5.0 WASTEWATER

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5.1 Introduction

This section sets out requirements for the design and construction of wastewater systems for land development and subdivision and guides the renewal and upgrade of existing wastewater systems.

The section is generally limited to the standards required for conventional reticulation systems. Alternative systems such as Effluent Drainage Systems (EDS), Modified Conventional Sewerage Systems (MCS), Low Pressure Sewer (LPS) and vacuum systems shall be subject to specific approval and agreement on design standards.

5.1.1 Objectives

To provide an environmentally sustainable wastewater system, which produces no objectionable odour, does not overflow or adversely affect receiving waters, and is affordable while meeting Hamilton City Council’s minimum level of service.

The design of the wastewater system shall ensure an acceptable wastewater service for each property by providing a:

a) Wastewater main allowing an appropriate single point of discharge by gravity from each property (pumped only with approval from Council).

b) Service connection from the main to each property.

Designers shall consider the hydraulic adequacy of the network including the specified levels of service, the ultimate service area of the system and impact on the existing network.

The wastewater system shall meet the minimum design life requirement taking into account structural strength, design loadings, soil conditions and wastewater conditions (internal and external corrosion). The system shall be designed to minimise the potential for water ingress through the use of good design practise and new technologies.

The wastewater network shall be cost efficient over its design life while accounting for environmental and community impacts through integrated three waters management and water reuse.

5.1.2 Level of Service

The design of the system shall be such that a wastewater connection can be provided for each lot.

New wastewater systems shall achieve the following minimum standards:

a) Pipelines shall not surcharge at the peak design wet weather flow.

b) The system shall not be designed to overflow under any conditions.

c) Storage shall not be used for flow buffering purposes unless approved by Council for the purpose of protecting the existing network.

d) The system shall be self-cleaning.

Where the existing network is affected by the development, system upgrades shall meet the following minimum standards (to be assessed in the city wastewater model):

e) Existing and predicted overflows shall not be made worse (volume or frequency).

f) Storage, if approved by Council shall clear within 24 hours.
5.1.3 **Areas not Serviced by Public Wastewater Systems**

Areas not served by a Council owned and operated public wastewater system shall comply with the Waikato Regional Plan, Section 3.5.7 Implementation Methods – On-site Sewerage Discharges.

5.1.4 **Alteration to Existing Infrastructure**

Connection of new development to the existing wastewater system shall not result in the minimum level of service not being met for existing infrastructure.

Alteration of the existing wastewater network to achieve the required level of service shall be at no cost to Council.

Existing private pipework will only be acceptable for vesting to Council if it can be shown that both the materials and construction methodologies meet the requirements of this specification.

5.1.5 **Planning Documents and Assessments**

All design shall be undertaken in accordance with the operative District Plan, Bylaws, Policies and this Infrastructure Technical Specification.

Where the following documents exist, planning and design of the wastewater network shall be in accordance with the principles and requirements contained within:

- An approved Integrated Catchment Management Plan or Water Impact Assessment
- City Wastewater Network Master Plan or Infrastructure Plan

Council will advise developers of the existence of the above documents during initial discussions regarding development. Design shall not occur until the requirements have been confirmed.

Master Plan and Integrated Catchment Management Plan documents may contain details of strategic infrastructure to be located within the development area. The responsibility for the design and construction of strategic infrastructure shall be agreed with Council prior to commencing design.

5.2 **Design**

5.2.1 **Design life**

Wastewater systems shall be designed and constructed for an asset life of at least 100 years. Specific components such as pumps, valves, and control equipment may require earlier renovation or replacement.

5.2.2 **Approved Materials**

Refer to the Approved Materials Section 8.

Materials and grades for gravity pipelines greater than DN375 shall be determined by specific design and in consultation with Council. Rising mains shall be specifically designed based on the characteristics of the pumped system being serviced.

Where a tradewaste discharge is being serviced material selection shall be specific to the nature of the discharge.
5.2.3 Catchment Design

The system shall be designed to serve the whole of the natural (gravity) catchment area. The design flow shall be calculated from all of the upstream catchment falling within the city boundary. The calculation shall assume complete urbanisation (excluding reserves).

