PART 7: WATER SUPPLY

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7.1 REFERENCED DOCUMENTS

Planning and Policy

- *Selwyn District Plan (District Plan)*

  www.selwyn.govt.nz/services/planning
- Selwyn District Council Development Contributions Policy - *Long Term Council Community Plan – Selwyn Community Plan 2009-2019*

  www.selwyn.govt.nz/council-info/selwyn-community-plan
- Selwyn District Council *Water Supply Bylaw 2008*

  http://www.selwyn.govt.nz/__data/assets/pdf_file/0003/2001/Water-Supply-Bylaw-2008.pdf
- New Zealand Building Code (1992)
- Selwyn District Council 5Waters – Strategies and Policies (2009)

  www.selwyn.govt.nz/__data/assets/pdf_file/0016/14047/5Waters---Strategies-and-Policies---Final.pdf
- Ministry of Health *Drinking Water Standards for New Zealand (2005)*

Design

- Christchurch City Council *Water Supply Wells, Pumping Station and Reservoir Design Specification*
- SNZ/PAS 4509:2008 New Zealand Fire Service *Fire Fighting Water Supplies Code of Practice (Fire Service Code of Practice)*
- AS/NZS ISO 9001:2008 *Quality Management Systems – Requirements*
- AS/NZS 4020:2005 *Testing of products for use in contact with drinking water*
- AS/NZS 2566.1:1998 *Buried flexible pipelines structural design*
- AS/NZS 2566.1:1998 *Buried flexible pipelines structural design, supplement 1*
- AS/NZS 2845.1:1998 *Water supply – Backflow prevention devices*
- AS/NZS 4130:2003 *Polyethylene (PE) pipes for pressure applications*
- NZS 4404:2010 *Land Development and Subdivision Engineering*

Construction

- Christchurch City Council *Authorised Water Supply Installer Specification*

  http://www.ccc.govt.nz/Water/AuthorisedInstallers/
- Christchurch City Council *Civil Engineering Construction Standard Specifications Parts 1-7 (CSS)*
  https://ccc.govt.nz/consents-and-licences/construction-requirements/construction-standard-specifications

Where a conflict exists between any Standard and the specific requirements outlined in the Engineering Code of Practice (COP), the COP takes preference (at the discretion of the Council).

7.2 INTRODUCTION

This Part includes:

- the assessment of required infrastructure;
- technical design requirements;
- material requirements.

The *Water Supply Bylaw* defines the Council's requirements for protecting the water supply along with minimum levels of service expected to be provided.

Selwyn District Council's water supply is essentially a number of separate schemes that sources high quality groundwater from confined aquifers, with a number of surface water takes.

Monitoring and control of pumps and pressures are undertaken from the Selwyn District Council's main offices in Rolleston, via telemetry, using a SCADA (Supervisory, Control and Data Acquisition) system.

SDC's networks include the following supplies:

Restricted Supplies:

- Burnham
- Otahuna
- Malvern Hills RWS
- Selwyn RWS
- Darfield (Rural A and B)

Unrestricted with private tanks:

- Johnson Road
- Jowers Road
- Raven Drive

On Demand Supplies:

- Rolleston
- Tai Tapu
- Prebbleton
- Lincoln
- Castle Hill
- Dunsandel
- Edendale
- Kirwee
- Lake Coleridge

- Leeston/Doyleston
- Southbridge
- Springfield
- Springston
- West Melton
- Armack Drive
- Branthwaite Drive
- Claremont
- Rakaia Huts
- Selwyn Huts
- Taumutu
- Darfield (Township)

Chlorinated Supplies

- Darfield
- Castle Hill
- Selwyn RWS

UV Disinfected Supplies

- Dunsandel
- Arthurs Pass
- Malvern Hills RWS (South)
- Selwyn RWS

7.2.1 Effects of development on the water supply network

The water supply system can usually be expanded incrementally without any adverse effect on the infrastructure. For many of the rural schemes water resources are restricted by ground water quantity and quality.

System extensions, upgrading headworks and any other specific works required to provide water for a new development will be funded in accordance with the Council's *Development Contributions Policy*.

7.2.2 Water supply resource constraints

Many parts of Selwyn District are fortunate in having readily available groundwater resources that can be developed very cost effectively, as required, to meet the increased need resulting from development. It should be remembered that this is a finite source and maintaining water quality is critical to its continued use.

Groundwater generally meets the *Drinking Water Standards* without treatment. However, groundwater from shallower wells in rural areas is often not appropriate for community water supply.

Consents to take groundwater in the Christchurch area are required for both public supply and private purposes from the Canterbury Regional Council (Environment Canterbury). Canterbury Regional Council must be consulted for information on likely consent conditions. Any development reliant on the municipal supply may be required to contribute to the infrastructure necessary for double pumping.

7.2.3 Supply alternatives

Gravity reticulation remains the preferred method of reticulation for most developments.

Living and business zones require a level of service that includes peak pressure and flows as defined in clause 7.5.1 – Flow and pressure for residential zones in on-demand water supply areas Chart 1, and fire fighting provision, as defined by the *Fire Service Code of Practice*.

The urban reticulated area does not necessarily extend to all parts of existing living and business zones. The developer is responsible for the cost (or part cost) of any system extension.
Upon consent application, developments with infrastructure that will be vested in the Council will be issued with design parameters.

In some cases, pumping and reservoir systems may be required to provide an appropriate level of service. For example, variable speed systems without storage may be appropriate for small groups of houses that otherwise have adequate fire-fighting capacity. A decision by the Council to accept responsibility for maintaining such systems will be made on cost-benefit grounds, and capitalised maintenance charges may be required to ensure that the lifecycle costs expected by the Council can be recovered.

On-demand water supply systems, without fire-fighting capacity to Fire Service requirements, will not be approved within living zones. In rural zones, approval for a restricted rural supply for domestic purposes only, without specific fire-fighting provision, may be granted at the discretion of the Council and special conditions may apply. Parameters for these systems will be specific to the development and will depend on the intended land use and availability of supply.

Subdivision without a reticulated supply may be approved, if a private potable source is available and if other options are impractical. Small community systems will normally be approved only if provision is made to ensure management in perpetuity without the Council's assistance.

If, for any reason, the Council approves a development without public supply to the Council's level of service, in an area where such a supply could reasonably be expected, the Council reserves the right to add a note to the property file advising of the situation.

7.3 QUALITY ASSURANCE REQUIREMENTS AND RECORDS

Provide quality assurance records that comply with the requirements in Part 3: Quality Assurance, during design and throughout construction.

7.3.1 The designer

The designer of all water supply systems that are to be taken over by Selwyn District Council must be suitably experienced. This experience must be to a level to permit membership in the relevant professional body. Refer to clause 2.6.1 – Investigation and design (General Requirements) for further information.

The design peer reviewer must have at least equivalent experience to the designer.

7.3.2 Design records

Provide the following information, to support the Design Report:

- hydraulic calculations, preferably presented in electronic form;
- all assumptions used as a basis for calculations, including pipe friction factors;
- calculations carried out for the surge analysis of pressure pipes, where appropriate;
- design checklists or process records;
- design flow rates;
- system review documentation as detailed in clause 7.6.7 – System review;
- thrust block design calculations, including soil bearing capacity;
- trenchless technology details.

7.3.3 Construction records

Provide the information detailed in Part 3: Quality Assurance and the *Construction Standard Specifications (CSS)*, including:

- pressure test results;
- chlorination test results;
- bacteriological test results;
- material specification compliance test results;
- compaction test results;
- subgrade test results;
- confirmation of thrust block ground conditions and design;
- site photographs.

The developer must provide the Council with a certificate for each pipeline pressure tested, including the date, time and pressure of the test. Provide details of the pipes in a form complying with the requirements of Part 12: As-Builts, including manufacturer, diameter, type, class, date of manufacture, serial number, jointing and contractor who laid the pipe.

7.4 WATER SUPPLY DESIGN

All pipe diameters are internal unless otherwise noted.

7.4.1 Design considerations

Consider the:

- hydraulic adequacy of the system;
- ability of the water system to maintain acceptable water quality, including consideration of materials and their disinfection demand, and prevention of back siphonage and stagnation;
- structural strength of water system components to resist applied loads, including ground bearing capacity;
- seismic design - all infrastructure must be designed with adequate flexibility and special provisions to minimise risk of damage during earthquake. Provide flexible joints and isolation valves at all junctions between rigid structures (e.g. reservoirs, pump stations, bridges, buildings, manholes) and natural or made ground;
- pipeline's ability to withstand both internal and external forces, taking into account any transient temperature changes;
- Poisson's effect and end restraint designs to compensate where necessary;
- requirements of the Fire Service Code of Practice;
- impact of the works on the environment and community;
- "fit-for-purpose" service life of the system;
- best way to minimise the "whole-of-life" cost;
- resistance of each component to internal and external corrosion or degradation. Refer to clause 6.11.3 – Aggressive groundwater (Wastewater Drainage) for further information;
- capacity and ability to service future extensions and development;
- location of major reticulation and its potential for significant traffic disruption. Discuss at an early stage with Council.
- networking, redundancy and security of supply.

In urban areas, also consider the Council's minimum levels of service, detailed in the *Water Supply Asset Management Plan*. In general a minimum of 300kPa is supplied at the point of supply.

Design all parts of the water supply system that are in contact with drinking water using components and materials that comply with AS/NZS 4020. Select the pipe material to ensure a minimal impact on water quality within the system.

7.4.2 Design life

All water supply distribution systems are expected to last for an asset life of at least 50 years with appropriate maintenance, and must be designed accordingly to minimise life cycle costs for the whole period.

7.4.3 Future system expansion

Design watermains with sufficient capacity to cater for all existing and predicted development within the area to be served. Make allowance for areas of subdivided or un-subdivided land capable of future development, as specified by the Council in the design parameters.

7.4.4 Contaminated sites

Avoid contaminated sites wherever possible. If a contaminated site cannot be avoided, provide details about the following issues with the Design Report:

- compliance with statutory requirements;
- options for decontaminating the area;
- selection of spiral welded steel, wrapped galvanised submains and jointing techniques to maintain the water quality (in accordance with the pipe selection chart shown in Appendix III – Water Distribution Mains – Materials Selection Flow Chart);
- safety of construction and maintenance personnel;
- any special pipeline maintenance considerations.

7.4.5 Specific structural design

Design pipelines being installed at depths greater than detailed in *CSS: Part 4* to resist structural failure. The design must comply with AS/NZS 2566.1 including Supplement 1. Provide details of the final design requirements in the Design Report.

Any ground that has an ultimate bearing capacity less than 150 kPa is unsatisfactory for watermain construction. In such environments, engage a geotechnical specialist to investigate the site and to design and supervise the construction of an appropriate support or foundation remediation system for the watermain. Refer to clause 4.6.4 – Peat (Geotechnical Requirements) for further information.

Wherever it is necessary to fill an area before laying a watermain across it, or to build an embankment in which to lay the watermain, seek advice from a suitably qualified geotechnical specialist, to ensure that the weight of the fill will not cause failure or leakage of the pipe joints, after the main is laid.

7.4.6 Reducing waste

When designing the development, consider ways in which waste can be reduced.

- Plan to reduce waste during demolition e.g. minimise earthworks, reuse excavated material elsewhere.
- Design to reduce waste during construction e.g. prescribe waste reduction as a condition of contract.
- Select materials and products that reduce waste by selecting materials with minimal installation wastage.
- Use materials with a high recycled content e.g. recycled concrete subbase.

See the Resource Efficiency in the Building and Related Industries (REBRI) website for guidelines on incorporating waste reduction in your project *www.rebri.org.nz*

7.5 DESIGN PARAMETERS

In developments where adequate system pressure and coverage from hydrants already exists, the Council will advise the point of supply and the minimum pipe size for the supply pipe. The developer is responsible for the full cost of the supply pipe from the point of supply to the individual connection points.

When the developer is providing water reticulation for vesting in the Council, the Council will provide the following parameters, after receipt of the application plan:

- point of supply;
- mains size at the point of supply;
- supply type (e.g. on-demand or restricted);
- design number of connections, as provided by the developer;
- additional development to be allowed for in the design;
- static pressure;
- residual pressure at peak system demand in the network;
- residual fire pressure during fire demand at point of supply;
- fire water classification at point of supply;
- the minimum residual pressure at house site at peak system demand;
- networking requirements;
- other requirements (e.g. minimum mains size).

