from SCADA alarms.

(b) New facilities

All new sewerage pump stations, water supply pump stations, and reservoirs are required to be connected to the telemetry system for the purposes of monitoring and control as required in TCC 24.

Functional system requirements such as network and repeater interfaces for the site and frequency details shall be determined during the design in consultation with council's electrical systems engineer.

(12) Mechanical services

(a) Pump design - general guidelines

(i) Pump selection

Pump selection shall be based on the following criteria:

1. Council's preferred equipment lists;
2. system resistance curves (refer Clause SC6.4.11.2 Water supply planning and design guidelines; and Clause SC6.4.11.4 Sewerage planning and design guidelines, Clause SC6.4.11.4 (5) Sewage pump station design). Pump selection shall achieve all expected duties as per the system resistance curves;
3. redundant (standby) pump capacity shall always be provided. Standby pump capacity should be at least equal to the capacity of the largest pump unit;
4. availability of local product support for maintenance purposes; and
5. whole of life costs.

For all pumps supplied as part of contracted works, the NPV shall be based on a 15-year design life and 8% real discount rate.

(ii) Motors

All pump motors shall be afforded a minimum of IP56 and be tropic proofed.

(iii) Water void protection

Water void protection shall be provided for all water pumping applications. Water void protection on large installations shall typically consist of limit switches mounted on an extended shaft of the non-return valve.

On smaller applications, flow switches may be used for water void protection.

(iv) Document requirements

The following documentation shall be provided as a minimum by the Contractor and/or pump supplier:

1. details of all recommended spare parts and servicing tools including a priced list of thecosts for each individual item;
2. operations and maintenance manuals which adequately detail servicing intervals and requirements, dismantling instructions, itemised parts lists;
3. pump performance – pump/motor factory test curves;
4. the results of specific pump/motor performance testing to AS 2417, showing flow rate,pressure, current, efficiency, and NPSH as a minimum; and
5. pump/motor specification plates – shall be fixed to the pump and motor. Two additional sets of specification plates shall be supplied, one for inclusion into the switchboard.

(b) Pumping applications

Types of pumps for typical applications shall generally be as follows:

(i) sewage pump stations shall be provided with wet well submersible centrifugal pumps for all new locations. Existing pump stations that are planned for upgrades shall be converted to dry well mounted submersible centrifugal type pumps. Grinder style pumps may also be offered where conditions exist that may prevent an 80 mm sphere being passed through the pump and discharge pipework;

(ii) water pumping stations shall generally be centrifugal pumps, with the number of pump stages to suit the duty point required;

(iii) RAS and WAS pumps at Sewage Treatment Plants shall generally be centrifugal submersible type controlled by VVVF Drives; and

(iv) positive displacement type pumps shall generally be installed for sludge handling applications.

Where sand infiltration causes excessive abrasion at pump stations, wear rings with increased hardness shall be fitted to the pumps and consideration given to ceramic coatings on the wearing surfaces.

Where pumps are provided with a double mechanical seal, a barrier fluid conductivity probe shall also be provided. This type of system shall be capable of producing an alarm which will be registered in the pump's switchboard and possibly the telemetry system when a change in conductivity is sensed. It is assumed that this will alarm due to a mechanical seal fault.

(c) Chemical dosing pumps

Dosing pumps shall generally be small diaphragm type pumps with either electronic or manual stroke adjustment depending on the application. Pump type and material is to be suitable for the chemical to be dosed.

Critical dosing pumps may require installation with automatic alarm considerations and feedback signals to the telemetry or PLC. These dosing pumps will generally be installed with means of electronically recording/confirming the flow in the dosing line and a means by which the flow in the dosing lines can be diverted back to the dosed fluid reservoir.

Dosing pumps may be required to be flow paced. Flow pace settings shall be manually adjustable.

Larger dosing pumps for dosing rates of between 5 and 50 L/hr shall generally consist of centrifugal pumps with magnetic drive. In this instance fluid void protection is to be provided.

Mass balance dosing systems are not desirable.

Generally, Sodium Hypochlorite tank levels shall only be monitored in treatment plant applications.

Council's standard P and ID control and pipework drawing shall be used for all dosing pump installations.

(d) Pumping equipment

(i) Motor cable

The designer is to consider the future application of the pump, including if future conversion to VVVFD operation is required. Pumps with present or future VVVF Drive requirements shall be fitted with screened flexible cable.

(ii) Guide rails

Guide rails for removal of submersible pumps shall generally be stainless steel pipe, SCH 40 or better and shall be a minimum of 40 mm diameter.

(iii) Lifting chains

Lifting chains shall be provided at each submersible sewage pump station. Lifting chains shall be selected to be suitable tensile strength to lift the attached pump and shall be manufactured from coated or galvanised steel.

(iv) Pressure gauges

Pumps for water pumping applications shall be supplied with suction and discharge pressure gauges.

(e) Vibration monitoring

Pumps shall generally be provided with the following vibration monitoring devices in three axis locations.

Motor Size	**Vibration Monitoring Requirements**
10 kW and under	No requirement for vibration monitoring devices
Over 10 kW and up to 99 kW	Vibration monitoring pads
100 kW and above	Inbuilt vibration monitoring devices

Inbuilt vibration monitoring devices shall have all alarms connected to the telemetry and/or SCADA based monitoring system.

(f) Pump works testing

Works testing of pumps shall be performed for units rated at 5 kW and above. All other pumps shall be provided with a Type Test Certification from the pump manufacturer.

Works testing shall be performed to AS 2417 *Rotodynamic pumps - Hydraulic performance acceptance tests - Grades 1 and 2:*

(i) Class 1 for water supply pumps greater than 20 kW; and

(ii) Class 2 otherwise.

The pump supplier shall provide copies of all test certification prior to the pump being dispatched from the manufacturer's factory.

Works testing will normally negate the requirement for a draw-down test to be conducted at each individual site. Where specified draw-down tests may be used to judge the

performance of the pumps installed.

(g) Mixers

Mixers shall be either of the submerged type or stool mixers.

(h) Manual valves

Pressure reducing valves shall generally be Derot 300 series (or approved equivalent) with throttling plugs.

Vee Port valves shall only be used with the permission of Council.

(i) Actuated valves

Actuated valves shall generally be installed with AUMA or Rotork electric actuators (or approved equivalent), in accordance with Council's preferred equipment lists.

Electrically actuated valves shall be three phase 415 V rated.

Pneumatically actuated valves shall generally be installed with Tyco Keystone pneumatic actuators, limit switches and/or positioners. In general, "spring close" is required for this type of installation.

All actuated control valves shall have analogue 4-20 mA signal position feedback into PLC and SCADA based monitoring and control systems. Where the actuated valve is not a control valve, limit switches may suffice for positioning.