Council strategic planning may require an adjacent catchment to be serviced via another. Where this is required it will be stipulated in an Integrated Catchment Management Plan or Master Plan where one exists, or it will otherwise be identified by Council.

Pipes shall be designed to service the entire catchment area and any future extension of the system. This may affect the pipe location, diameter, depth, and maintenance structure location and layout. Designers shall adopt best practice to ensure a system with lowest whole of life cost.

5.2.3.1 Extent of Infrastructure

Where pipes are to be extended in the future, the ends of pipes shall extend past the boundary of the development by a distance equivalent to the depth to invert and be capped off. This ensures that future extension of the pipe does not require unnecessary excavation within lots or streetscapes which are already developed.

5.2.4 Design Criteria

5.2.4.1 General

Wastewater flows are a function of water consumption, infiltration and direct ingress of stormwater.

All wastewater pipelines shall be designed such that they have sufficient capacity to cater for the design wet weather flow from the area they serve without surcharge and that on at least one occasion every day a minimum velocity for solids re-suspension (self-cleaning) is achieved.

5.2.4.2 Calculation of Flows

The wastewater flows shall be calculated from the following design parameters:

- Water consumption is 200 litres per person per day
- Infiltration allowance is 2250 litres per hectare per day
- Surface water ingress is 16500 litres per hectare per day
- Peaking Factors as per Table 5-1.
- Population Equivalent as per Table 5-2.
- Gross Contributing Land Area upstream of the wastewater pipe is defined as the total catchment area, excluding reserve land, but including land within legal road boundaries

Contact Council for advice regarding the extent (both present and future) of any upstream catchment boundaries if an Integrated Catchment Management Plan does not exist.

Average Daily Flow

The Average Daily Flow (ADF) is calculated as the sum of the infiltration allowance and the daily wastewater flow.
ADF (m³/day) = \((\text{infiltration allowance} \times \text{catchment area}) + (\text{water consumption} \times \text{population equivalent})\)

**Peak Daily Flow**

The system shall achieve a daily self-cleaning velocity the Peak Daily Flow (PDF).

\[
PDF (\text{L/sec}) = \frac{(\text{infiltration allowance} \times \text{catchment area}) + (\text{peaking factor} \times \text{water consumption} \times \text{population equivalent})}{86400}
\]

**Peak Wet Weather Flow**

The system shall accommodate the design Peak Wet Weather Flow (PWWF) without surcharge.

\[
PWWF (\text{L/sec}) = \frac{(\text{infiltration allowance} \times \text{catchment area}) + (\text{surface water ingress} \times \text{catchment area}) + (\text{peaking factor} \times \text{water consumption} \times \text{population equivalent})}{86400}
\]

**Table 5-1: Wastewater Peaking Factors**

<table>
<thead>
<tr>
<th>Population Equivalent for Catchment or Sub catchment Area</th>
<th>Wastewater Peaking Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Residential</td>
</tr>
<tr>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>25</td>
<td>9.1</td>
</tr>
<tr>
<td>30</td>
<td>8.5</td>
</tr>
<tr>
<td>35</td>
<td>8.0</td>
</tr>
<tr>
<td>40</td>
<td>7.5</td>
</tr>
<tr>
<td>45</td>
<td>7.0</td>
</tr>
<tr>
<td>50</td>
<td>6.8</td>
</tr>
<tr>
<td>55</td>
<td>6.7</td>
</tr>
<tr>
<td>60</td>
<td>6.3</td>
</tr>
<tr>
<td>65</td>
<td>6.2</td>
</tr>
<tr>
<td>70</td>
<td>6.0</td>
</tr>
<tr>
<td>75</td>
<td>5.9</td>
</tr>
<tr>
<td>80</td>
<td>5.8</td>
</tr>
<tr>
<td>90</td>
<td>5.5</td>
</tr>
<tr>
<td>100</td>
<td>5.3</td>
</tr>
<tr>
<td>125</td>
<td>5.0</td>
</tr>
<tr>
<td>150</td>
<td>4.8</td>
</tr>
<tr>
<td>175</td>
<td>4.4</td>
</tr>
<tr>
<td>200</td>
<td>4.1</td>
</tr>
<tr>
<td>250</td>
<td>4.0</td>
</tr>
</tbody>
</table>
### Wastewater Peaking Factors