7.5.1 Flow and pressure for residential zones in on-demand water supply areas

The design average flow rates for the district are based on a peak flow rate of 0.15/s/connection. Provide the design flow rates, for developments other than standard living zones (e.g. multi-unit developments or older persons' housing), with the Design Report.

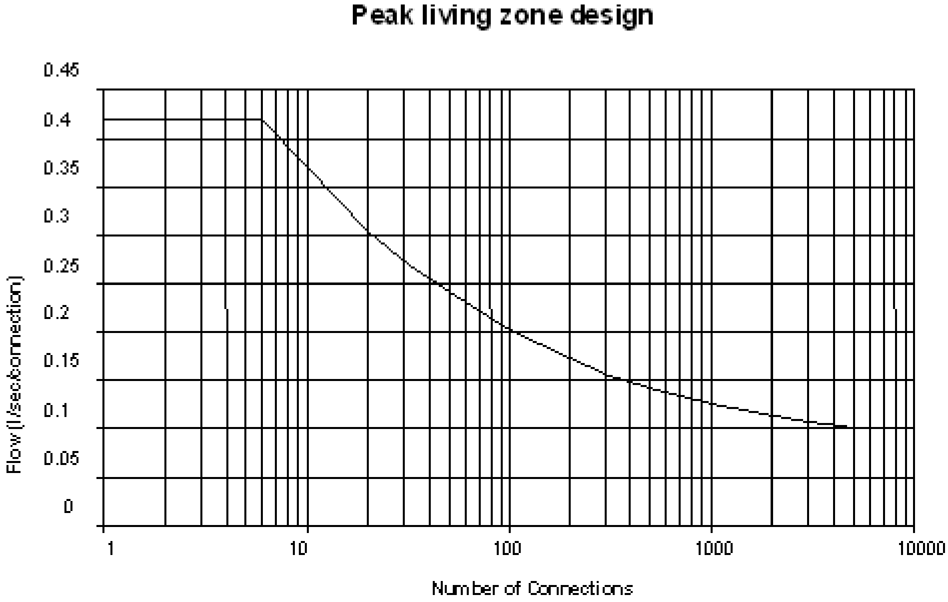
The minimum residual pressure at the house site is shown in Table 1 and applies to ground level at the highest likely building site on each allotment.

Table 1 Minimum residual pressure at the point of supply

Lowest Residual Mains Pressure (kPa)	Minimum Residual Pressure at Point of Supply at Peak System Demand (kPa)
less than or equal to 450	200
between 450 and 600	300
greater than 600	400

These requirements may be varied by the Council to suit specific usage or geographic conditions. Reasons for significant changes to the average figures will be outlined in the design parameters for the development, when applicable.

Chart 1 Peak living zone design flow rates



7.5.2 Flow and pressure for business zones in on-demand water supply areas

Industrial and commercial zones shall be developed with a minimum flow rate of 1.0 l/s/Ha unless it can reasonably be shown that consumption will be higher, in this case use the higher consumption figure.
The minimum residual pressure at the boundary (rather than the point of use as for residential development) is shown in Table 2. Increase this minimum pressure by any rise in elevation between the point of supply and the highest likely building site.

Table 2 Minimum residual pressure at boundary

Lowest Residual Mains Pressure (kPa)	**Minimum Residual Pressure at Boundary of Industrial Allotment at Peak Total Demand (kPa)**
less than or equal to 450	250
between 450 and 600	350
greater than 600	500

7.5.3 Design for restricted water supply areas

Restricted water supply areas apply to:

- developments outside the urban area;
- developments not within 100 metres of an operational fire hydrant;

Design any rural restricted supply to provide $3m^3$/day for each property. Provide each property with a restrictor at the time of connection that will pass 1, 2, or $3m^3$ over a 24-hour period, depending on the volume set down under the building consent.

Each property is required to provide on-site storage, at the time of building consent. The minimum storage capacity must be 48 hours normal gross supply. The supply must plumb into the storage vessel using a ballcock (to provide air gap separation) located above the overflow for the tank. Any other sources of water on any property must not be connected to the reticulation upstream of the air gap separation. Design rural restricted supplies for domestic purposes, rather than for stock water or irrigation purposes.

Individual sites may provide their own water bores for domestic purposes. These bores must be established in accordance with the consent requirements of Canterbury Regional Council. The water must be tested to show that the water quality is potable in accordance with the *Drinking Water Standards*.

If the water supply design proposes to establish an independent bore and reticulation to serve more than one property, the rules of urban supply apply (except for the fire fighting provision) if the development is within a rural zone. In addition, the Council may not necessarily take over an independent scheme, as it is unlikely to be an economic extension of service. If the Council does take over such a scheme, it reserves the right to require a capitalised maintenance fee based on the expected long-term operation and depreciation cost, capitalised at the current official cash rate. Provide proof to the Council, for schemes in private multiple use, that the scheme will be maintained in perpetuity, for the benefit of the users and to the satisfaction of the Ministry of Health. Present this proof as a legal document, prior to application for the 224(c) certificate.

7.5.4 Fire service requirements

The water supply reticulation should comply with the Fire Service *Code of Practice*. In particular, the reticulation must meet the requirements for fire fighting flows, residual fire pressure and the spacing of hydrants.

Location of hydrants shall comply with SNZ PAS 4509: 2008 with minimum hydrants spacing of 135 metres. Blue RRPM’s (cat eyes) shall be installed to offset from the road centreline adjacent to all hydrants. Hydrant Marker posts are to be installed to comply with Section G3.4 of the NZ Fire Service *Code of Practice*. Hydrant posts are not required in urban areas. The type of hydrant marker required is shown on drawing WS10.0 (see Appendix V).

7.5.5 Fire services

Many industrial and commercial sites require the installation of fire services. The site owner is responsible for providing these fire services, which must be designed to meet the requirements of the New Zealand *Building Code*.

All fire service connections to the Council reticulation will have a meter fitted by Council to detect any unlawful water use.

Do not assume that current pressure and flow will be available in the future when designing private fire services. Pressure and flow available is likely to reduce in the future, due to demand growth and pressure management.

7.6 RETICULATION DESIGN

7.6.1 Maximum operating pressure (head)

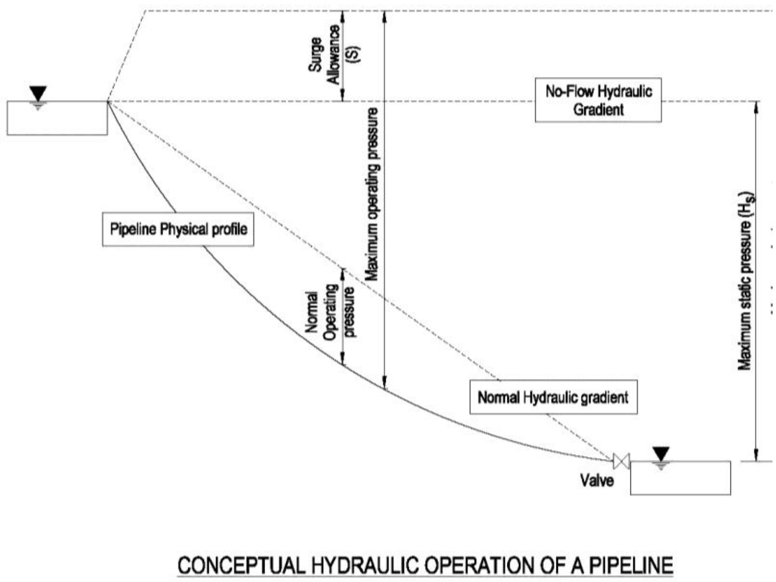
Calculate the maximum operating pressure for the mains as follows:

Equation 1 Maximum operating pressure at E

$$\begin{aligned}
&\text{Maximum Operating Pressure (m)} = Hs + S - E \\
&\text{where - } Hs = \text{static pressure (m)} \\
&\qquad S = \text{surge allowance (m)} \\
&\qquad E = \text{lowest ground level of the proposed main (m).}
\end{aligned}$$

Figure 1 illustrates the relationship between these pressures.

Figure 1 Pressure definitions



Use the calculated operating pressure when:

- selecting pipe materials and classes.
- selecting pipe fitting types and classes.
- designing thrust and anchor blocks.
- specifying the test pressure.

Where the main supplies directly to the reticulation system, the proposed maximum operating pressure must comply with the maximum operating pressure normally supplied in that zone. Alternatively, if supply is required to a small area adjacent to the trunk main, the supply pressure may be reduced using a pressure reducing valve before its transition to a reticulation main.

7.6.2 Standard main sizes

Acceptable standard nominal main diameters are 100, 150, 200, 300, 375, 450 and 600mm. Acceptable standard nominal OD submain diameters are 50 and 63mm. Polyethylene only is specified by a nominal outside diameter (OD).

7.6.3 Minimum pipe and fitting class

The minimum pipe class for reticulation mains is PN12. The minimum class for fittings is PN16. Check the Council's minimum requirement, using Appendix III – Water Distribution Mains – Materials Selection Flow Chart, before specifying the required pipe class.

7.6.4 Losses

When determining the residual pressure at each site, take into account the minimum residual pressure to be available at the point of supply, as specified in the design parameters for the development, and, for residential developments, also consider any friction losses through the supply pipe at peak flow rate.

Assume all private service pipes on the street side of the meter are not more than 20mm diameter, unless a statement specifying the service pipe diameter is registered on the Property File relating to that allotment.

For residential developments, design losses through meter(s) and the submain must be such that the design flow rate downstream of any point corresponds with the value given in clause 7.5.1 – Flow and pressure for residential zones in on-demand water supply areas Chart 1 above. Alternatively, design the submain in accordance with Appendix II – Submain Design Charts.

Assume connections to individual allotments on the house side of the meter are 15mm diameter, unless consent has been given to design for a larger connection. Determine mains losses using flow rates in accordance with Chart 1 or clause 7.5.2 – Flow and pressure for business zones in on-demand water supply areas Chart 2, for the number of allotments downstream.

7.6.5 Pipe hydraulic losses

Take differences in elevation across the subdivision or development into account.
Calculate pipe friction losses from the pipe supplier's technical information or from representations of the Darcy-Weisbach/Colebrook-White formula. Use friction factors that take into account the effects of pipe aging.

Table 3 Friction factors

Pipe material	**Ks (mm)**
PVC-U, PVC-O, PE	0.15
Ductile Iron	0.6

Note:
1) These friction factors are extracted from NZS 4404, Table 6.1.
2) Manufacturers' design charts may be based on smoother pipe assumptions than these (e.g. Ks = 0.03) but such charts usually assume 'as new' laboratory conditions and ignore effects such as fittings and pipe ageing.

Some of Selwyn's water must be pumped, so keep hydraulic gradients (other than for fire fighting purposes) below 0.01m/m. The Council may approve exceptions to this rule in isolated cases where the pressure is independent of pumping rates.

7.6.6 Surge and fatigue re-rating of plastic pipes

Plastic pipes are susceptible to damage from cyclic loads. Although plastic pipes may be permitted in zones affected by pressure variations (e.g. pump zones), in locations downstream of pressure reducing valves, and in high surge areas, it is essential that the pipe class be reclassified for both surge and fatigue in accordance with the criteria set out in Appendix V - Design for Surge and Fatigue.

7.6.7 System review

When the pipe selection and layout have been completed, perform a system review, to ensure that the design complies with both the parameters specified by the Council and detailed in the IDS. The documentation of this review must include a full hydraulic system analysis. Compliance records must cover at least the following requirements:

- minimum residual pressure can be maintained at all property connections;
- maximum operating pressure will not be exceeded anywhere in the system;
- pipe class is suitable for the pipeline application (including operating temperature, surge and fatigue);
- pipe and fittings materials are suitable for the particular application and environment;
- pipe and fittings materials are approved materials;
- minimal likelihood of water quality problems or water stagnation;
- valve spacing and positioning allows isolation of required areas;
- mains layout and alignment meets the Council's requirements;
- meets minimum fire fighting demands;
- control valves, where required, are positioned to provide the required control of system;
- watermains are extended to boundaries;

- connections, to existing or future subdivisions, form a cohesive network and provide security of supply;
- capacity provided for future adjacent development.