(j) Air supply blowers

Air supply blowers for treatment plant applications shall generally be lobe type or roots blowers. Council's preference is for Robuschi manufactured blowers (or approved equivalent) of the positive displacement rotary type.

Blowers shall be provided with sound attenuation devices to limit the operating noise to levels that are within the limits that provide a safe working environment without the need for ear protection and are in accordance with the relevant local laws and environmental requirements.

(13) Equipment manuals

When purchasing equipment, the designer shall specify that, detailed operations and maintenance manuals are to be provided.

As a minimum operation and maintenance manuals shall contain details of:

(a) general description of systems and equipment;

(b) operation and maintenance of systems and equipment instructions which adequately detail servicing intervals and requirements, dismantling instructions, itemised parts lists Maintenance of Systems and Equipment Instructions;

(c) equipment schedules;

(d) manufacturer's literature;

(e) as constructed equipment drawings; and

(f) commissioning and test data.

The following copies of the manual shall be provided:

(a) three hard copies of the manuals; and

(b) one PDF copy of all documentation.

Specific requirements for sewerage Pump Stations shall refer to *CTM Water Alliance Design and Construction Code.*

SC6.4.11.7 On-site water supply

(1) Introduction

(a) Objectives

(i) The objective of this section is to outline the requirements for the design and supply of potable water and non-potable water where development is located outside of a reticulated water supply area.

(ii) Specifically, the following overall objectives are sought to be achieved as identified by the Townsville City Plan:

1. to ensure adequate water supplies are available for people and fire-fighters to defend buildings from bushfires and to suppress other property fire;

2. ensure that development is provided with a reliable and safe supply of on-site water supply when located outside of a reticulated water supply area;

3. ensure that on-site water supply facilities are efficient;

4. ensure that on-site water supply facilities do not compromise environmental values;

5. ensure that on-site water supply facilities are not subject to sources of contamination; and

6. ensure the safety and wellbeing of residents and the protection of water quality and other environmental values.

(b) Scope

(i) This section sets out the requirements for development located outside of reticulated water supply area for the provision of potable and non-potable water supply facilities.

(ii) This section contains guidelines and statements for the design of potable water supply facilities and non-potable supply, including for fire protection.

(iii) This section may be applied to areas where a reticulated water supply exists, and an alternative supply is sought to supplement the reticulated supply.

(c) Applicability

(i) This section is to be used for assessment against the following codes where development is required to provide water supply outside of a reticulated water supply area:

Part 6.6.1 Rural zone code (Cungulla Precinct);

Part 8.2.2 Bushfire hazard overlay code;

Part 8.2.9 Water resource catchment overlay code;

Part 9.3.4 Reconfiguring a lot code; and

Part 9.3.6 Works code.

(d) Terminology

Available roof area	means the whole of the roof area of every building on the lot included in a development application
Blackwater	is defined as:

	- the waste discharged from the human body into a toilet; and - the waste used for discharge.
Drinking water or Potable water	water of a quality suitable for drinking, cooking, and personal bathing. The standards that define potable water are described in the Australian Drinking Water Guidelines.
Drinking water supply System (water supply system)	all aspects from the point of collection of water to the consumer (can include catchments, groundwater systems, source water, storge reservoirs, and intakes, treatment systems, services reservoirs and distribution systems, and consumers.
Greywater	means wastewater from a bath, basin, kitchen, laundry, or shower, whether or not that wastewater is contaminated with human waste.
Greywater treatment plant	a treatment plant, approved and installed under the *Plumbing and Drainage Act 2002*.
Hazard	a biological, chemical, physical, or radiological agent that has the potential to cause harm.
Non-potable water	water that is not of drinking water quality, but which may still be used for other purposes, depending on its quality.
On-site water supply	is defined as a private, non-mains supply, such as water that is not provided as a reticulated council supply.
Required fire-fighting Capacity	the volume of water required to comply with Part E of the *Building Code of Australia*.
Service reservoir/tank	a storage for drinking water, generally within the distribution system, used to meet fluctuating demands, accommodate emergency requirements and/or equalise operating pressures.

(e) Reference and source documents

(i) Legislation:

Food Act 2006

Plumbing and Drainage Act 2018 (and associated Regulations)

Public Health Act 2005

Water Act 2000

Water Supply (Safety and Reliability) Act 2008

Public Health Regulation 2005

Plumbing and Drainage Regulation 2019

(ii) National Codes and Standards:

Australia New Zealand Food Standards Code

Building Code of Australia

National Construction Code Volume 3 – Plumbing Code of Australia

(iii) Queensland Government:

Queensland Development Code

Queensland Plumbing and Wastewater Code

Department of Health	*Guidance on use of Rainwater tanks*
Department of Housing and Public Works	*Rainwater tanks. A Guide to keeping your tank safe*

(iv) Australian Standards:

AS/NZS 5667.1	*Water quality - Sampling - Part 1: Guidance on the design of sampling programs,sampling techniques and the preservation and handling of samples.*
AS/NZS 3500	*Plumbing and drainage (Set)*
AS/NZS 4766	*Rotationally moulded buried, partially buried and non-buried storage tanks for water and chemicals*
AS/NZS 3735	*Concrete structures retaining liquids*

(v) Standard Australia:

NHMRC, NRMMC (2011) *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy. National Health and Medical Research Council,* National Resource ManagementMinisterial Council, Commonwealth of Australia, Canberra.

Water made clear: A consumer guide to accompany the Australian Drinking Water Guidelines 2004. National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.

HB230-2008 *Rainwater tank design and installation handbook, S*tandards Australia.

(2) On-site water supply general requirements

(a) This section outlines the on-site water supply systems suitable for use in the Townsville local government area.

(b) The on-site systems may be used in combination with one another to deliver a reliable supply of potable and non-potable water.

(c) Any on-site water supply should use water efficiently and minimise the whole of lifecycle cost for that infrastructure.

(d) Any on-site water supply should not adversely affect environmental values.

(e) Unless water is known to be of potable quality (e.g. from a drinking water supply system) it should be regarded as non-potable and used appropriately (firefighting, irrigation of landscaping).

(f) On-site water supplies must not be subject to hazards and hazards must be managed appropriately to ensure a safe supply is available at all times for potable use in addition to fire-fighting requirements.

(g) Water supplied to the public must not constitute a public health risk:

(i) Under the *Food Act 2006*, food businesses must ensure water used in their business (which may include roof harvested rainwater) complies with the requirements of the *Australia New Zealand Food Standards Code*, Standard 3.2.3.