<table>
<thead>
<tr>
<th>Population Equivalent for Catchment or Sub catchment Area</th>
<th>Residential</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>3.8</td>
<td>3.3</td>
</tr>
<tr>
<td>350</td>
<td>3.7</td>
<td>3.1</td>
</tr>
<tr>
<td>400</td>
<td>3.5</td>
<td>3.0</td>
</tr>
<tr>
<td>450</td>
<td>3.4</td>
<td>2.9</td>
</tr>
<tr>
<td>500</td>
<td>3.3</td>
<td>2.8</td>
</tr>
<tr>
<td>600</td>
<td>3.2</td>
<td>2.7</td>
</tr>
<tr>
<td>700</td>
<td>3.2</td>
<td>2.6</td>
</tr>
<tr>
<td>800</td>
<td>3.1</td>
<td>2.55</td>
</tr>
<tr>
<td>900</td>
<td>3.0</td>
<td>2.5</td>
</tr>
<tr>
<td>1000</td>
<td>3.0</td>
<td>2.4</td>
</tr>
<tr>
<td>1500</td>
<td>2.9</td>
<td>2.2</td>
</tr>
<tr>
<td>2000</td>
<td>2.8</td>
<td>2.1</td>
</tr>
<tr>
<td>2500</td>
<td>2.8</td>
<td>2.0</td>
</tr>
<tr>
<td>3000</td>
<td>2.7</td>
<td>1.9</td>
</tr>
<tr>
<td>3500</td>
<td>2.6</td>
<td>1.85</td>
</tr>
</tbody>
</table>

The following equivalent population densities per hectare shall be adopted in the absence of specific supportable design data.

#### Table 5-2: Population Equivalent

<table>
<thead>
<tr>
<th>Area</th>
<th>Population Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Residential, Medium Density Residential, Temple View, Special Heritage, Special Residential Zones</td>
<td>45 persons per hectare, or not less than 2.7 persons per dwelling</td>
</tr>
<tr>
<td>Residential Intensification Zone</td>
<td>120 persons per hectare</td>
</tr>
<tr>
<td>All Business Zones, Community Facilities Zone</td>
<td>30 persons per hectare</td>
</tr>
<tr>
<td>All Industrial Zones, City Centre Zone, Major Facilities Zone</td>
<td>45 persons per hectare</td>
</tr>
<tr>
<td>Future Urban and Rural Zones</td>
<td>15 persons per hectare</td>
</tr>
<tr>
<td>Other Zones</td>
<td>2 persons per hectare</td>
</tr>
<tr>
<td>Other establishments should be treated as follows:</td>
<td></td>
</tr>
<tr>
<td>Primary Schools</td>
<td>45 persons</td>
</tr>
<tr>
<td>Secondary Schools</td>
<td>150 persons</td>
</tr>
<tr>
<td>Hospitals</td>
<td>3.5 persons/bed</td>
</tr>
<tr>
<td>Motels</td>
<td>0.6 persons/bed</td>
</tr>
</tbody>
</table>
Assessment criteria to determine flows from any development, or re-development, not covered in this section shall be determined in conjunction with Council.

### 5.2.4.3 Commercial and Industrial Flows

Where the industrial domestic waste and trade waste flows from a particular industry are known, these shall be used as the basis of the wastewater design. Where this information is not available, flows shall be calculated using the relevant peaking and population densities defined in Table 5-2.

Provision for liquid trade waste and ‘wet’ industries shall be considered and provided for by the design.

Notwithstanding the above, provision for trade waste shall be made by arrangement with the Council and shall be subject to the provisions of the Trade Waste Bylaw.

### 5.2.4.4 Hydraulic Design

The hydraulic design of pipelines should be based on the Colebrook-White formula. The coefficients to be applied are as per Table 5-3. Minimum grades and maximum velocities are provided in Sections 5.2.4.5 and 5.2.4.7 respectively.