7.7 PUMPING STATIONS AND RESERVOIRS

Any requirement for a secondary pumping station will become apparent during the preliminary reticulation design. The Council will take into account the long-term cost-effectiveness (i.e. total life-cycle costs) of the structure before accepting any infrastructure to be vested in the Council. Design and construct any such infrastructure to accord with the *Water Supply Wells, Pumping Station and Reservoir Design Specification*. Design secondary pumping stations that supply residential zones to supply 0.05 litres/second/connection unless otherwise specified.

Obtain requirements for pumping stations from the Council prior to design. On hills, all pumping stations must pump to a reservoir to even out any fluctuations in demand, unless the Council states otherwise in the design parameters.

When designing and sizing reservoirs, refer to the Water Supply Wells, Pumping Station and Reservoir Design Specification.

7.8 RETICULATION LAYOUT

Lay watermains in public roadways unless there is no practicable alternative. Remove any existing reticulation between new lots.

7.8.1 Mains layout

Consider the following factors when deciding on the general layout of the mains:

- the need for mains to be replaced due to their physical condition and/or inadequate capacity or whether new mains are required to provide additional capacity;
- providing easy access to the main for repairs and maintenance;
- whether system security, disinfectant residual maintenance and mains cleaning meet operational requirements;
- the location of valves for shut off areas and zone boundaries. Note the ‘50 property’ constraint in clause 7.10.1 – Sluice valves, for shutting off sections of the network;
- provision for scour and air valves;
- required clearances to other utilities. Refer to clause 9.5.3 – Typical services layout and clearances (Utilities);
- topographical and environmental considerations;
- avoidance of dead ends;
- providing dual or alternate feeds to minimise customer disruptions.

Generally, the connection of reticulation to trunk mains is not permitted, as these mains may be shut down for servicing over extended periods, disrupting supply to reticulation where alternate feeds have not been provided.

Identify obstructions along the pipeline route and specify clearances. Specify clearances from other utility services, such as electricity, telecommunication cables, gas mains, stormwater drains and sewers. Where bending pipes, comply with the requirements of clause 7.9.7 – Working around structures.

7.8.2 Duplicate mains

Provide duplicate mains to provide adequate fire protection in these situations:

Table 4 Duplicate mains

Situation	Duplicate main
Roads with split elevation	Required
Parallel to large distribution/trunk mains that are not available for service connections	Required
Industrial/commercial areas	May be required
Arterial and dual carriageway streets	May be required

7.8.3 Reticulation in legal road

Evaluate and incorporate the following design considerations when locating reticulation in legal roads:

- Situate the pipeline in the least costly location, such as on the side of the legal road that serves the most properties;
- Wherever roads are cut into the hillside, situate pipes on the cut or high side, to make best use of road drainage and limit the risk of consequential damage;
- Excavate for the pipeline in undisturbed ground;
- Consider the balance between initial capital cost versus ongoing operational and maintenance costs, for factors such as access and soil type;
- Consider special cover requirements when renewing or laying new pipes in streets with a high crown and dish channels (refer to clause 7.9.5 – Cover over pipes);
- Allow for known future utility services and road widening.

Lay principal mains on one side of all residential streets to within 65m of the end of the cul-de-sac. In commercial and industrial streets, lay principal mains to within 20m of the end of the cul-de-sac. Measure the distance to the terminal hydrant from the road boundary at the end of the cul-de-sac. If the cul-de-sac is short enough to provide adequate fire protection from the intersecting road, locate the fire hydrant at the intersection.

The preferred location for principal mains is in the berm at least 1.5 m clear, of the kerb, footpath or private property boundary. Lay principal mains in new subdivisions only after the kerb and channel has been laid, unless the Council has given prior approval. Principal mains must not be less than 100mm diameter and must be fitted with fire hydrants in accordance with the *Fire Service Code of Practice*, with minimum hydrant spacing of 135 metres.

The preferred position of surface boxes, e.g. sluice valves and fire hydrants, is in line with either side of property entranceways, to avoid interference with parked vehicles. Locate surface boxes clear of feature paving such as cobblestones, and within roundabout islands where possible.

7.8.4 Watermains in easements

The preferred solution for water reticulation is to avoid easements over private property. This is generally only used as a temporary solution to landlocked developments, pending the future provision of a permanent supply within a legal road.

Typical situations where the Council may approve mains in easements include those where there is the need for a link main to provide continuity of supply or to maximise water quality, or where fire protection is required for multiple properties within a private right-of-way. Easements may be located over private property, public reserves, crown reserves, other government-owned land, private roads or accessways in both conventional and community title subdivisions.

Equation 2 Easement width

$$\begin{array}{l} \text{The easement width is the greater of:} \\ \quad \triangleright\ 2 \times (\text{depth to invert}) + OD \\ \quad \triangleright\ 3.0\,m \\ \text{where } OD = \text{outside diameter of pipe laid in easement} \end{array}$$

The easement registration must provide the Council with rights of occupation and access and ensure suitable conditions for watermain operation and maintenance.

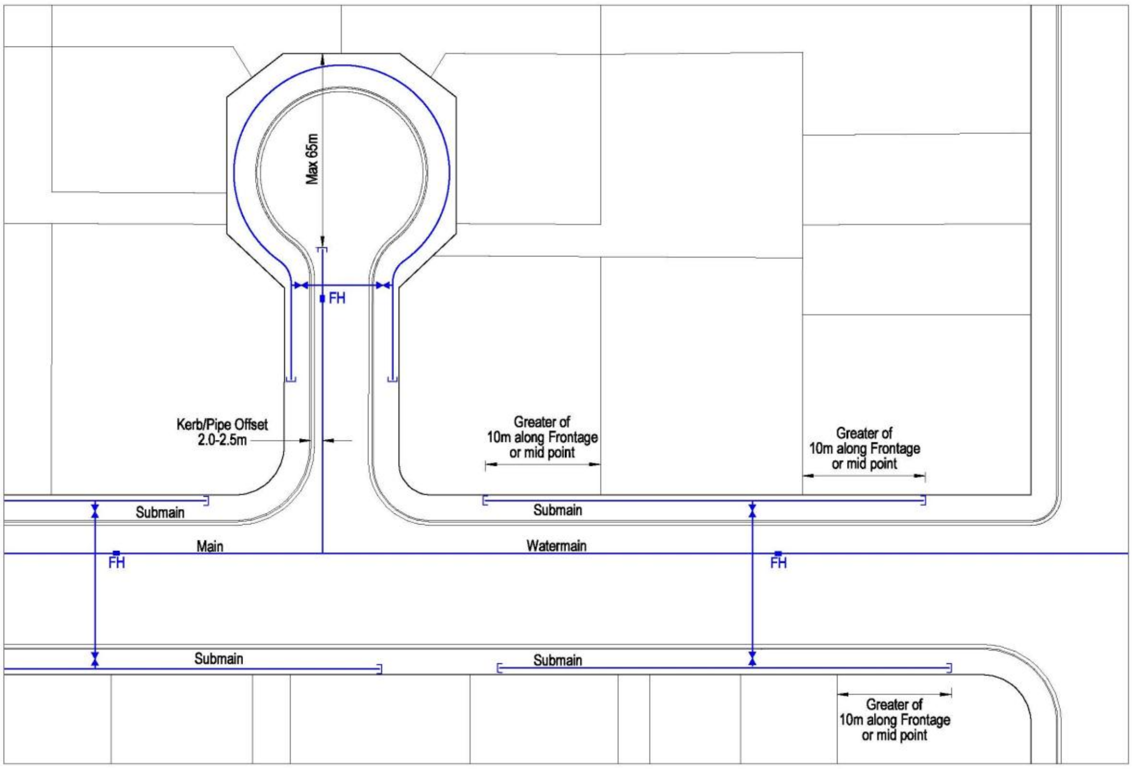
Construct principal mains, which are in any easements excluding over private rights of way, of steel, ductile iron, PE 80B or PE 100. Install valves in order to isolate that section of pipe.

7.8.5 Submains

In industrial areas and/or business zones all submains must be 50mm diameter. In residential areas and/or living zones, obtain submain sizes from the design charts shown in Appendix II – Submain Design Charts or by specific design.

Install submains approximately 150mm from boundaries to serve all allotments. In category V roads (as defined in Table 2 – Lighting categories, Table 3 – Lighting Category Selection (Lighting)), amend the submain's design location to allow for the location of the lighting poles on the road boundary.

Figure 2 Submain layout



Serve submains from crossovers, which are usually located at fire hydrants. The preferred method of connection is into a tapped hydrant riser or into the main at a hydrant tee. All crossovers must be 50mm diameter, regardless of the submain size. Locate 50mm diameter valves next to the submain on the crossover. Wherever a crossover serves both directions and more than ten properties each way, locate valves on the submain on either side of the crossover.

The preferred submain layout on straight roads is to locate crossovers at every second hydrant, with submains laid in an H-pattern. The ends extend back adjacent to the intermediate hydrant but do not connect, that is submains will be single-end fed.

7.8.6 Termination points and hydrants at the end of mains

Avoid termination points or dead ends, in order to prevent poor water quality. Consider alternative configurations such as a continuous network, link mains and use of submains to serve properties off the end of mains.

A hydrant must be placed within 1.5m of the end of all permanent and temporary sections of dead end mains greater than or equal to 100mm diameter. Apart from the fire fighting function, this also allows the section of dead end main to be flushed regularly to ensure acceptable ongoing water quality. This is particularly important in new subdivisions, where only a small number of properties may be connected initially.

7.8.7 Temporary ends of watermains

Lay watermains to within 1.0m of a subdivision boundary, where it is intended that the road will extend into other land at some future time.

In new development areas, construct mains to terminate approximately 2.0m beyond finished road works, with a hydrant within 1.5m of the temporary end, as detailed in clause 7.8.6 - Termination points and hydrants at the end of mains. The hydrant must be suitably anchored, to ensure that future works do not cause disruption to finished installations.

7.8.8 Connecting new mains to existing mains

When specifying the connection details, consider the:

- pipe materials, especially capacity for galvanic and other corrosion;
- relative depth of mains;
- standard fittings;
- pipe restraint and anchorage;
- limitations on shutting down major mains to enable connections;
- existing cathodic protection systems.

Anchor valves unless they are secured by restrained joint pipes.

Where connecting to mains that are deeper than the standard cover, obtain the correct cover on the proposed reticulation main by utilising joint deflection of the reticulation pipes downstream of the valve that is attached to the branch connection.

Design connections from the end of an existing main to address any differing requirements for the pipes being connected, particularly restraint, spigot/socket joint limitations and corrosion protection. Use standard fittings and pipework to connect to non-metallic mains. Confirm all sluice valves near the connection are restrained.

Any alterations or connections to the existing reticulation system must be done at the developer's expense.

7.8.9 Temporary works

The Council may, at its discretion, approve a delay in providing the total infrastructure requirements for large developments that will be developed over a period of several years. Such approval is conditional on the provision of a temporary infrastructure of sufficient capacity for the immediate development and a bond to ensure construction of the remaining infrastructure when necessary.

7.9 RETICULATION DETAILING

7.9.1 Proposed method of installation

There are a number of methods of installing underground services. These include open trenching, directional drilling, pipe bursting or slip lining. Factors that may influence the selection of installation method include the ground conditions, disruption to traffic, need to work around trees, topographical and environmental aspects, site safety and the availability of ducts or redundant services, e.g. old gas mains or their offsets.

Wherever the intention is to lay a number of utilities with a submain in a common trench, pay particular attention to obtaining the required minimum cover and clearances for each utility in the trench cross-section. Mains must always be laid in a separate trench. These clearances are summarised in clause 9.5.3 – Typical services layout and clearances (Utilities).

Where specified in the Engineering Conditions of Approval appropriate measures shall be undertaken.

7.9.2 Sloping terrain

Give special consideration to the design and installation of pipelines in any land prone to slips or instability or with a gradient steeper than 1:10. Use the flow chart in Appendix IV – Watermains – Pipe Laying on Sloping Terrain as a guide in these situations. Refer to clause 6.12.3 - Scour (Wastewater Drainage) for lime stabilisation specifications.