(ii) The *Australia New Zealand Food Standards Code*, Food Safety Standard 3.2.3 – *Food Premises and Equipment*, requires food businesses to use potable water for activities conducted on the premises. Where businesses do not have access to a potable water source, they must be able to demonstrate that the water is safe to use. Non potable water may only be used when it will not affect food safety I.e. , the washing of non-food contact surfaces such as floors.

(iii) The water must be of a potable quality unless the food business can demonstrate that the non-potable water will not adversely affect the safety of the food handled by the business.

(iv) Food businesses must ensure the water they use for food related activities conducted at their premises is potable (safe for human consumption).

These activities include:

1. washing food or ingredients;
2. cooking;
3. adding to food and drinks;
4. making ice;
5. cleaning of food contact surfaces;
6. cleaning of food containers and utensils; and
7. personal hygiene.

(h) Council may set conditions of approval dealing with the following matters (but not limited to):

(i) a maximum volume of ground water extraction for the development based on the findings of the groundwater resource assessment study;

(ii) annual review of the effect of the authorised level of extraction in light of regional ground water level data collected from all relevant observation bores in the district. If regional ground water levels are declining, council may limit the previously authorised level of extraction, in terms of pumping rate or duration or both;

(iii) maintenance of safe access to bores for inspections by council staff; and

(iv) on-going monitoring, including:

1. provision of a report recording ground water levels each month for 6 months; and
2. regular testing of ground water quality (e.g. for nitrates and bacteria) if the ground water is to be used for potable purposes. If levels are found to be above the relevant drinking water quality standard, provision for an alternative potable source of water will be required.

(i) The following on-site water supplies are permitted (Refer Water Resource Catchment Overlay):

(i) rainwater harvesting (tanks);

(ii) groundwater (bore water);

(iii) surface water;

(iv) carted drinking water;

(v) recycled water (reclaimed water); and

(vi) greywater (non-portable from manual supply service).

(j) The following on-site water supplies are not considered appropriate for supply:

(i) recycled carted water; and

(ii) greywater – (potable supply from permanent structure).

(3) Water quality for on-site supplies generally

(a) The *Australian Drinking Water Guidelines* (ADWG) are the standards for potable water for use in the Townsville area. Clause SC6.4.11.7 Attachment A sets out the potable drinking water requirements to be achieved.

Editor's Note - The current *Australian Drinking Water Guidelines* cover a range of topics, including management of water supply systems, water quality (microbiological, physical, chemical, and radiological) and monitoring.

(b) The following information should be used in undertaking testing of water quality.

References:

AS 5667.1.

Editor's Note - Physical and chemical samples:

Use a bottle supplied by the laboratory or thoroughly clean a plastic bottle about one litre in volume (i.e., Soft drink bottle), then rinse several times with the sample before filling.

Transport the sample directly to the laboratory on the day of sampling, if possible, otherwise refrigerate and deliver within 24 hours of collection.

DO NOT FREEZE SAMPLE.

Editor's Note - Microbiological samples

Collect sample in sterile bottle provided by the laboratory, or in a 250 ml sterile container which can be bought from a Pharmacy. Do not rinse out the bottle with sample.

Remove cap, fill bottle leaving a small air space, then replace cap without touching the insides of the cap or bottle.

Transport the sample directly to the laboratory on the day of sampling, if possible, otherwise refrigerate and deliver within 24 hours of collection.

DO NOT FREEZE SAMPLE.

Editor's Note - Pumped supply:

Pump for four hours to remove stagnant water from the bore hole and pipes before sampling.

If the bore runs dry before four hours are up, let it stand until it can be pumped again, then pump again until dry, repeat this process once more, then sample.

Note pumping time, type of pump, type of casing, depth, age of bore, etc. (this information can be useful to the laboratory for interpretation of results).

(4) Rainwater harvesting (tanks)

Editor's Note - HB 230:2008 Rainwater tank design and installation handbook—provides practical information for the collection, use and storage of rainwater.

(a) A tank installed for a building must have sufficient collection and storage capacity to provide an acceptable contribution for its external and/or internal connections and their associated water use, having regard to the following:

(i) the local rainfall pattern;

(ii) the roof catchment area; and

(iii) the area available for the location of the rainwater tank.

(b) Installed tanks must ensure they comply with the requirements of the *Public Health Regulation 2018*. The legislation stipulates a “relevant tank”— a tank or other receptacle that is used or intended to be used for holding or storing water — must have at every opening:

(i) Mosquito proof screens that:

1. are made of brass, copper, aluminium, or stainless-steel gauze;

2. have a mesh size of not more than 1 mm;

3. are installed in a way that does not cause or accelerate corrosion; and

4. stop mosquitos passing through the openings; or

(ii) Flap valves that, when closed, stop mosquitoes passing through the openings.

(c) A tank must have suitable measures to prevent:

(i) insects (mosquitoes) and other fauna from breeding inside the tank;

(ii) if a wet system supplies the tank— insect (mosquito) and fauna proofing for each pipe opening that supplies the tank, with screen mesh with an aperture of no greater than 1 mm; and

(iii) vermin from entering the tank.

(d) A tank must have suitable measures to prevent contaminants from entering the tank especially having regard to the potential nature and level of contaminants within the locality and on-site uses.

A tank must have a minimum of 20 litres of first flush from the roof catchment area so that potentially contaminated rainwater is diverted and discarded before entering the tank where the tank is connected to:

(i) a shower or wash basin; or

(ii) a swimming pool; or

(iii) kitchen or hot water service; or

(iv) another fixture required by a local government in a local planning instrument.

Editor’s Note - For those with a rainwater supply, it is important to check regularly to ensure that first flush devices are working properly. It is also important to keep the roof catchment clean — bird droppings, peeling paint and dirt on the roof are the biggest sources of contamination. Guttering should be cleared regularly, and overhanging branches should be kept to a minimum, because they can be a source of debris and allow birds and small animals access to the roof.

Editor’s Note - HB 230:2008 Rainwater tank design and installation handbook—provides practical information for the collection, use and storage of rainwater.

(e) The occupier of a place where a rainwater tank is installed (or if there is no occupier, the owner of the premises) must ensure that the tank is maintained at all times to ensure a reliable supply.

(f) Where in a reticulated water supply area, water from a tank must not contaminate the potable water within a reticulated town water supply system. Where tank/s are installed, the reticulated town water supply system is protected from the potential of back-flow by the installation of:

(i) a back-flow prevention device that complies with AS/NZS 3500; or

(ii) for a tank, a dual check valve with an atmospheric port.

(g) A tank stand and the support base of a tank must be capable of withstanding loads likely to be imposed. The base of the tank is well supported by a ground treatment in accordance with the manufacturer's specifications and standard drawings for that tank.