**Table 5-3: Guide to Roughness Coefficients for Gravity Wastewater Lines**

<table>
<thead>
<tr>
<th>Material</th>
<th>Colebrook-White coefficient $k$ (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC</td>
<td>0.6</td>
</tr>
<tr>
<td>PE</td>
<td>0.6</td>
</tr>
<tr>
<td>GRP</td>
<td>0.6</td>
</tr>
<tr>
<td>Cement Lining</td>
<td>1.5</td>
</tr>
<tr>
<td>PE or epoxy lining</td>
<td>0.6</td>
</tr>
</tbody>
</table>

**Note:**

a) These values take into account possible effects of rubber ring joints, slime, and debris

b) The $k$ values apply for pipes up to DN 300

c) For further guidance refer to WSA 02:1999 table 2.4; AS 2200 table 2; Plastics pipes for water supply and sewage disposal (Janson), Metrication: Hydraulic data and formulae (Lamont), or the Handbook of PVC pipe (Uni-Bell)

### 5.2.4.5 Minimum Grades for Self-Cleaning

Self-cleaning of grit and debris shall be achieved by providing minimum grades, as specified in Table 5-4 and Table 5-5.

**Table 5-4: Minimum Gradients for Self-Cleaning**

<table>
<thead>
<tr>
<th>Reticulation</th>
<th>Pipe Size DN (mm)</th>
<th>Minimum Grade (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reticulation</td>
<td>150</td>
<td>0.55</td>
</tr>
<tr>
<td>Lateral</td>
<td>225</td>
<td>0.33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lateral Connections</th>
<th>Pipe Size DN (mm)</th>
<th>Minimum Grade (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reticulation</td>
<td>150</td>
<td>0.55</td>
</tr>
<tr>
<td>Lateral</td>
<td>225</td>
<td>0.33</td>
</tr>
</tbody>
</table>
1. Permanent Upstream Ends

<table>
<thead>
<tr>
<th>Pipe Size DN (mm)</th>
<th>Minimum Grade (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1.0</td>
</tr>
<tr>
<td>150</td>
<td>1.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 5-5: Minimum Gradients for Self-Cleaning – Small Developments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Houses</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>3-4*</td>
</tr>
<tr>
<td>5-8</td>
</tr>
<tr>
<td>9-18</td>
</tr>
<tr>
<td>More than 18</td>
</tr>
</tbody>
</table>

*see also the guidelines for service connections Section 5.2.8

5.2.4.6 Steep Grades

Where the pipeline gradients are greater than 1 in 5, anchor and/or antiscour blocks shall be constructed of a type comparable to that illustrated in Drawing D5.5.

Note: on gradients flatter than above where scour is a problem, sand bags are to be used to stabilize the trench backfill.

5.2.4.7 Maximum and Minimum Velocity

The preferred maximum velocity for peak wet weather flow is 3.0m/s. Where a steep grade that will cause a velocity greater than 3.0m/s is unavoidable refer to the Water Services Association of Australia: Sewerage Code of Australia: WSA 02-002 for precautions and design procedures.

The minimum velocity for self-cleaning at peak daily flow will be deemed to be 0.6m/s.

5.2.4.8 Piped Reticulation System Minimum Requirements

a) Irrespective of other requirements, the minimum pipe size for a public wastewater pipe shall be not less than 150DN and a lateral connection not less than 100DN

b) In no circumstances shall the pipe size be reduced on any downstream section

5.2.4.9 Structural Design for installation of buried pipes

AS/NZS Standards provide methods and data for calculating the working loads on buried pipes due to:

a) The materials covering the pipes

b) Superimposed loads

PE and PVC Pipes
AS/NZS 2566 (including the commentary) provides the method to assess the pipe selection and embedment method of buried flexible pipelines. This standard is also applicable to other materials listed in the Table included in section 1.2 APPLICATION of the AS/NZS Standard.