7.9.3 Backfill and bedding

Specify backfill materials for the specific installation location. The material used must be capable of achieving the backfill compaction requirements set out in *CSS: Part 1* clause 23.0 - Backfilling. Use the flow chart in Appendix IV – Watermains – Pipe Laying on Sloping Terrain to determine the Council’s recommendation.

Bedding materials should comply with *CSS: Part 4* and the pipe manufacturer’s specifications. Highlight in the Design Report wherever there is a conflict in bedding specifications between the requirements of the *CSS* and the pipe manufacturer and state what was specified for the design.

7.9.4 Detector tape – add to clause

An approved 'detectable' warning tape shall be installed 200mm above all water main pipe, whether installed by open cut or trenchless technology. The tape shall include a stainless steel wire for use with a metal detector.

7.9.5 Trenchless technology

Trenchless technology can be used for alignments passing through:

- environmentally sensitive areas.
- built-up or congested areas.
- areas not suitable for trenching (e.g. railway and main road crossings).
- difficult hill crossings.
- private land.

Excavation by methods such as directional-boring, thrust-boring, micro-tunnelling and pipe-jacking may be used in order to lessen the impact of the works on pavements and trees.

Submit the following, with the Design Report:

- how the required clearances from other services and obstructions will be achieved;
- the location of access pits and exit points;
- the depth at which the pipeline is to be laid and the tolerance on this, to ensure minimum cover is maintained;
- how pipe support and ground compaction will be addressed;
- details of pipe materials and jointing.

The Council may also request process details.

7.9.6 Cover over pipes

Watermains 100mm diameter and above must have not less than 0.75m cover at all times. The maximum cover must not exceed 1.5m.

Special design considerations apply to the installation of pipes in streets with high crown and/or dish channels. These roads are likely to get reconstructed in future years, which usually results in a lower crown, hence pipes must be installed at greater depths so that the 750mm cover is maintained after road reconstruction. To estimate future road levels, take spot levels along the property boundaries, which will most likely be the future crown level. Deduct 125mm from that level to get the future kerb level. Install water mains with 750mm cover over those future levels.

Watermains smaller than 100mm diameter must have minimum pipe covers complying with Table 6. The maximum cover must not exceed 0.75m.

Table 5 Minimum cover for watermains

Material and location	Cover (mm)
Metal pipes in carriageways or where likely to be crossed by vehicles	500
Metal pipes elsewhere	300
Plastic or other than metal pipes in carriageways or where likely to be crossed by vehicles	750
Plastic or other than metal pipes elsewhere	600

7.9.7 Clearances to other services or obstructions

Become familiar with the required clearances from existing and proposed overhead and underground utilities. Identify all underground and surface obstructions, or utility assets that may be hazardous, on the engineering drawings. Refer to clause 9.5.3 – Typical services layout and clearances (Utilities) for clearances for utility services.
When using a trenchless technology installation method, apply the clearances required for watermains laid in an open trench.

New parallel water reticulation services must cross as close as practicable to 45°.

7.9.8 Working around structures

Watermains that are located close to structures, such as foundations for walls and buildings, must be clear of the “zone of influence” of the structure’s foundations, to ensure that the stability of the structure is maintained and that excessive loads are not imposed on the watermain. Refer to the table below for guidance on minimum clearances from structures.

Table 6 Minimum clearance from structures

Pipe Diameter (mm)	Clearance to Wall or Building (mm)
<100	300
100-150	1000
200-300	1500
375	2000

Watermains that are constructed from metallic materials must not be located within 30m, measured horizontally, of overhead electricity transmission towers having a voltage 66kV or higher, especially if cathodic protection will be provided. Galvanic anodes for cathodic protection should be located away from the transmission lines or approximately midway between the transmission towers.

Deviate a mains pipeline around an obstruction by deflection at the pipe joints and with bends. If plastic pipes are used, the pipes may be bent, within the limits set by the manufacturer and the *CSS*. The deflection angle permitted at a flexible joint must comply with the manufacturer's recommendation. Provide a detailed design, showing the route of the watermain around the obstructions.

7.9.9 Crossings

Wherever watermains cross under roads, railway lines, waterways, drainage reserves or underground services, make the crossing, as far as practicable, at right angles. Design and locate the main to minimise maintenance and crossing restoration work. Make all crossings of natural waterways below the invert level of the waterway.

Wherever pipelines are located under major infrastructure assets, carriageways, intersections or waterways, determine whether the pipeline may require mechanical protection, or if different pipeline materials are needed for the crossing.

7.9.10 Above-ground watermains

Include the design of pipeline supports and loading protection with the design of above-ground watermains. Address any exposure conditions such as corrosion protection, UV protection and temperature re-rating. Provide details of mechanical protection to prevent vandalism and rockfall.

7.10 RETICULATION FITTINGS

7.10.1 Sluice valves

Sluice valves are required next to the branch of any tee. Other valves must also be provided to ensure that turning off a maximum of five valves can isolate the network in any area. The maximum five-valve shut off must not isolate more than 40 properties.

Locate sluice valves at street intersections and also along the line of the main as required. Consider the following when deciding on the location of sluice valves:

- the operational needs of the system so that continuity of supply is maximised;
- operation and maintenance requirements;
- the safety of maintenance personnel.

Keep the number of valves to a minimum, without compromising the ability to easily identify and isolate a section of the network.

Attach sluice valves to flanged fittings at junctions rather than plain-ended fittings.

Sluice valves shall be anticlockwise closing resilient seated.

The force required to open or shut a manually operated valve, using a standard valve key, with pressure on one side of the valve only, must not exceed 15kg on the extremity of the key. Specify geared operation, motorised valves or a valve bypass arrangement, to reduce pressure across the valve, if the allowable force cannot be met.

7.10.2 Backflow

Design and equip drinking water supply systems to prevent back siphonage. Locate air valves and scours to avoid water entering the system during operation. Backflow prevention devices must meet the requirements of AS/NZS 2845.1.
High Risk properties shall have testable RPZ type backflow prevention devices installed at the point of supply. These devices to be installed with frost proof protection in compliance with AS/NZS 3500.1 at the point of supply, likely to be the property boundary. High Risk is to be interpreted as those properties with activities that have the potential to cause death.

This work will be undertaken by the Council on behalf of, and at the cost of, the owner of the property to which backflow prevention device is installed.

The Council will undertake annual backflow testing on point of supply backflow prevention devices on behalf of, and at the cost of, the owner of the property to which the backflow prevention device is installed and keep appropriate records.

7.10.3 Scour valves

Scours are required on mains of 300mm diameter and larger. Generally, valves must be 150mm diameter in size. Scours are required on mains less than 300mm diameter where there are no fire hydrants. Install scour valves at the lowest point between isolating valves, and discharge to an approved outfall.

7.10.4 Air valves

Air can accumulate at high points when it is drawn into the system at reservoirs and pumps. Mains should be laid evenly to grade between peaks to ensure all possible locations of potential air pockets are known. Investigate the need for air valves at all high points, particularly those more than 2.0m higher than the lower end of the section of watermain, or if the main has a steep downward slope on the downstream side.

Air may also come out of solution in the water due to a reduction in pressure, such as when water in a main flows uphill or at pressure reducing valves. Air valves may be required to allow continuous air removal at these locations.

The number and location of air valves required is governed by the configuration of the distribution network, in terms of both the change in elevation and the slope of the watermains. Install air valves in a secure enclosure above the ground, with an isolating valve to permit servicing or replacement without needing to shut down the main.

Air valves are not normally required on reticulation mains in residential areas, as the service connections usually eliminate air during operation. Where the need is primarily for admission and exhaust of air during dewatering and filling operations, a high-point hydrant usually adequately serves reticulation networks.

On hillsides, locate a fire hydrant adjacent to and downhill from any sluice valve where the main descends from that location to release air.

300mm and 375mm diameter reticulation mains, with only a few service connections, may require dual-acting air valves, to automatically remove accumulated air that may otherwise cause operational problems in the water system.

Dual-acting air valves, incorporating an air valve (large orifice) and an air release valve (small orifice) in a single unit, are generally preferred for distribution and trunk mains, and where required on reticulation mains. The nominal diameter of the large orifice of air valves must be 50mm, for installation on mains less than or equal to 300mm diameter.

7.10.5 Additional hydrants and scour valves for maintenance activities

Hydrants, additional to those required by the *Fire Service Code of Practice*, may be needed to facilitate maintenance activities, such as flushing the watermains. Ensure that there are approved and adequate drainage facilities to cope with the contents of the watermain from dewatering and flushing operations.

Where automatic dual-acting air valves are not installed at high points on the watermains, install a hydrant to release air during charging, to allow air to enter the main when dewatering and for manual release of any build up of air as required. Install a fire hydrant at the top section of a hillside main, to act as an air intake and prevent the creation of a vacuum.

Provide hydrants at low points on watermains, to drain the pipeline when scours are not installed. As a general rule, place a hydrant or scour at the lowest point of elevation where the volume of water unable to be drained exceeds $15m^3$. This normally applies to mains greater than or equal to 200mm diameter.

7.10.6 Pressure reducing valves and check valves

Pressure reducing valves are preferred over break pressure tanks, and must be sized for minimum and maximum demand. The pressure reducing valves must have V-porting and relief valves, capable of taking full flow to an approved outfall, which is visible to the public.

Consider and allow for increased pressures as a result of pressure reducing valve failure.

Pressure reducing valves that are 50mm diameter and larger must have bypass pipe work and shutoff valve arrangements. This allows the valve to be isolated for maintenance or to reverse the flow if necessary.

7.10.7 Thrust blocks on mains

Design thrust blocks for all fittings and valves, to withstand the greater of:

- maximum operating pressure and test pressure, including transient and pump shut off head;
- adjacent pipeline class rating;
- a minimum pressure of 1200kPa.
- The precast thrust block detailed in *CSS: Part 4*, SD 406 may be used if all of the following criteria are met:
- the fitting or valve is up to and including 200mm diameter;
- the maximum operating pressure is up to and including 700 kPa;
- the trench ground conditions can sustain an ultimate bearing capacity greater than 450 kPa, as established by testing;

- the thrust block will not experience up-thrust.

The thrust block must have a minimum surface area of $0.18m^2$ in contact with an undisturbed trench wall.

If the above criteria are not all complied with, design and detail thrust blocks individually for the site bearing capacity. Consider the buoyancy effect of any alteration in the watertable.

Confirm the bearing capacity of the in-situ soil and the installed thrust block design and record in the Contract Quality Plan prior to installation.

Also detail anchorage for in-line valves on pipelines that are not capable of resisting end bearing loads.

7.10.8 Restrained joint watermains

Restrained joint watermain systems can be used in place of thrust and anchor blocks to prevent the separation of elastomeric seal-jointed pipelines.

Restrained joint systems include welded steel joints, flanged pipes and fittings and commercial mechanical restrained joint systems. Polyethylene pipe fabricated joints are not acceptable. Specify details of commercial restrained joint systems in the Design Report, including the:

- length of restrained pipeline and adjacent fittings required to ensure the transfer of thrust forces to the ground strata;
- requirement for placing suitably worded marking tape in the trench over the pipeline to define the limits of the restrained joint system;
- requirement for details of the commercial restrained jointing systems to be shown on the as-built records, including the location of restrained portions of pipelines.

7.10.9 Provision for sterilisation

The fittings and reticulation layout must provide for chlorination. At the point of connection, provide a 20mm diameter tapping band for chlorination. The connection to the existing main must be capable of 500 litres/minute capacity from the reticulation. Provide an outlet (normally 50mm diameter, or a fire hydrant) to flush the chlorinated water out of the reticulation, at the end of each section of main and specify the outfall in the Design Report.

7.10.10 Connections and meters

For design purposes, assume a 15mm diameter connection and meter, unless Council consent has been granted for other sizes.

Individual connections (including air gap separators required for the development) will not be installed until applied for by the consumer. Any connections (including meters) will become the property of, and be maintained by, the Council, whether or not they are in private property and regardless of the ownership of the supply pipe.