(h) Where a premises is providing tank water supply and required to also install a static water supply for firefighting purposes, applicants will need to also comply with Clause SC6.4.11.7 (11) Requirements for firefighting supply.

(i) Where a tank is installed to supply water to the plumbing fixtures, the tank must have appropriate and clear signage to warn that the water in the tank is suitable for drinking.

(j) All water tank overflows are to be connected to or able to discharge to a lawful point of discharge.

(k) Development proposing to utilise a rainwater tank must determine that adequate rainwater volume can be collected to meet the annual water demand.

Editor's Note - calculating the maximum amount of rainwater that can be collected from the available roof area can be completed using the following formula.

Run-off (litres) = A x (Rainfall – B) x roof area

"A" is the efficiency of collection and values of 0.80-0.85 (that is, 80-85% efficiency).

"B" is the loss associated with absorption and wetting of surfaces and a typical value of 2 mm per month (24 mm per year) can be used.

"Rainfall" should be expressed in mm and "roof area" in square metres (m2).

For example, the runoff from a 200 m^2 roof which receives 750 mm of rain per year, with an efficiency of collection of 80% (A = 0.80)and loss of 2 mm per month (B = 24) would be: Run-off = 0.8 x (750-24) x 200 = 116,160 Litres (or 116.2 kL).

(l) If the maximum volumes are less than the annual water demand, then either the catchment area will need to be increased or water demand will need to be reduced or an alternative and supplementary source will need to be nominated.

(5) Groundwater (bore water)

(a) In Queensland, the Department of Resources manages access to and use of underground water.

The right to take underground water is either established under the *Water Act 2000* (the *Water Act*) or granted under a "licence" or "water allocation". The drillers' licensing arrangements under the *Water Act 2000* ensure all water bore drillers are properly skilled and that their work meets minimum standards.

Editor's Note - Information on water bore drillers and bore drilling requirements can be found on the Department of Resources website.

(b) Each lot created or use proposed is to be provided with a proven and available long term sustainable resource of potable groundwater, properly licensed as required, supplemented where practical, with an alternative supply such as rainwater.

Editor's Note - Water from a deep, encased, and well-maintained bore and/or from a confined aquifer will generally not need treatment after addition to a rainwater tank, but the chemical quality of some groundwater is not suitable for drinking.

(c) Only groundwater that is compliant with values cited in the *Australian Drinking Water Guidelines* (ADWG) should be used.

Editor's Note - Key health parameters for groundwater are arsenic, nitrate, fluoride, and health related heavy metals. Salinity is an important aesthetic parameter.

Editor's Note - Groundwater from shallow or unconfined aquifers is readily contaminated by agricultural, industrial, or urban activities and generally should not be used as a source of drinking water unless it has been recently tested for microbial and chemical quality and is compliant with guideline values cited in the ADWG.

(d) Water treatment devices/technologies to improve the aesthetic values, microbial and chemical quality of water are to be installed to ensure that all ground water achieves the guideline values cited in the ADWG. Methods used to treat groundwater must be certified by a registered professional in the field of ground water quality and must be installed and commissioned prior to occupation of the use (except where water supply is combined with firefighting water).

(e) Any proposed ground water extraction, when combined with existing levels of extraction in the area, is to be sustainable on both a local and regional level. The average annual demand for ground water must not exceed the average long-term recharge in the area.

To demonstrate compliance with the above criteria, council may request that a Groundwater resource assessment be undertaken by a qualified hydro-geologist.

A Groundwater resource assessment should include, at a minimum:

(i) consideration of information available from previous studies and new information collected as part of the investigation;

(ii) consideration of the maximum ground water extraction rate attainable, proposed pumping rates, land slope, flooding, drainage, geology, ground water recharge potential, local experience, proximity to and protection from potential contaminants, soil characteristics (colour, texture, structure, permeability, and presence of rock), percolation testing, direction of ground water flow, seasonal fluctuation in ground water levels, and the current degree of district and local extraction;

(iii) a comparison between the average annual ground water demand and the average annual ground water recharge, on a local and a district level;

(iv) the results of drilling and testing of an adequate number of bores, supplemented with ground water modelling where necessary, to ensure a thorough and accurate investigation of the ground water resources available. Bores are required for two purposes, namely, for interference testing and for regional ground water level observation;

(v) results of independent and simultaneous pumping of test bores, and measurement of water levels t0 check for localised pumping interference with any existing and proposed neighbouring bores. Pumping tests should be undertaken for a minimum of 8 hours duration and pumped at the rate the pump is intended to be operated in the proposed development. The available draw down in neighbouring bores during the test must not be reduced by greater than 20% when compared to available draw down in these bores prior to pumping;

(vi) if bore interference is found to be greater than 20% of the available draw down, supplementary pumping tests must be undertaken to measure the effect of reducing either the pumping rate, the duration of pumping, or both, until the resulting interference is within this level;

(vii) water quality testing to determine whether extracted water will be of a potable quality, including where relevant, written advice from a registered professional in the field of ground water quality. Table SC6.4.11.9 outlines appropriate standards for bore water testing (potable uses);

(viii) investigation of previous land uses and the possibility of contamination of aquifers to determine the quality of ground water;

(ix) details of the pump type, capacity and pumping curve for bores; and

(x) preparation of a report detailing all the studies and works undertaken, the resource assessment findings and assumptions made.

(f) Methods used to treat groundwater to meet health and aesthetic guidelines must be certified by a registered professional in the field of ground water quality.

(g) For licensing and construction requirements for underground water the local Department of Resources office should be consulted.

Editor's Note - Before considering sinking a water bore refer to fact sheet Drilling for Water on the Department of Resources website.

(h) The bore shall be constructed to ensure that contamination of the groundwater source does not occur, either during construction or operation.

(i) The bore head shall be mounded to prevent ponding and stagnation of water around the bore to eliminate the possibility of mosquitoes breeding and problems caused by flies or odour.

(j) All drainage shall be directed away from the bore.

(k) Bores nominated to supply potable water supply are to be appropriately site away from sources of contamination, including on-site sewerage facilities. For further details relating to on-site sewerage facilities, refer to Clause SC6.4.11.8 Onsite sewerage facilities for non-sewered properties.

(i) On-site sewerage treatment facilities shall be placed as far away as possible from ground water bores used for potable groundwater supply. Minimum allowable distances are to be in accordance with the *Plumbing and Drainage Act 2002* and relevant codes and regulations established pursuant to the *Plumbing and Drainage Act 2018*, which are applicable at the time of making application for development approval.