Definitions:
Embedment – the material surrounding the pipe and which is composed of the following zones:

a) **Bedding** – the zone between the foundation and the bottom of the pipe
b) **Haunch support** – the part of the side support below the spring line of the pipe
c) **Side support** – the zone between the bottom and top of the pipe
d) **Overlay** – the zone between the side support and either the trench fill or embankment fill

Fill – One or more of the following:

a) **Embankment fill** – fill material placed over the overlay for the purpose of creating an embankment
b) **Trench fill** – fill material placed over the overlay for the purpose of refilling a trench
c) **Foundation** – *a naturally occurring or replacement material beneath the bedding*

**Concrete Pipes**

AS/NZS 3725 provides the basis for determining the vertical working load on concrete pipes under a range of installation conditions. The standard relates these loads to the loads applied to pipes so that the appropriate ‘strength class’ of pipe can be selected to suit the ‘pipe support’ method chosen for the particular field application.

The minimum pipe support design shall be ‘H’ (H1 and H2)

Definitions:

Bed zone – The area between the foundation and the level of the bottom of the pipe. Variable depth

Bedding – The specified type and extent of materials supporting the lower portion of the pipe, usually taken to be the materials occupying the bed zone and the haunch zone.

Fill – One or more of the following.

a) **Backfill or Embedment fill** The material placed over the overlay zone for the purpose of refilling a trench or creating an embankment
b) **Ordinary fill** The material obtained from excavation of the pipe trench or elsewhere and containing not more than 20% by mass of stones with a size between 75mm and 150mm and non larger than 150mm
c) **Select fill** The material obtained from excavation of the pipe trench or elsewhere with a particle size not greater than 75mm and which conforms with the soil classes given in Table 1 AS/NZS3725

Foundation – A naturally occurring or replaced material beneath the pipe bed.

Haunch zones – The areas bounded by the trench walls and the outside of the pipe, the top of the bed zone and a level surface whose height above the bottom of the pipe is determined in accordance with the requirements of AS/NZS 3725
Section 5 Wastewater

Overlay zone – The area extending around the outside of the pipe to the tops of the last placed side zone, haunch zone or bed zone as appropriate. Each has a breadth of not less than 150mm at any point measured radially from the outside of the pipe.

Side zones – the areas bounded by the trench walls and the outside of the pipe, the top of the haunch zones and a level surface whose height above the bottom of the pipe is not less than 0.5.

5.2.5 System Layout

The preferred layout/location of pipes is as follows:

**Table 5-6: Pipe Locations**

<table>
<thead>
<tr>
<th>Area</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>Within the Transportation Corridor normally 2m out from the kerb except where the properties served are below road level</td>
</tr>
<tr>
<td>Industrial</td>
<td>Within the Transportation Corridor normally 2m out from the kerb or alternatively in the front yard area with approval</td>
</tr>
<tr>
<td>Business</td>
<td>Within the Transportation Corridor normally 2m out from the kerb or alternatively in the rear service lane with approval. The major reticulation and trunk lines, however, shall be in the Transportation Corridor (as for Residential Zones)</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Within the Transportation Corridor except where the properties served are below road level</td>
</tr>
<tr>
<td>Private Property</td>
<td>If no other option is available, pipelines may be laid within private property. Where a pipeline is within a property, it is required to be parallel to the boundary. No new private drains shall pass between one lot and another. If crossing of private property is unavoidable, those parts of the pipeline serving more than one lot shall be Council mains with service connections to the property boundaries</td>
</tr>
</tbody>
</table>

Where a wastewater pipeline changes location within a street, crossings of roads, railway lines, and underground services shall, as far as practicable, be at an angle of 45 degrees or greater. Pipes shall be located and designed to minimise maintenance and crossing restoration.

5.2.5.1 Topographical considerations

In steep terrain the location of pipes is governed by topography. The pipe layout shall conform to natural fall as far as possible to remove the need for gravity pipelines operating against natural fall and thus creating the need for deep installations.