Where required under Council Policy water meters shall be installed to Council specifications. Meters shall be Kent MS-M meters or approved later versions and meter numbers shall be provided. Where water meters are not reading zero after installation provide the initial water meter reading at time of project completion or application for a S224 certificate.

7.10.11 Flowmeters

Flowmeters are to be supplied and installed when requested for the recording of water velocity and flow at suitable locations in the water network. The flowmeter requirements shall be specified by SDC at the time of development.

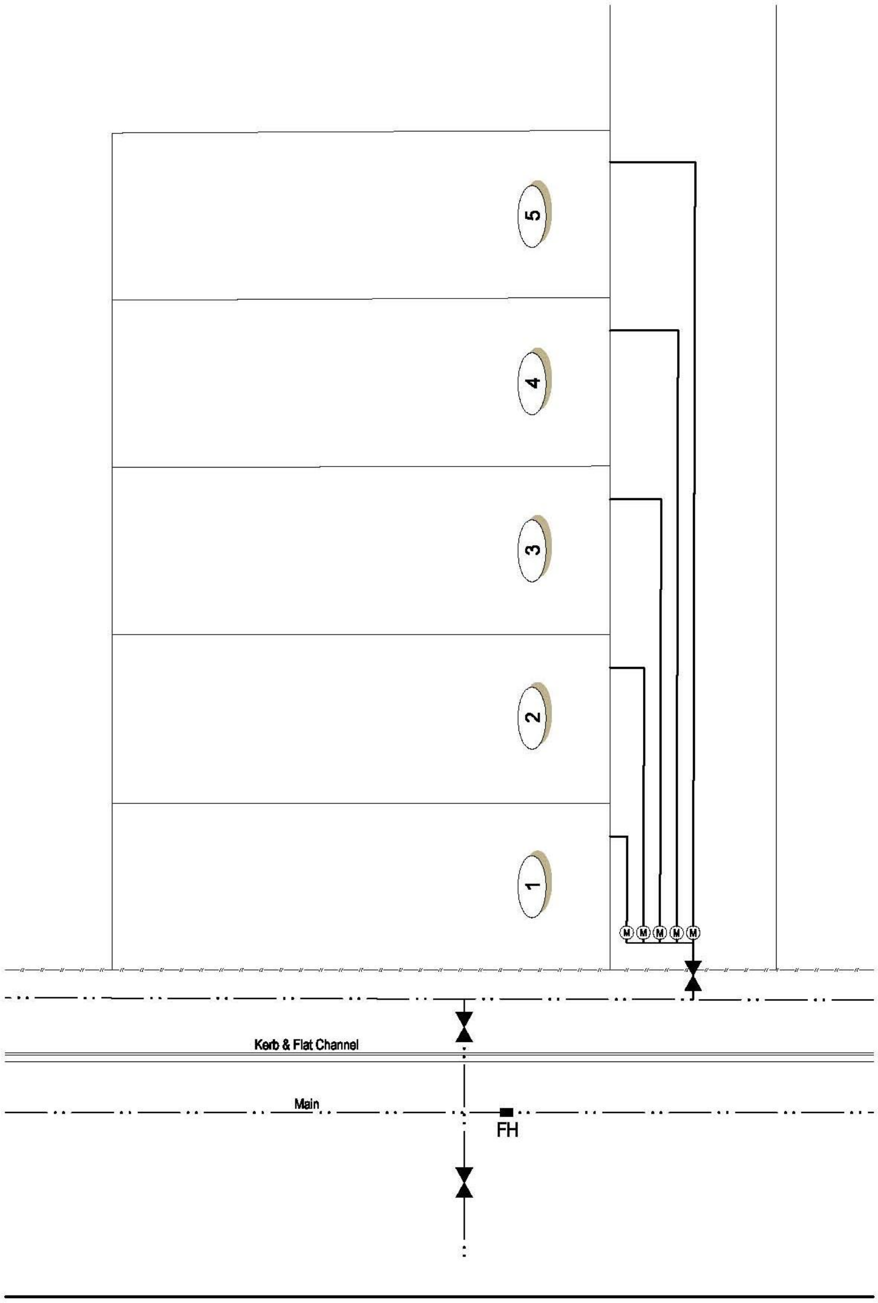
7.11 RETICULATION ON PRIVATE PROPERTY

Supply pipes in private property and mutually owned right-of-ways are considered to be privately owned and must be protected by easements in favour of the dominant tenants.

Fee simple, cross lease, unit title or multi-storey developments must have multiple meters. A single connection for high rise buildings will be only given at Council's discretion.

Locate all the meters at the legal road boundary. For one to four dwellings with access from the right of way, locate the meters in the footpath. For five or more dwellings, locate the meters within the property, immediately (less than 1.0m) behind the legal road boundary and in the common property as shown in Figure 3.

Figure 3 Multiple meters at boundary



7.12 MATERIALS

The Council has adopted specifications for most material components of the reticulation system. These specifications apply equally to Council contracts and to infrastructure installed as a condition of subdivision and development. They are available on the Christchurch City Council web page at: *www.ccc.govt.nz/webapps/approvedmaterials/frmAPRSearch.asp*.

Each specification refers to relevant standards and any other requirements that must be met. In some cases, materials may have an interim approval date, as the Council phases out materials that do not conform to the latest requirements.

7.12.1 Material selection

Select watermain materials in accordance with the pipe selection chart in Appendix III – Water Distribution Mains – Materials Selection Flow Chart and the material specifications on the Council website: http://www.ccc.govt.nz/webapps/approvedmaterials/frmAPRSearch.asp. Interpretation of this flow chart shall be at the discretion of the Council.

The following pipe materials currently available in New Zealand are acceptable for distribution mains:

- ductile iron.
- PVC-U and PVC-O.
- PE 100 and PE 80B.

These pipes, with internal diameters of 100, 150, 200 and 300mm, are readily available and are the sizes commonly used in Christchurch City and Selwyn District. Acceptable outside diameters (OD) for polyethylene are 125, 180, 250 and 355mm.

Each material has specific design and installation issues, as identified in the manufacturers' design manuals, specifications and other literature. Consider these issues, as tabulated below, when specifying materials.

Table 7 Material design issues

Mains Pipeline Material	Issues to be Considered
Ductile iron	▪ Internal lining and external coatings must be undamaged or fully restored after repairs or fabrication work. ▪ Potential problems with stray electric currents and bimetallic corrosion.
Polyvinyl Chloride and variants PVC and PVC-O	▪ Tests pressure not to exceed 1.25 times the rated pressure of the lowest rated component but to be at least 1.25 times the maximum operating pressure. ▪ UV degradation. ▪ Scratching, gouging and impact damage. ▪ Proper bedding and installation required. ▪ Permeation by contaminants possible.
PE 80B, PE 100	▪ Very susceptible to some organic contaminants. ▪ Sophisticated equipment and highly skilled workers required. ▪ UV degradation (Blue pipe). ▪ Bedding support to prevent excessive deformation. ▪ Pulling forces for PE are not to exceed the manufacturer's recommendations. ▪ Minimum radii.

All plastic pipes used in the Selwyn district public supply must have a nominal pressure rating (PN) of not less than 12 bar or PN12 (1200 kPa). PVC-M pipe will not be accepted.

Submains must be made from polyethylene pipe of resin type PE 100 or PE 80B, with a minimum pressure rating of PN12. Contaminated sites will require careful material selection. Refer to clause 7.4.4 – Contaminated sites.

7.12.2 Material specifications

The Council has an asset service life requirement of 50 years. Pipes and fittings must have a minimum required design life of 50 years and a minimum warranty period of 50 years. All products must be fit for their respective purpose and comply in all respects with the Council's current specification for the supply of that material and the standards referenced.

Manufacturers of any pipes and fittings intended for use in the Selwyn district distribution system must have a certified quality management system in place that complies with AS/NZS ISO 9001. This system must apply to all aspects of the manufacturing processes, including product handling, administration and stock control.

The Council requires the right to verify that any and all contracted and subcontracted products conform to the specified requirements (clause 7.5.2 of AS/NZS ISO 9001). Full product identification and traceability is required (clause 7.5.3 of AS/NZS ISO 9001). Protection of the quality of the pipe and fittings includes transportation and off-loading at the delivery point (clause 7.5.5 of AS/NZS ISO 9001). Full quality records (as per the manufacturer's Quality Assurance manual) must be available on request for evaluation by the Council and be kept for a minimum period of 10 years.

Both the developer and the contractor are responsible for ensuring the appropriate handling, storage, transportation and installation of pipes and fittings to avoid damage and to preserve their dimensions and physical properties. The total exposed storage period from the date of manufacture to the date of installation for all PVC pipe must not exceed 12 months. Store fittings under cover at all times.

The Council reserves the right to require full details of the manufacturer's means for demonstrating compliance. Irrespective of the means of demonstrating compliance and the supplier's and manufacturer's quality assurance systems, responsibility remains with the developer to ensure the installation of products that conform with the requirements of the COP and the appropriate standards. The Council may arrange for independent testing to be carried out on randomly selected samples or assembled joints.

Positive verification inspections or testing results obtained by the Council shall not limit the supplier's responsibility to provide an acceptable product, nor shall it preclude subsequent claims made under warranty due to manufacturing defects, faulty design, formulation or processing.

7.13 AUTHORISED INSTALLERS

All works which involve connection to or operation of Council's water reticulation network shall be undertaken under the supervision of Council's nominated contractor.

Where water is needed to be temporarily shut off to enable the connection of a subdivision water reticulation to Council reticulation, Council's contractor must be given 48 hours notice to attend. Council's contractor must be in attendance for every water outage with their costs to be covered by the developer or project. Attendance both at the start of the outage and also for the reconnection of the Council supply is to be covered. Council reserves the right to recover 100% of costs related to Council's nominated contractor supervision.

7.14 CONNECTION AND STERILISATION

Design a chlorination point in the reticulation.

Construction of the water supply system must not start until approval in writing has been given by the Council.

Wherever works are installed within existing legal roads, send a road Corridor Access Request (CAR) for that work. The works must comply with requirements as set out in *CSS: Part 1* for this type of work.

7.14.1 Connecting into existing system

New pipe work must not be connected to the Council reticulation until after the mains have been sterilised and passed a pressure and bacteriological test. The pressure test must be carried out as specified in *CSS: Part 4* clause 17.0 – Performance Testing, in the presence of the Council. Details of the bacteriological test requirements are set out in the *Authorised Water Supply Installer Specification*. Bacteriological testing takes 24 hours.

7.14.2 Sterilisation

Sterilisation of the new reticulation or infrastructure and testing of the water to confirm compliance with the *Drinking Water Standards* shall be completed prior to commissioning. Further details are set out in *CSS: Part 4* and the *Authorised Water Supply Installer Specification*.

Where new water reticulation is to be commissioned and adopted by Council, chlorination shall be undertaken to achieve a minimum of 30ppm chlorine dose and left to stand for at least 24 hours, before being fully flushed.

A record sheet shall be completed, detailing the chlorine dose used, the FAC (free available chlorine) at the start of the 24 hour period and prior to flushing.

7.15 AS-BUILT INFORMATION

Present as-built information which complies with Part 12: As-Builts and this Part.

APPENDIX I. SUBMAIN DESIGN CHARTS

The following tables show the minimum submain sizes (OD) required to restrict head losses to the following:

Table 8 Maximum head losses in different pressure areas

Pressure Area	Loss (kPa)
Low Pressure (less than 450 kPa)	50
Medium Pressure (463 – 600 kPa)	100
High Pressure (greater than 600 kPa)	250

- A 20 kPa allowance for minor and metering losses, assuming 15mm diameter connections, is included.
- A maximum flow rate of 0.42 litres/second per connection is assumed, with a diversity factor applied for more than six properties on a submain.
- The charts apply to Polyethylene PE 80B pipe to AS/NZS 4130. Other materials will require calculations to support sizings.