(ii) New land parcels or existing land within non-sewered areas must provide evidence prior to the sealing of the plan of survey or the commencement of the use that an appropriate on-site sewerage treatment facility can be designed and accommodated within each proposed lot in addition to the potable supply of ground water.

(6) Surface water

(a) Surface water includes water derived from dams, creeks, rivers, and streams.

(b) The use of surface water is generally considered permissible only when in a non-urban zone (excluding rural residential).

(c) Surface water supplies are more prone to contamination from sources such as animal and human waste and algal blooms.

(d) Due to the potential for contamination, surface water is not recommended as a source of drinking water unless additional treatment processes such as filtration and disinfection are in place.

(e) Unless drinking water quality can be assured through disinfection and routine testing, surface water should be utilised for purposes other than drinking such as irrigation and toilet flushing and firefighting. Treatment may still be necessary for non-drinking uses.

(f) Water subject to potential contamination from human or livestock waste, such as dams, rivers, and creeks, can contain a wide range of pathogenic organisms including chlorine resistant Cryptosporidium. Water of this type may not be suitable for drinking even after disinfection.

(g) Surface water that is protected from human and livestock waste can be used and should be demonstrated.

(h) Surface water must be able to provide a reliable year-round supply of water for both potable and fire-fighting purposes and should be demonstrated.

(i) Potable water quality:

(i) When used, pumped, or captured surface water should be added to a storage tank in one action, then treated and allowed to stand for at least one hour before use.

(ii) Where surface water is to be the primary source of a potable water supply, the quality of water extracted is to be of a potable quality and meet aesthetic, chemical and microbial requirements.

(iii) Water treatment devices/technologies to improve the aesthetic values, microbial and chemical quality of water are to be installed to ensure that all surface water achieves the guideline values cited in the ADWG.

(iv) Methods used to treat surface water must be certified by a registered professional in the field of water quality and must be installed and commissioned prior to occupation of the use (except where water supply is combined with firefighting water).

(j) Each surface water pump point must be metered (or where there are multiple meters, collectively recorded), with the meter maintained, read and the volume pumped recorded on a quarterly basis.

(k) Any proposed surface water use is to be sustainable on both a local and regional level. The average annual demand for surface water must not exceed the average long-term recharge in the area to ensure ground water supplies are maintained.

(l) To demonstrate compliance with the above criteria, council may request that a groundwater resource assessment be undertaken by a qualified hydro-geologist.

(7) Carted drinking water

(a) The use of carted drinking water supply is only used as a supplementary/secondary supply measure to ensure a long term and sustainable supply of water to a premises.

(b) Water cartage is necessary in some instances to supplement existing rainwater supplies.

Editor's Note: If rainwater collection is limited by the size of storage tanks or roof catchment areas or a lack of rain, drinking water supplies may need to be augmented with carted water.

(c) Carted water is not to be used as a sole source of supply except as a temporary use.

(d) Carted water is to be stored in water tanks as outlined in Clause SC6.4.11.7 (4) Rainwater harvesting (tanks).

(e) Drinking water is recognised as a food. Water carters/carriers may need to be registered as a food business if the supply of additional potable water is needed.

(f) When using carted water, it is advisable to ensure the water carter can provide evidence that water supplied will be safe to drink. This evidence could include: any authorisations issued for the purpose of supplying drinking water; the identity and quality of the source water; proof that tankers used are suitable for the purpose of carrying drinking water (for example, not likely to have carried other materials that would contaminate drinking water).

(g) Ensure that carted water supplied for drinking is disinfected at the point of supply (such as the rainwater tank) as this provides protection against contamination introduced during filling of the water tanker and during transport to the point of supply.

(8) Recycled water

(a) Recycled water is any water that has been used at least once and then supplied for reuse, either treated or untreated. Without appropriate treatment, recycled water may contain a range of contaminants.

Editor's Note - For example, water used for the final rinse in a commercial laundry is only lightly contaminated and thus may be used again, untreated, for the first wash cycle. On the other hand, sewage must be treated at a sewerage treatment plant before it can be recycled for any purpose.

Recycled water from sewerage treatment plants is put into different classes depending on its microbiological quality. These classes range from Class A+ (the highest) to Class D (the lowest).

(b) The use of recycled water can reduce the demand on alternative supplies that are potable.

(c) Recycled water can be used where it is demonstrated that it is safe to do so and does not adversely affect the environment, adjoining properties or constitute a public health risk.

(d) Recycled water is not to be used for potable water, food preparation or topping up of pools or spas, but may be appropriate for private and commercial purposes such as irrigation and possibly toilet flushing, car washing and dust suppression (or similar), including for fire-fighting.

(e) Recycled water when used for watering plants and lawns (source of irrigation) can be an effective means of saving water provided some sensible precautions are undertaken, including watering several locations to prevent salts and other contaminants from accumulating in the soil and rotation of irrigation using mains or rainwater to help flush salts from the soil.

(f) Signage must be erected at sources of recycled water use to advise that the water is not suitable for drinking.

(g) The static storage of recycled water must be separately stored from other sources of potable water.

(h) The quality of the water will determine the permitted uses and businesses using recycled water are required to obtain approval and adhere to any specified conditions.

(i) The storage of untreated water for more than 24 hours (bacteria and organic contaminants in water will cause it to turn septic and produce strong and offensive odours).

(j) Recycled or untreated water is not allowed to pool or run-off onto other properties, into watercourses, public space or the stormwater system.

(9) Non-restricted water supply risks

(a) Selecting an alternative supply, consideration must be given to the potential health concerns, sensible practices, and disinfection options available as well as the location, rainfall patterns, supply required and overall cost (initial and maintenance).

Editor's Note - Advice on the use of on-site water supply:

(i) ensure water is collected from the most suitable and safest source available;

(ii) determine what microbial or chemical contaminants are in the surrounding environments and what effects they may have on the water used;

(iii) treat water if necessary to make it safe. This could involve the removal of solids, chemicals, and microorganisms;

(iv) ensure collection sources for rainwater such as roofs and gutters are kept free of extraneous matter such as leaves and bird droppings;

(v) ensure a first flush system is used for all rainwater collection to ensure that the first water collected during a rain fall event is discarded thereby reducing the amount of microorganisms entering the tank;

(vi) ensure tanks which are used to store water are cleaned out regularly to remove any build-up of sludge or debris. This reduces the potential risks of chemical or microbiological contamination of the water;

(vii) where water is supplied by a water carrier, it should be sourced from a potable water supply. The carrier should have hoses which are in good operating condition and are capable of being effectively cleaned and sanitised. The water carriers should only be used for the purpose of carrying potable water, the operator should be able to provide documentation showing this;

(viii) ensure all equipment that is used to collect and store the water is suitable and well maintained;

(ix) ensure all equipment used in the collection and storage of water is well positioned to minimise the risk of contamination; ensure all water storage equipment is vermin proof; and

(x) monitor the water regularly to ensure that the conditions of the water have not changed, and any treatments being undertaken are appropriate to ensure its safety. It is important to remember that some water sources such as bore water may have a very high mineral load. While this may not affect the safety of the water, it may affect the quality, flavour and hardness and have an undesirable effect on the equipment that is used. It is recommended that water is tested by an accredited laboratory on a regular basis to ensure the steps that have been put in place are still adequate to maintain the safety of the water.