5.2.5.2 Aerial Pipes and Pipe Bridges

a) Aerial pipes and pipe bridges are discouraged
b) Before adopting the use of aerial pipework and pipe bridges alternative routes and solutions shall be investigated
c) Benefit cost analysis shall be completed for all proposals and whole life costs including future maintenance shall be provided. Benefit cost analysis shall be completed for all alternative designs for comparison purposes

5.2.5.3 Minimum/Maximum Cover

All pipelines, other than those in private property, shall be specifically designed to support the likely loading in relation to the minimum cover to be provided in accordance with the terms of
Section 5 Wastewater

AS/NZS 3725:2007. The minimum cover for all types of pipes under all conditions shall be 600mm.

For private pipelines in private property the depth of cover is dealt with under the Building Act 2004 and approved by the Council’s Building Unit.

5.2.5.4 Clearances from Underground Services

Clearance from underground services shall be as per NZS 4404:2010 Section 5.3.7.9.

5.2.5.5 Clearance from Structures

Pipes adjacent to existing buildings and structures shall be located clear of the ‘zone of influence’ of the building foundations. Refer Drawing D5.6. If this is not possible, a specific design shall be undertaken to cover the following.

- Protection of the pipeline
- Long term maintenance access for the pipeline
- Protection of the existing structure or building

The protection shall be specified by the Developer for evaluation and acceptance by Council.

Sufficient clearance for laying and access for maintenance is also required. Table 5-7 may be used as a guide for minimum clearances for mains laid in public streets.

Table 5-7: Minimum Clearance from Structures

<table>
<thead>
<tr>
<th>Pipe diameter DN (mm)</th>
<th>Clearance to Wall or Building (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100</td>
<td>600</td>
</tr>
<tr>
<td>100 – 150</td>
<td>1000</td>
</tr>
<tr>
<td>200 – 300</td>
<td>1500</td>
</tr>
<tr>
<td>375 +</td>
<td>1500 + 2 x diameter</td>
</tr>
</tbody>
</table>

NOTE – These clearances should be increased by 400mm for mains in private property as access is often more difficult and damage risk greater.

5.2.6 Venting and Odour Control

Situations where venting will be required include:

a) At pumping stations
b) At manholes where pumping stations discharge to a gravity pipe

A specific engineering design shall be submitted to Council for acceptance where pressure wastewater lines are likely to discharge odours because of changes in hydraulic conditions and/or for aged sewage.

5.2.7 Manholes

Manholes are to be located.

a) On Council property or Transportation Corridors whenever possible and if located within the carriage way, manholes shall be located 2m out from the kerb
b) Out of hollows, dips or any area that may be subjected to inundation or identified as a secondary flow path
c) Clear of all boundary lines by at least 1.5m from the outer edge of the manhole chamber plus the height of any nearby retaining walls if they exist

d) 2m clear of new structures in private property as shown in Drawing D5.6

Manholes are required at the following locations.

a) Intersection of pipes except for junctions between mains and lateral connections

b) Changes of pipe size

c) Changes of pipe direction, except where horizontal curves are permitted

d) Changes of pipe grade, except where vertical curves are permitted

e) Combined changes of pipe direction and grade, except where compound curves are permitted

f) Changes of pipe invert level

g) Changes of pipe material, except for repair/maintenance locations

h) Permanent ends of a pipe

i) Discharge of a pressure main into a gravity pipe

For infill developments, manholes shall not be required for a 150mm connection on a 150mm pipeline where a manhole is provided immediately inside the property being served and another manhole exists within 100m on the existing pipe as these provide adequate accessibility without needing another manhole.

### Section 5.2.7.1 Distance between Manholes

For reticulation pipes, the maximum distance between any two manholes shall be 120m.

### Section 5.2.7.2 Size of Manholes

Manholes shall be a minimum of 1050mm diameter for depths of 1.0m or more.

Manholes of 750mm diameter are permitted to be used for depths less than 1.0m at the upstream end of public sewers.

### Section 5.2.7.3 Manhole Materials and Parameters

All Manholes shall be pre-cast concrete with an external flange base.

Manholes up to 2400mm deep shall be constructed using a single riser with a pre-cast external flange base. Manholes in excess of 2400mm deep shall be constructed using a 2400mm deep pre-cast riser with external flange base and then completed to final ground level using no more than a single riser for manholes up to 5.0m deep. Three risers are allowable for manholes in excess of 5.0m depth.