LOW PRESSURE AREAS (less than 450 kPa)

Table 9 Submain fed from one end. Connections evenly spaced

Number of connections	Length in Metres									
	25	50	75	100	150	200	250	300	350	500
1	50	50	50	50	50	50	50	50	50	50
2	50	50	50	50	50	50	50	50	63	63
3	50	50	50	50	50	63	63	63	63	63
4		50	63	63	63	63	63	63	63	
5			63	63	63	63	63			
6			63	63	63					
8			63	63						
11			63							

Table 10 Submain fed from one end. Connections from opposite end

Number of connections	Length in Metres									
	25	50	75	100	150	200	250	300	350	500
1	50	50	50	50	50	50	50	50	50	63
2	50	50	50	50	50	50	63	63	63	63
3	50	50	50	50	50	63	63			
4		50	63	63	63					
5			63	63						
6			63							
8										
11										

Table 11 Submain fed from both ends

Number of connections	Length in Metres									
	50	100	150	200	300	400	500	600	700	800
2	50	50	50	50	50	50	50	50	50	50
4	50	50	50	50	50	50	50	50	63	63
6	50	50	50	50	50	63	63	63	63	63
8		50	63	63	63	63	63	63	63	
11			63	63	63	63	63			
14			63	63	63					
25			63	63						
27			63							

MEDIUM PRESSURE AREAS (between 463 and 600 kPa)

Table 12 Submain fed from one end. Connections evenly spaced

Number of connections	**Length in Metres**									
	25	50	75	100	150	200	250	300	350	500
2	50	50	50	50	50	50	50	50	50	50
4	50	50	50	50	50	50	50	50	50	63
6		50	50	50	50	63	63	63	63	63
8			50	50	63	63	63	63		
11			50	63	63	63				
14			63	63	63					

Table 13 Submain fed from one end. Connections from opposite end

Number of connections	**Length in Metres**									
	25	50	75	100	150	200	250	300	350	500
2	50	50	50	50	50	50	50	50	50	63
4	50	50	50	50	63	63	63	63	63	63
6	50	50	50	63	63	63				
8		50	63	63	63					
11			63	63						

Table 14 Submain fed from both ends

Number of connections	**Length in Metres**									
	50	100	150	200	300	400	500	600	700	800
4	50	50	50	50	50	50	50	50	50	50
8	50	50	50	50	50	50	50	50	50	63
14		50	50	50	50	63	63	63	63	63
25			50	50	63	63	63	63		
27			50	63	63	63				
30			63	63	63					

HIGH PRESSURE AREAS (greater than 600 kPa)

Table 15 Submain fed from one end. Connections evenly spaced

Number of connections	Length in Metres									
	25	50	75	100	150	200	250	300	350	500
2	50	50	50	50	50	50	50	50	50	50
4	50	50	50	50	50	50	50	50	50	50
6	50	50	50	50	50	50	50	50	50	50
8		50	50	50	50	50	50	50	63	63
11			50	50	50	50	63	63	63	63
15			50	50	63	63	63	63	63	63
25				63	63	63	63	63		
30				63	63					

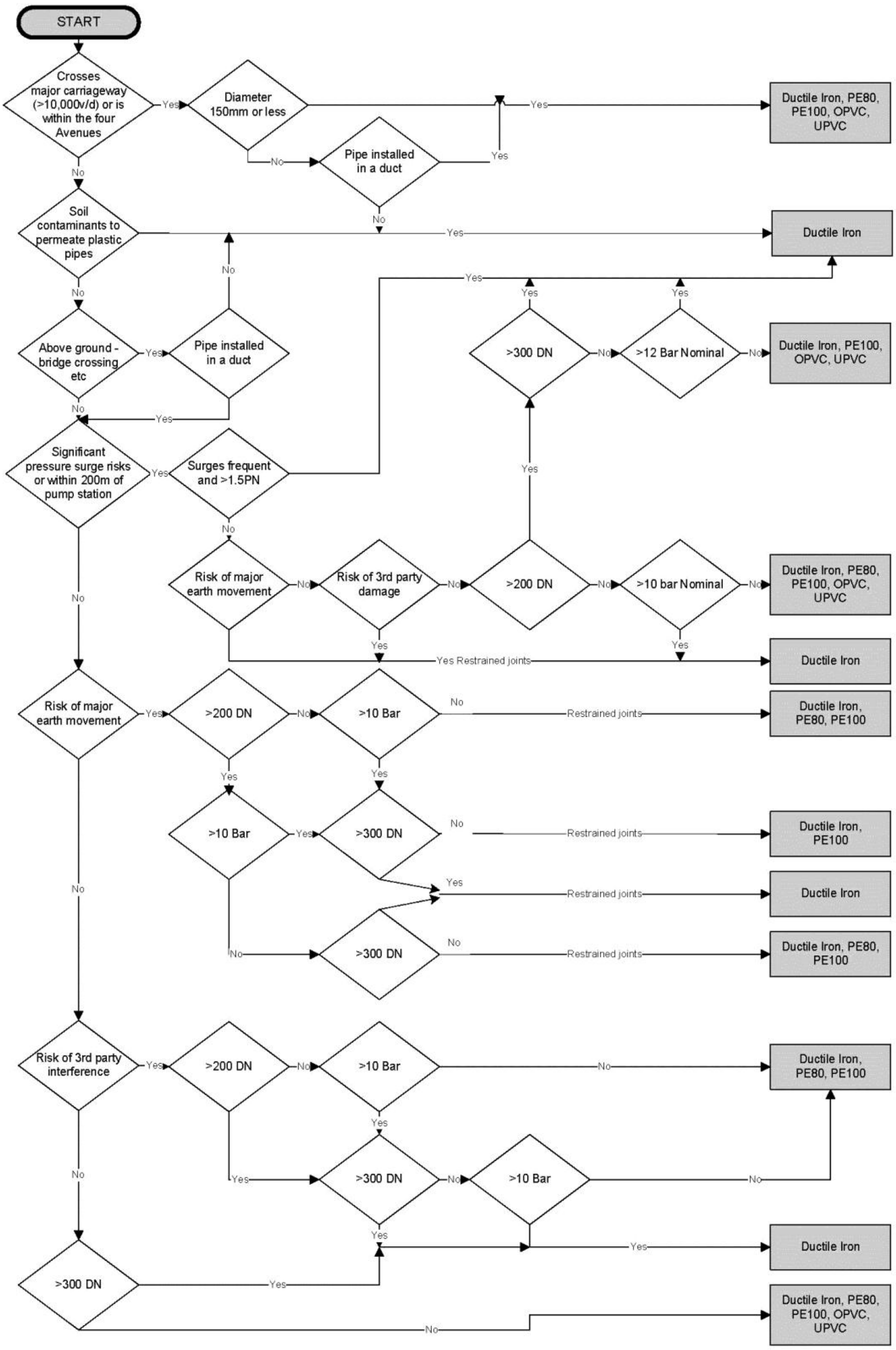
Table 16 Submain fed from one end. Connections from opposite end

Number of connections	Length in Metres									
	25	50	75	100	150	200	250	300	350	500
2	50	50	50	50	50	50	50	50	50	50
4	50	50	50	50	50	50	50	50	50	50
6	50	50	50	50	50	50	63	63	63	63
8		50	50	50	50	63	63	63	63	63
11			50	50	63	63	63	63		
15			63	63	63	63				
25				63						

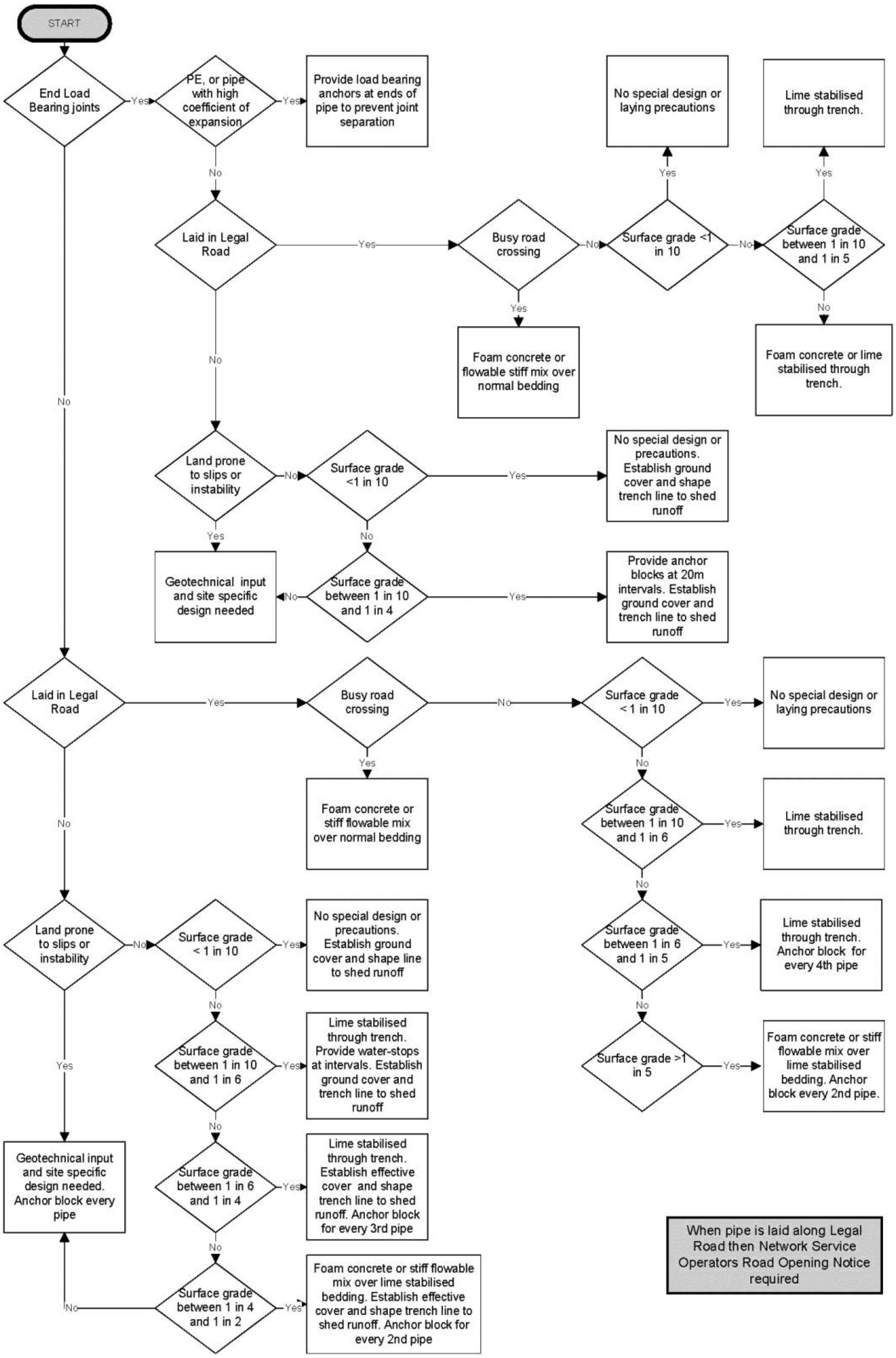
Table 17 Submain fed from both ends

Number of connections	Length in Metres									
	50	100	150	200	300	400	500	600	700	800
4	50	50	50	50	50	50	50	50	50	50
8	50	50	50	50	50	50	50	50	50	50
14	50	50	50	50	50	50	50	50	50	50
25		50	50	50	50	50	50	50	63	63
27			50	50	50	50	63	63	63	63
63			63	63	63	63	63	63		

APPENDIX II. WATER DISTRIBUTION MAINS – MATERIALS SELECTION FLOW CHART



APPENDIX III. WATERMAINS – PIPE LAYING ON SLOPING TERRAIN



APPENDIX IV. DESIGNING FOR SURGE AND FATIGUE

Introduction

All pipelines are subjected to pressure surges during their lifetimes. Some of these pipelines, e.g. rising mains, will experience significant and regular pressure surges, while others may be subjected only to minor diurnal pressure variations.

Rapid pressure fluctuations and surges generally result from events such as pump start-up and shutdown, or rapid closing or opening of valves, including “slamming” of air valves as can happen during venting of bulk air from pipelines.

For the purposes of the IDS, a pressure surge is defined as a rapid, short-term pressure variation. Surges are characterised by high-pressure rise rates, with minimal time at the peak pressure. Surge events usually consist of a number of diminishing pressure waves that cease within a few minutes.