For advice on what constitutes good quality water see the *Australian Drinking Water Guidelines 2011* available from the National Health and Medical Research Council's website.

(10) Requirements for non-potable water supply

(a) The *Plumbing Code of Australia* requires that a non-drinking water supply:

(i) must only be connected to outlets clearly identified for non-drinking use and must be limited to the uses specified in the Code; and

(ii) is not to have a cross connection with a drinking water service.

Editor's Note: If non-potable water is adequately treated, its quality will improve, and it can be used for a wider range of purposes. Some examples of non-potable water used are:

1. class A recycled water from a sewage treatment plant used for dust suppression, car washing, landscape irrigation or irrigation of sporting ovals;
2. quarry water used for dust suppression and landscape irrigation;
3. swimming pool backwash water used for toilet flushing;
4. agricultural wastewater used for crop irrigation; and
5. creek, dam, and river water used for dust suppression.

(11) Requirements for fire-fighting supply

Editor's Note - Firefighting uses large amounts of water. If fire fighters need to leave a site to obtain more water, that site will be undefended and may be damaged or lost. If fire fighters don't have access to adequate water supplies at a site, they may not even attempt to defend the site because it will be unsafe.

Editor's Note - Where the *Building Code of Australia* and applicable Queensland Building Codes provide standards for the installation of firefighting appliances, the provisions of those standards shall prevail.

The purpose of this section is to outline adequate and accessible water supplies required for fire-fighting purpose and to ensure that they are available for people and fire-fighters to defend from fires. Suitable water supplies and appliances shall be provided, and easily accessible at all times.

(a) The minimum dedicated amount of water for fire-fighting purposes is 10,000L of stored (static water) for a property less than 2500 square metres in area and at least 20,000L of stored (static water) for property greater than 2500 square metres. The amount of stored static water must be available, and accessible at all times.

Editor's Note - Some development may require more water to comply with the *Building Code of Australia* or to ensure that an adequate supply to available to service a particular development where that development is likely to require increased firefighting capacity.

(b) Firefighting water supply needs to be provided, and always accessible, although it does not need to be drinkable (potable).

(c) A dedicated water tank for the storage of fire-fighting water is the accepted standard. Where alternatives are provided, it should be demonstrated that the water supply will be available and accessible at all times.

(d) Where not using a dedicated firefighting storage tank, the outlet for the internal fixtures is located above the point at which the tank will contains the dedicated amount for fire-fighting purposes.

(e) Firefighting water supplies (including pipelines, hydrants, fittings, and storages) are:

(i) provided before building construction commences;

(ii) designed, located, and fitted to ensure reliability during a fire (e.g. polyethylene pipes are buried or shielded - refer to the National Plumbing and Drainage Code AS 3500);

(iii) properly maintained and accessible at all times by emergency vehicles;

(iv) tanks must be located so that a vertical clearance of 4 m to overhanging obstructions is achieved (vegetation, power lines) ;

(v) a cleared area on either side of the tanks, a minimum of 6 m, to allow firefighting vehicles and crews access to the tanks; and

(vi) tanks should avoid be located on slopes, including access to, greater than 12 per cent.

Editor's Note - A fire truck has to be within about 3 metres from a water supply to be able to pump from it.

Editor's Note - Plastic tanks dedicated for fighting purposes are not recommended, however if they are submerged, they may be acceptable.

(f) At least one tank is within 100 m of the building which has fire brigade tank fittings. If the tank is underground, it has an access hole of 200 mm (minimum) to allow access for suction lines.

(g) A water supply for firefighting purposes must be clearly marked and identified by emergency services and others. Where a dedicated tank for storage of firefighting water is used, the tank must have appropriate signage to warn that the water in the tank is not suitable for drinking.

Editor's Note - The following is applicable for development within the Water resource catchment overlay map OM-09 (Schedule 2 of Townsville City Plan) and where development is to address the assessment criteria of the Water resource catchment overlay code found in Part 8.2.9 of the Townsville City Plan.

(12) Water resource catchment overlay

(a) To demonstrate the protection of water quality, ecological values and other environmental values, applicants may be asked to provide groundwater resource assessment where the proposed development is to use any ground resource as outlined in Clause SC6.4.11.7 (5) above.

(b) No on-site water supply infrastructure, including underground pipe, is to be located such that it will not change the physical integrity of waterways, wetlands, lakes, springs, and riparian areas.

(c) On-site water supplies may only be from harvested rainwater (tanks) or ground water (where undertaken and demonstrated sustainable by a ground water assessment) and may be supplemented by carted water.

(d) Recycled water or greywater is not to be used, to protect the water catchment from potential contamination.

(e) The capture of ground surface water is not permitted.

(f) A ground water level observation bore is to be installed adjacent to the site. The observation bore must be installed remote from all production bores to ensure there is no local interference to ground water levels at the observation bore.

(g) Council may set conditions of approval dealing with the following matters:

(i) a maximum volume of ground water extraction for the development based on the findings of the groundwater resource assessment study;

(ii) annual review of the effect of the authorised level of extraction in light of regional ground water level data collected from all relevant observation bores in the district. If regional ground water levels are declining, council may limit the previously authorised level of extraction, in terms of pumping rate or duration or both;

(iii) maintenance of safe access to bores for inspections by council staff; and

(iv) on-going monitoring, including:

1. provision of a report recording ground water levels each month for 6 months; and

2. regular testing of ground water quality (e.g. for nitrates and bacteria) if the ground water is to be used for potable purposes. If levels are found to be above the relevant drinking water quality standard, provision for an alternative potable source of water will be required.