In no case shall a series of short risers be permitted.

The joints of all abutting units shall be sealed against ingress of water by the use of Expandite BM100 'Sealastrip' or an approved equivalent.

The cover frame shall be set over the opening and adjusted to the correct height and slope using adjustment rings and mortar so as to conform to the surrounding surface (refer to Drawings D5.4 – D5.3). The cover frame shall be held in place with a bold fillet of concrete.

### Section 5.2.7.4 Manholes Requiring Specific Design

Where manholes are more than 5.0m deep they shall be specifically designed in accordance with the manufacture’s requirements for external pressures and resist floatation.
Where a manhole is to be constructed in soft ground, the area under the manhole shall be undercut to provide an adequate foundation and backfilled with suitable hard fill for the manhole base. Where undercutting exceeds 1.5m, a special design will be required.

### Flotation

In areas of high water table, all manholes shall be designed to provide a factor of safety against flotation of 1.25.

#### Allowable Horizontal Deflection through Manholes

A maximum allowable deflection through a manhole for pipe sizes 150 to 225DN is up to 90 degrees. The maximum allowable deflection for pipe sizes greater than DN225 is 110 degrees.

#### Connections to Manholes

a) The invert of a connection must connect to the manhole at a level no lower than the average of the soffit levels of the main inlet and outlet pipes

b) Maximum angle of deflection of lateral connection into the manhole main channel shall be 90 degrees

c) Drop connections at manholes shall be designed as external connections in a manner similar to the illustrations in Drawing D5.4

d) Internal drops shall only be approved where existing manhole diameters are 1200mm or greater

#### Internal fall through Manholes

In addition to the normal pipeline gradient, all manholes shall have a minimum drop of 20mm plus 5mm per 10 degrees of the angle of change of flow within the manhole.

The construction tolerance for drop through the manhole shall be:

\[
\text{Constructed Manhole Drop} = \text{Manhole Drop (as calculated above)} + 5 \text{ mm}
\]

Grading the channel shall be limited to falls through manholes of up to 150mm.

To avoid excessively steep channels within manholes, steep grades shall be ‘graded-out’ at the design phase where practicable.

#### Covers

Watertight manhole covers with a minimum clear opening of 600mm in diameter, complying with AS 3996:2006, shall be used. Refer to Approved Materials Section 8.

a) ‘Non-rock’ covers must be used on all State Highway and Level 2 roads (roads with greater than 10,000 vehicles per day).

b) ‘Heavy Duty’ covers must be used in the Transportation Corridor, carriageway, commercial and industrial properties and all public areas.

c) ‘Standard’ covers may only be used on residential properties.

#### Manhole Steps

All manholes shall be provided with 20mm diameter stainless steel step irons or steps in order to provide access. These shall be of the ‘dropper’ or ‘safety’ type to prevent feet sliding sideways off them

Manhole steps shall be provided at 300mm centres vertically (refer Drawings D5.4 – D5.2). The top step shall not be more than 450mm below the top of the top slab, and the lowest step
shall be not more than 375mm above the bench, or such lower level if detailed on other than standard manholes. The manhole steps shall be located over the downstream pipe.

5.2.9 Connections

5.2.9.1 General

Before connection to the public wastewater system, the Council connection process and forms shall be completed by the applicant and acceptance provided. This applies to:

a) All new connections and disconnections from private property
b) All new connections of new wastewater mains to be tied into the existing public wastewater system
c) For all connections where trade waste will be discharged, compliance with the Trade Waste Bylaw is required

The lateral connection should be designed to suit the existing situation and any future development. The lateral will be positioned so that the private section of the connection with each lot can be constructed in accordance with the Building Act. This is generally at the lowest location in the lot.