The frequency and magnitude of the pressure transients affects the choice of pipe pressure class. Ensure that the following aspects are considered when designing for surges and fatigue:

- that the maximum and minimum pressures are within acceptable limits for the pipe and fittings for all surge events (including infrequent events such as power failure, emergency shut-down, rapid closure of fire hydrants);
- consider the potential for fatigue and select the pipe pressure class accordingly, to allow for frequent repetitive pressure variations;
- the pipe and the quality of installation and their influence on the fatigue resistance of the pipe.

The following sections provide a methodology for dealing with surge and fatigue, so that pipe lifetimes are maximised.

Pressure surge events

A surge analysis is required to check whether damaging pressure surges (or surges that could cause customer complaint) could occur in a system. The level of detail of the surge analysis should be appropriate to the pipeline, e.g. a reticulation pipeline may require only consideration of rapid closure of fire hydrants and conservative selection of pipe pressure rating.

Pipelines that may be subjected to more severe surge effects e.g. rising mains, areas close to control valves (reservoir inlet valves and pressure reducing valves) and where specified by the Council, require a more detailed level of analysis, or the selection of pipe materials that may not be subject to surge and fatigue problems.

The source(s) of significant pressure surges in a water system should be identified and included in any surge analysis. Mitigating measures may be needed to minimise any surges generated, and any surge control devices must be designed accordingly. As a minimum, such a surge analysis should consider:

- identified causative scenarios (e.g. power failure, pump trip, component failure, air valve operation);
- the highest pressure along the pipeline;
- the lowest pressure along the pipeline;

- rapid closure of valves;
- vacuum and air relief requirements along the pipeline under all conditions.

Note that non-slam air valves may be required on plastic pipelines, to minimise the risk of severe surges being generated by the movement of trapped air, and to minimise the potential for instantaneous "slamming" shut of a conventional air valve.

If, during the design phase, it is found that the minimum pressure in the mains could fall below atmospheric pressure during pressure surge events or drain down, mitigating measures must be designed to eliminate or minimise these effects. If negative pressures are a possibility, buckling of the pipe must be considered and a safety factor of at least 2.0 applied.

The maximum operating pressure for a pressure pipe network must include an allowance for pressure surge (see Figure 4). The allowance for surge to be included must be the higher of the calculated surge value or 200 kPa.

Plastic pipes are able to accommodate occasional short-term surge pressures well in excess of their nominal design pressure (PN) rating, e.g. as caused by power failure or accidental events. In such cases, the material PN may be multiplied by the surge factors given below.

Table 18 Surge factors for various pipe materials

Pipe Material	Surge Factor	Material Capacity (kPa)
PVC-U, PVC-O	1.5	1.5 x pipe PN
PE 80B, PE 100	1.25	1.25 x pipe PN

Fatigue

Consideration of the effect of fatigue is particularly relevant to plastic pipes that are subjected to a large number of stress cycles. Fatigue considerations can generally be ignored for ferrous pipe materials, e.g. ductile iron and concrete-lined steel. The important factors are the magnitude of the stress fluctuations and the frequency of these loads.

For fatigue loading situations, the maximum pressure reached in the pressure cycle must not exceed the capacity of the pipe, as defined above.

Fatigue does not need to be considered if the number of pressure cycles during the pipe's designed lifetime does not exceed the values below

Table 19 Critical number of surges in pipe lifetime

Pipe Material	Critical Number of Cycles in Lifetime
PVC-U, PVC-O	100,000
PE 80B, PE 100	300,000

The procedure for fatigue design is:

- confirm the design lifetime of pipeline (The pipeline design life must be taken as 100 years unless specified otherwise by the Council);
- estimate the likely number of pressure cycles during design life;
- calculate the range of pressure surges;
- calculate the fatigue load factor;
- determine the equivalent operating pressure;
- select the pipe PN rating.

Number of pressure cycles

Calculate the expected number of cycles during the pipe's lifetime, based on realistic estimates of the number of pressure cycles per day or per hour. If the primary pressure variation is followed by a smaller number of pressure fluctuations on each cycle, as shown in Figure 4, the calculated number of cycles should be doubled.

Table 21 shows the number of pressure cycles over 100 years for various numbers of cycles per day and hour.

Table 20 Pressure cycles in 100 years for various numbers per hour and per day

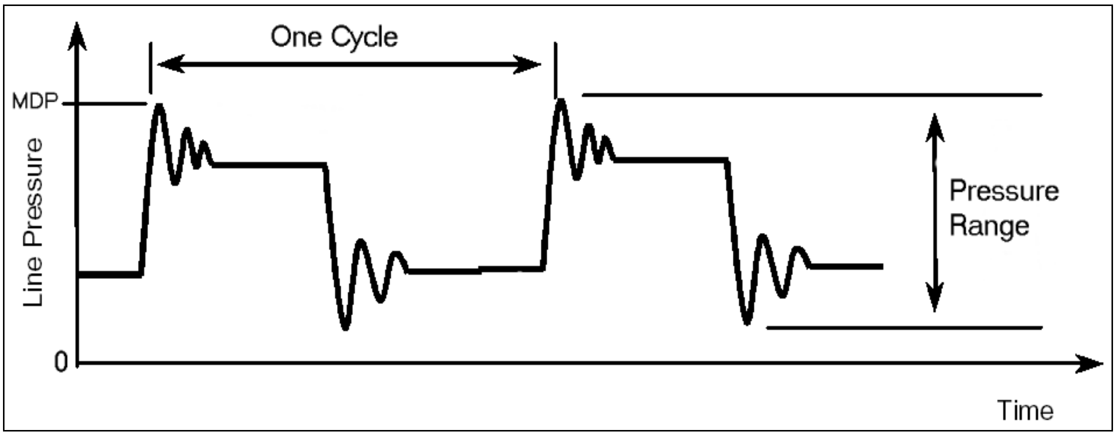
Cycles Per Hour	Cycles Per Day	Total Number of Cycles in 100 Years
0.04	1	36,000
0.5	12	440,000
1	24	880,000
10	240	8,800,000
60	1440	52,500,000
120	2880	105,000,000

Range of pressure surges

Calculate the pressure range of the regular pressure surges by surge analysis. Figure 4 shows a typical cyclic pressure pattern. Where pumps are controlled by variable frequency drives, select a pressure cycle that is representative of the anticipated worst case operating cycle, unless sound judgement indicates that a lesser pressure cycle will be representative of the pipeline operation over 100 years.

The effects of infrequent or accidental conditions, e.g. power or surge protection device failures, may be ignored provided the peak surge pressure does not exceed the values derived from Table 19.

Figure 4 Pressure cycle and pressure range

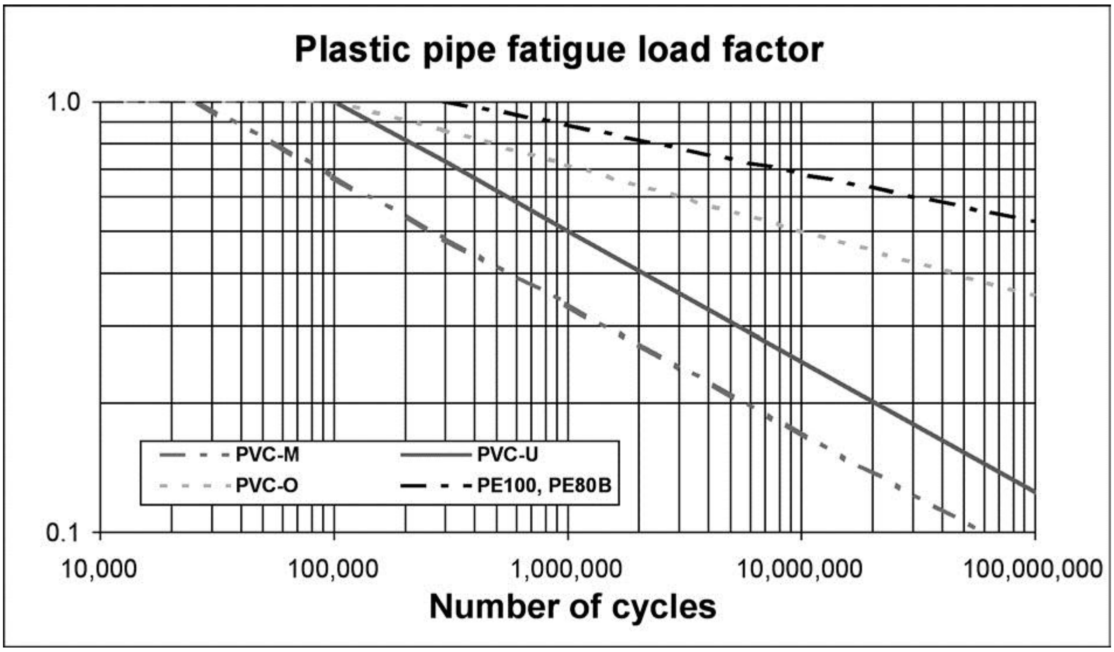


Note that the pressure range will vary along the pipeline. Economies may be possible on some pipelines by dividing the pipeline into sections and evaluating the fatigue design for each, subject to the approval of the Council.

Fatigue load factor

The fatigue load factor for the relevant plastic pipe material(s) must be determined from Figure 5. PE 80C (HDPE) is not approved for pressure pipelines in Christchurch city.

Figure 5 Determining fatigue load factor



EQUIVALENT OPERATING PRESSURE

Calculate this using the following equation:

Equation 3 Equivalent operating pressure

$$P_{eo} = \frac{\Delta P}{FLF}$$

where:

Equation 4 Equation variables

P_{eo} =	Equivalent operating pressure (bar)
ΔP =	Cyclic pressure range (bar) (refer Figure 4)
FLF =	Fatigue Load Factor (refer Figure 5)

Pipe PN rating

The specified pipe pressure rating must exceed both the equivalent operating pressure, P_{eo} and the maximum operating pressure for the system.

De-rating factors for PE fittings

It is necessary to de-rate fabricated or moulded PE sweep bends and tees that are used with PE pipes conforming to AS/NZS 4130. See *CSS: Part 4* for requirements for forming and welding. The use of de-rated fabricated fittings is only allowed in special circumstances and requires Council approval.

The two tables below show the geometry and manufacturing factors to be applied for various fitting geometries and fabrication techniques.

Table 21 Geometry factors

Fitting Description	Geometry Factor
Equal Tee	0.6
Reducing Tee (Branch dia < 0.33 x dia of main)	0.6
Reducing Tee (Branch dia > 0.33 x dia of main)	0.8
Formed sweep bends (no reduction in wall)	0.9
Segmented bends (butt welded)	0.7