Table SC6.4.11.9 – Guideline Values for Physical and Chemical Characteristics

Physical and chemical tests	Health	Aesthetic
pH	n/a	6.5 - 8.5
TDS (mg/L)	n/a	<600
Hardness (mg/LCCO^3) (incl Ca and Mg)	n/a	200
Aluminium (mg/L)	0.1 (dialysis patients)	0.2
Cadmium (mg/L)	0.002	n/a
Copper (mg/L)	2.0	1.0
Iron (mg/L)	n/a	0.3

Lead (mg/L)	0.01	n/a
Manganese (mg/L)	0.5	0.1
Zinc (mg/L)	n/a	3.0
Sodium (mg/L)	n/a	180
Chloride (mg/L)	n/a	250
Fluoride (mg/L)	1.5	n/a
Nitrate (mg/L)	50	n/a
Sulphate (mg/L)	500	250

(Source) NHMRC *Australian Drinking Water Guidelines 2011*

SC6.4.11.8 On-site sewerage facilities

(1) Introduction

This section provides standards, advice, and guidelines for applicants in the design, installation and siting of wastewater treatment and disposal systems.

The principle underpinning the use of on-site wastewater treatment and disposal is that all design, installation, and construction will meet the demands of a development, whilst having full consideration of the effects to public health and ensuring that adverse impacts on environmental values are avoided.

Council will apply these guidelines when processing applications involving on-site sewerage facilities or servicing of development outside of reticulated sewerage supply areas, or applications incorporating the use of an on-site sewerage facility.

Editor's Note - Development within SC2.5 Natural resources overlay map - Water resource catchments (OM-09) or Natural assets environmental importance overlay map (OM-08) will need to consider additional setback requirements, including requirements for exclusions of infrastructure in some instances when applying the standards of this policy.

Editor's Note - Before an on-site sewerage facility can be installed on a property, the applicant is required to apply for a permit to install the treatment facility on that property. Applications to install an onsite sewerage facility are to be lodged with the Hydraulic and Building Services Unit of council as part of the plumbing/drainage application. Applicants should also refer to the On-site sewerage facilities for non-sewered properties guidelines, which provides details on the application and installation stages of an on-site sewerage facility. This document may be found on council's website.

(a) Terminology

Unless noted otherwise all terms have the same meaning as given in the *Plumbing and Drainage Act 2018* (the PD Act), the *Plumbing and Drainage Regulation 2019*and the relevant Australian/New Zealand Standard or Australian Standard. If a definition given in the relevant Australian/New Zealand Standard or Australian Standard is inconsistent with the PD Act or Regulation, the PD Act or Regulation prevails to the extent of the inconsistency.

Intermittent water course	A natural or artificial channel, identifiable by recognisable bed and banks, along which rainwater or storm water usually or occasionally flows. The term does not include a closed conduit for conveying storm water.
Top bank	The same meaning as outer bank as defined in the *Water Act 2000.*

(b) Reference and source documents

Reference and source documents that are to be read and applied in conjunction with this policy section areas follow:

AS/NZS 1546.1 *On-site domestic wastewater treatment units – Part 1: Septic tanks*

AS/NZS 1547 *On-site domestic wastewater management*

AS/NZS 3500.2 *Plumbing and drainage – Part 2: Sanitary plumbing and drainage*

Environmental Protection Act and all subordinate legislation, in particular the *Environmental Protection (Waste Management) Regulation 2000* (Design Rules)

National Construction Code Volume 3 – Plumbing Code of Australia

Plumbing and Drainage Act 2018 (and associated Regulations)

Queensland Plumbing and Wastewater Code

Editor's Note - Council has specifically referred to AS/NZS 1547 *On-site domestic wastewater management* and is, for the purpose of this policy, the adopted standard to be read and applied in conjunction with this policy section.

(2) Application guidelines

(a) The following section details the design standards and reporting requirements for wastewater treatment systems generally, to assist applicants in demonstrating they have met the requirements of the Townsville City Plan.

(b) Development which is not connected to council's sewerage system and is not within a reticulated service area will require an on-site sewerage disposal report to demonstrate the effective and safe disposal of sewerage on- site, having regard to the nature of the development proposed, demands the development will place on a system, the land and surrounding environment and known hydro-geologic, public health, or otherwise constrained concerns.

The report should be prepared by a professional engineer or hydraulic consultant, to document a site and soil evaluation and design of disposal facility as per procedures, reporting requirements and standards outlined AS/NZS1547.

(c) As a minimum, the on-site sewerage disposal report submitted in support of an application should provide detailed information on the following; the report should:

(i) provide sufficient information for deciding whether or not a development area, subdivision, or lot is suitable for on-site system(s);

(ii) provide detailed site-specific information identifying the site and soil characteristics to be taken into account when selecting and designing an on-site system;

(iii) identify, analyse, and evaluate any risks posed by site and soil characteristics which might compromise the long-term effectiveness of the on-site system(s);

(iv) identify, analyse, and evaluate any risks of contamination of groundwater or surface water and of associated health risks; and

(v) specify measures required to reduce and monitor such risks.

Editor's Note - The flow rates should be determined using Appendix 4.2D (H in 2012 standard) *Typical Domestic* Wastewater Flow Design Allowances in AS/NZS 1547.

(d) The designer's report/design, at a minimum, must comply with the requirements of the AS/NZS 1547. For the purposes of reporting, Table 3.1 of AS/NZS 1547 Part B; Unsewered subdivision proposals, Sections 2 (Subdivision design) and Section 3 (System Design) as well as Section 4 of AS/NZS 1547 are considered relevant and should be used as a primary guide for preparing reports as it outlines the essential stages and implementation processes required. To the extent relevant, reporting should also consider the requirements of the *Queensland Plumbing and Wastewater Code*.

(e) The designer must undertake (or have undertaken) soil testing as necessary to enable an appropriate design to be completed. This may include but not be limited to the following: soil percolation tests; bore holes; test pits and soil textural analysis. The report should consider the following points when carrying out a site and soil evaluation:

(i) the determination of potential effluent disposal problems. These may include gullies, rock formations, hollows, or inconsistent soil texture, both on and off the property;

(ii) the consideration of previous and current weather conditions in the determination of the site's suitability for effluent disposal;

(iii) the demonstration that the disposal area is located above the 5 per cent AEP;

(iv) the site plan showing the setback requirements (for buildings, pools, bores, permanent and intermittent water courses, vehicular traffic areas and drains etcetera) both on and off the property, which may influence the location of the disposal area;

(v) a proposed land application area that shall not be cut, filled, or modified in any way after the site evaluation has been carried out. If this does occur the designer must be informed so that appropriate amendments can be made to the design; and

(vi) the designer is to make their recommendation based on the site and soil evaluation carried out.

In addition to the above, the following must also be reported on:

(i) topography and drainage;

(ii) climate data and statistics;

(iii) groundwater information (extractive bores, uses and quality);

(iv) infrastructure (existing and proposed) ;

(v) potential for cumulative effects on receiving environments;

(vi) off-site impacts;

(vii) presence of any fill material;

(viii) geotechnical hazards;

(ix) setback distances;

(x) potential for environmental or public health impacts; and

(xi) site plans (individual or multiple lots).

Much of the Townsville coastal plain is derived from Quaternary alluvium which in many places has been transported and reworked as a result of changes in drainage patterns over time. This has resulted in varying soil texture types occurring in both top and sub-soil zones with a variety of geometries that cannot be assumed on a broad-scale. In recognition of this fact, site soils assessments should form part of all reports. This approach provides for a representative assessment of the respective area's soils and enables the determination of the

land capability and hydraulic loading required for the development (e.g. LTAR, DIR/DLR).

The soil assessment should be able to provide information on the suitability of different methods of wastewater disposal based on soil textures and hydraulic properties of the actual soils in the area of interest. In order to develop an appropriate level of confidence in the results presented, the details, locations and results of soil sampling and hydraulic property testing should accompany any report submitted.

Site specific data relating to soil properties must be utilised for any method employed as this is the media through which any potential impacts or mitigation caused by wastewater disposal must pass through. Any assessment that does not include this data collection and input carries with it an inherent risk of inaccurate prediction of effluent transport and behaviour and may even accentuate the utilisation of inappropriate system and disposal methods.

(f) Water tables in tidal areas are to be determined to the minimum accepted tidal water table in seaside areas that experience tidal influence (for example Cungulla, Magnetic Island, Cleveland Palms). The minimum water table level is taken to be the contour level of 2.25 m (Australian Height Datum). This allows for an astronomical tide of 4.1 m. Therefore, to determine vertical separation distances, this level must be taken into consideration. A site and soil evaluation may indicate the presence of a higher water table. This, along with wet weather water tables, shall be taken into consideration.

To assist applicants, the following report structure can be used in preparing an On-site sewerage disposal report, when read and applied in conjunction with relevant provisions found in AS/NZS1547, including procedures outlined in sections 4.1.3.4 and 4.2.3.2 of AS/NZS1547.

(i) Site and soil evaluation report (all references are to AS/NZS1547)

1. details of the site and soil evaluation personnel confirming:
    a) past experience of site and soil evaluation assessments;
    b) successful completion of an accredited training program (if applicable);
    c) knowledge of the regulatory assessment requirements; and
    d) professional liability for the interpretation of, conclusions drawn, and recommendations made as a result of the site evaluation;
2. desk top study as per relevant section of 4.1A2;
3. site and soil check as per relevant section of 4.1A3;
4. soil assessment items as per relevant section of 4.1A4; and
5. evaluation of results as per relevant section of 4.1.4; and

(ii) Design report

1. Details of land application facility designer confirming:
    a) past experience designing on-site sewerage disposal facilities;
    b) successful completion of an accredited training program;
    c) knowledge of the regulatory design requirements; and
    d) professional liability for the interpretation of, conclusions drawn from, and recommendations made, as a result of the design; and
2. Documentation of the design process, including:
    a) system selection as per section 4.2A4;

b) soils and LTAR/DLR values as per section 4.2A5; and

c) design flows as per section 4.2A6; and

3. Reserve area as per section 4.2.3.4;
4. Distribution system as per section 4.2.3.6;
5. Nutrients as per section 4.2.3.6;
6. Rainfall surface flow control as per section 4.2.3.7;
7. Land use activity as per section 4.2.3.8;
8. Site plan:

a) north point;

b) full property description;

c) name of person who evaluated the site;

d) scales of 1:200 or 1:500;

e) predominant wind direction;

f) location, height, density, and type of vegetation;

g) access roads, tracks, vehicle manoeuvring areas, storage areas;

h) test boreholes/pits;

i) fall of land;

j) setbacks;

k) water supply bores, top banks of water courses, lakes, ponds, unlined stormwater drainage channels, dams;

l) buildings, fences, property boundaries, pedestrian paths, walkways, recreation areas, retaining walls, in-ground swimming pools, in-ground potable water tanks; and

m) primary and reserve land application areas.

It is the designer's responsibility to carry out their duties in accordance with the AS/NZS 1547, the Queensland Plumbing and Wastewater Code (where relevant), and any other relevant legislation and supported by good engineering practice.

(g) Design flows

Any consideration of design flow should utilise guideline appendices of AS/NZS 1547 and incorporate allowance for peak usage and occupancy.

(h) System selection and land application design

The selection of the appropriate wastewater treatment system and disposal method should be based on the individual characteristics of the lot in question and any reporting recommendations based on investigation (as outlined in this policy section). The assumption of a single type, wastewater system being utilised across all lots in any subdivision application is not recommended.

Any system proposed for a lot should comply with all relevant Codes and Standards such as AS/NZS 1546.1 and the *Queensland Plumbing and Wastewater Code*. Water balance and nutrient loadings need to be considered prior to the determination of appropriate lot sizes.

The assessment of soil properties (texture and hydraulic) assists in determining ideal rates of application, and also, the suitability of proposed methods of disposal. The *Queensland Water Recycling Guidelines* (2005) provide indicative concentrations of total nitrogen (TN), total phosphorous (TP) and total dissolved solids (TDS).

It is recommended that a two-stage approach be undertaken for supporting the final determination of lot sizes in a subdivision and which is based on the suitability of the soils to certain methods of wastewater disposal,as well as any requirements of the Townsville City Plan, including any applicable overlay provisions. The results of the site and soil assessment inform the selection of an appropriate system and subsequent land application design.

(3) Design considerations

(a) Set back distances

Set back distances are to comply with the requirements of the *Queensland Plumbing and Wastewater Code*, and AS/NZS 1547.

Council may consider viral die off and nutrient decay calculations as a means of justifying a reduced set back distance from the following features:

(i) top bank of an intermittent water course; or

(ii) easement boundary of an unlined open stormwater drainage channel or drain.

The consideration of reduced setback distances are subject to the requirements of the Townsville City Plan, which may require increased setback distances to watercourses or in some instances, development to be placed outside of riparian or wetland buffer areas as detailed in the Water resources catchment overlay code or the Natural assets overlay code. Furthermore, it will be necessary for applications to demonstrate that there will be no adverse environmental impacts, taking into consideration cumulative impacts from other development, to place infrastructure near a watercourse, wetland, or open stormwater drainage channel/drain.

SC6.4.11.9 Attachments, forms and checklists

Attachments, forms and checklists	To obtain a copy the document
Attachment A - Applicant's Network Model Needs Consultation Process	Click here
Attachment B - Map of Available Sewer Network Model Areas (ex Toomulla)	Click here
Online Form A - Form M1: Request for network modelling information	Click here Please note that this form requests for either simple or detailed network modelling requirements.
Checklist A - Model Submission Checklist (Water and Sewer)	Refer Section SC6.4.2, Checklist 14 (Click here to view the document)