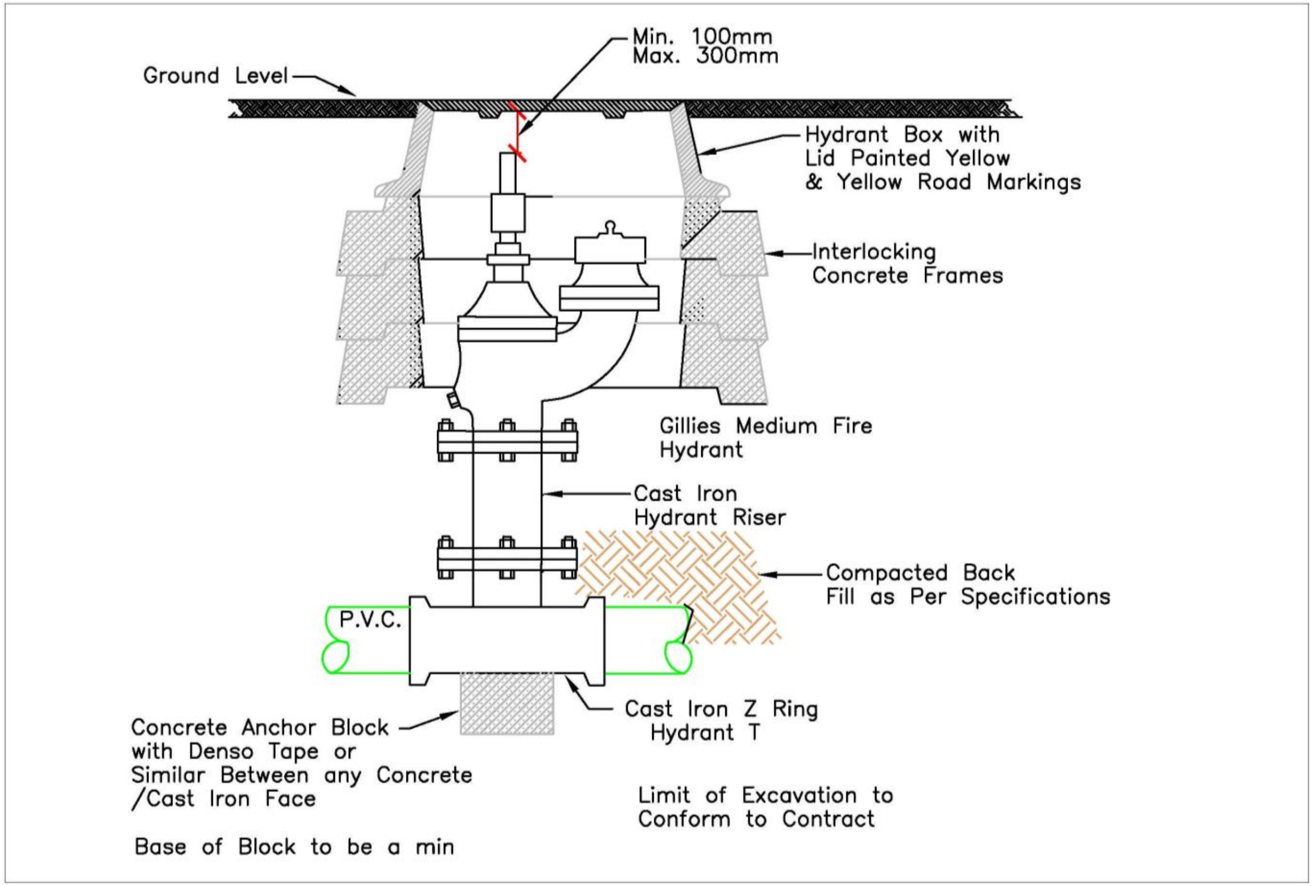
Table 22 Manufacturing factor

Welding Technique	Manufacturing Factor
Moulding	1.0
Butt welding	0.9
Socket fusion	0.8
Extrusion welding	0.6
Saddle fusion	1.0
No other welding method is acceptable.	

De-rate the nominal pressure rating of the fitting by multiplying its rating by the product of the geometry and manufacturing factors.

APPENDIX V. STANDARD DRAWINGS

WS	1.0	Standard Fire hydrant connection
WS	3.0A	GM-900 Manifold Unit Jumbo Box
WS	3.0B	GM-900 Manifold Unit Standard water meter & restricted connections
WS	10.0	Standard Fire hydrant marker post



Selwyn DISTRICT COUNCIL

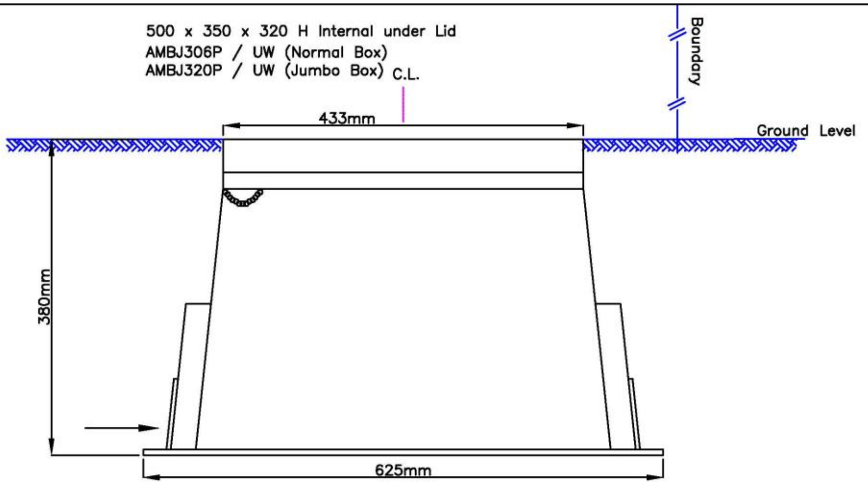
STANDARD FIRE
HYDRANT CONNECTION

STANDARD NO WS 1.0

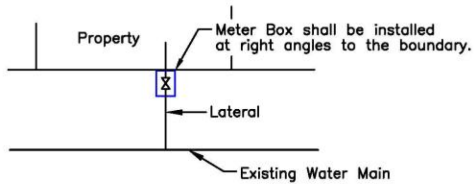
SCALE NTS Oct 2007

AST-04-02-07-10

ORIGINAL SHEET SIZE A4



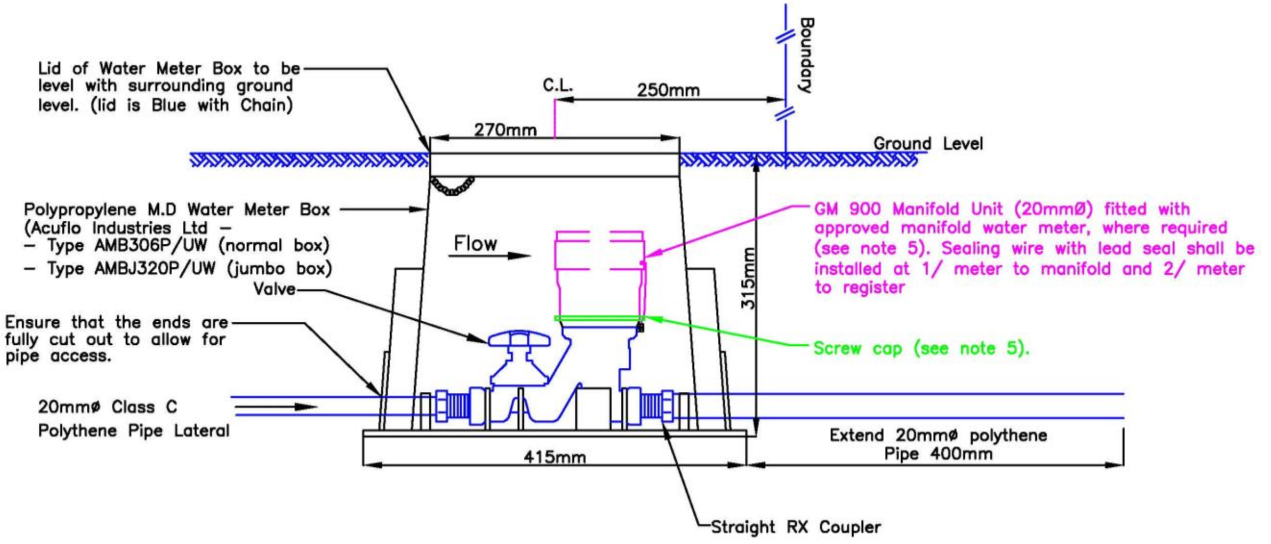
NOTES:
1/ Only fittings as detailed in this drawing or as approved by the Engineer may be used.
2/ Laterals may only be placed under entranceways if the physical entranceway is less than 2.5m wide and the lateral is in the centre (so as not to be driven on). To be approval by the Engineer.
3) No PTF tape shall be used when fitting meter to manifold
4) When restricted supply is required the maric insert for required flow shall be installed in Manifold.
5) Water Meters are not required to be fitted to laterals in Arthur's Pass, Castle Hill, Lake Coleridge, Leeston, Lincoln, Prebbleton, Rakaia Huts, Southbridge, Springston, Tai Tapu and Taumutu.



Selwyn DISTRICT COUNCIL

GM–900 Manifold Unit
Jumbo Box

STANDARD NO WS 3.0A
SCALE NTS
Feb 2003
AST–04–02–07–10
ORIGINAL SHEET SIZE A4



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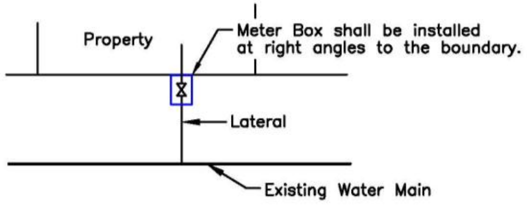
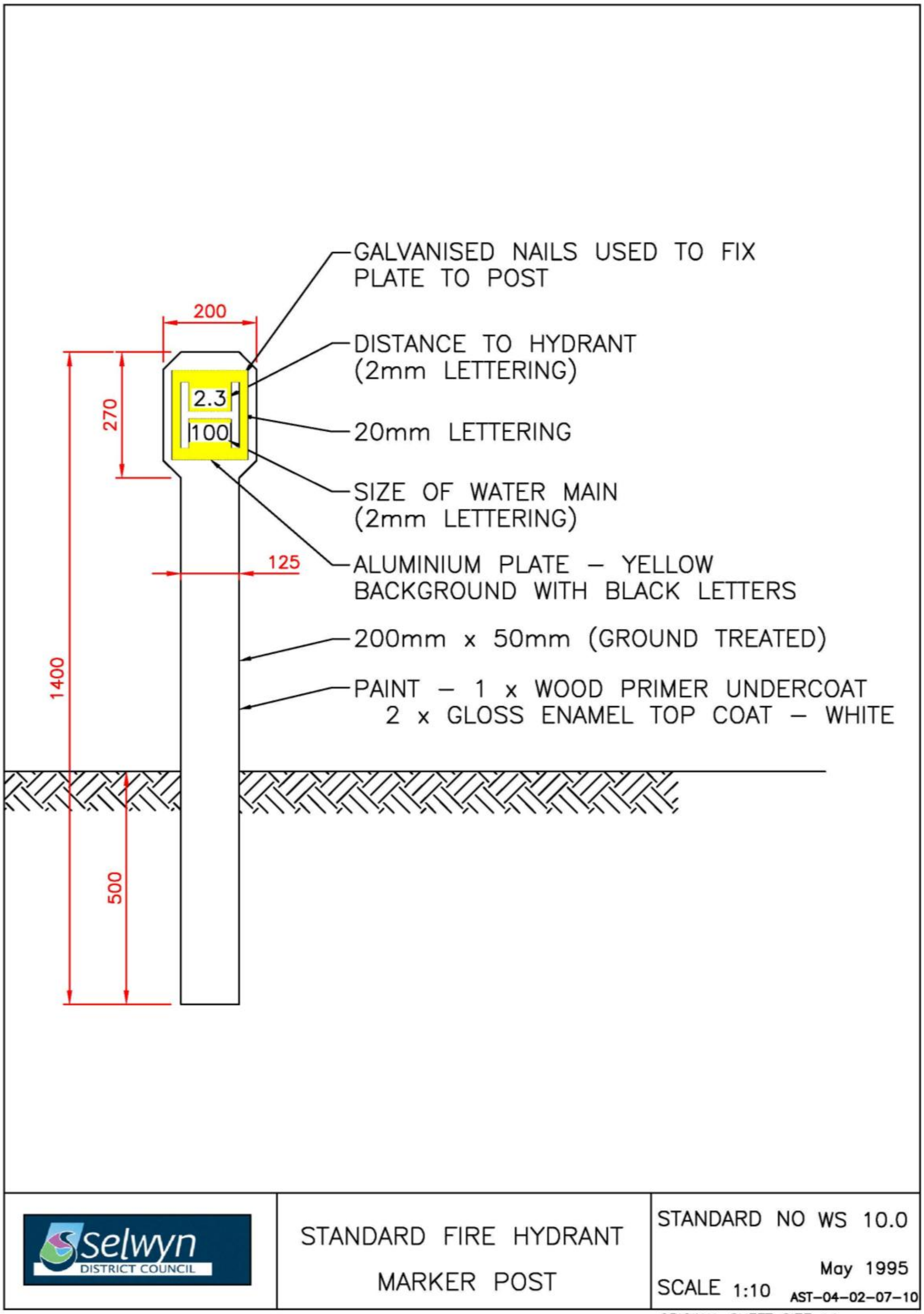


Selwyn DISTRICT COUNCIL	GM–900 Manifold Unit Standard Water Meter & Restricted Connections	STANDARD NO WS 3.0B SCALE NTS Oct 2007 AST–04–02–07–10

ORIGINAL SHEET SIZE A4



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