5.2.9.2 Requirement of Design

The following design requirements shall be met.

a) Irrespective of other requirements, the minimum sizes of lateral connection and reticulation pipes shall be not less than those shown in Table 5-8: Minimum Pipe Sizes for Lateral Connections
b) Each connection shall be capable of serving the whole of the lot by gravity. This requirement shall allow adequately graded drains within the lot, together with the depth required for gully traps. Note: Private wastewater pumps will not be approved where gravity discharge is feasible
c) The standard depth of a new connection at the boundary is 1.2m (range 0.9 - 1.5m).
d) Drop connections at manholes shall be designed as external connections. Internal drops shall only be used where existing manhole diameters are 1200mm or greater with only one drop connection being permitted refer Drawing D5.4
e) Where practicable and where the connection to be installed is to be within 5.0m of a manhole the connection shall be to the manhole
f) All connections, which are to be made directly to the line, shall be designed using a factory manufactured ‘wye’ or ‘London Junction’ and shall be watertight
g) Service connections shall generally enter each lot from the road frontage. Where a property has no road frontage, pipes shall be located within that property's legal access (right of way)
h) Where feasible:

(i) Private pipes will not cross property boundaries
(ii) Existing private connections crossing boundaries shall be replaced by a public connection

Table 5-8: Minimum Pipe Sizes for Lateral Connections

<table>
<thead>
<tr>
<th>Pipe</th>
<th>Minimum Size DN (mm)</th>
</tr>
</thead>
</table>

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In laying greenfield service connections which are capped pending connection of house drainage (refer Drawing D5.4) the maximum depth at the end of the service connection pipe shall be 1.5m.

Sections which slope away from the drainage direction may require a service connection which is deeper than 1.5m at the boundary in order to comply with the requirement to drain the whole of the lot. In such cases the service pipe shall be extended into the property on grade and to the extent that it’s end cap is no deeper than 1.5m.

| Connection servicing up to four dwelling units | 100 |
| Connection servicing more than four dwelling units | 150 |
| Connection servicing commercial and industrial lots | 150 |

Figure 5-1: Single Property and Subdivisions

Note: private pipes are indicative only and are subject to the requirements of the Building Act / Code.
5.2.9.3 Services in Access Ways, Access Lots, or Rights of Ways

The following should be considered when preparing design.

a) Where a right-of-way is to be provided, wastewater services for all newly created lots should drain to the right-of-way where possible.

b) Council will adopt the wastewater system in the right-of-way where it services two or more properties. All private drainage reticulation that has been upgraded in accordance with this standard shall be declared public at the point where it crosses a boundary once as-built information has been recorded by Council.

c) Where the existing lot does not have direct access to the public wastewater after subdivision, the connection which runs through the newly created lot shall be designed and constructed as per this specification and vested in Council to allow for normal operations, maintenance, renewals and prevent building over.

Note: private pipes are indicative only and are subject to the requirements of the Building Act / Code.

Figure 5-2: Connections in Rights of Ways

5.2.9.4 Multi-Unit Properties

For multiple occupancies (unit title, cross lease or company lease), service of the whole property shall be achieved by providing a single point of connection to the wastewater system. Connection of the individual units is by joint service pipes owned and maintained by the body corporate, tenants in common or the company as the case may require. Private drainage is to be approved and constructed as per the Building Act / Code.
Section 5 Wastewater

Note:
Private pipes are indicative only and are subject to the requirements of the Building Act / Code. For 150mm dia connections a private manhole will be required inside the boundary.

Figure 5-3: Multi Unit Developments

5.2.9.5 Ramped Risers

Unless required otherwise by Council, a ramped riser shall be constructed to bring the connection to within 0.9m - 1.5m of ground level, or to such depth that will permit a gravity connection to service the whole lot. Ramped risers shall be constructed as shown in Drawing D5.4.

5.2.9.6 Connection to Trunk and Interceptor Pipelines

Connections to wastewater trunk pipelines shall be preferably at manholes, or alternatively, and only with specific approval of Council, utilising factory fabricated ‘wye’ junctions in pipelines of PVC or vitrified clay materials.

A reticulated pipe connection to a wastewater interceptor shall only be designed in conjunction with the Council.

*Note: No individual lot connections are permitted into an interceptor.*

5.2.9.7 Connections to Deep Lines

Where an existing or proposed wastewater pipe is more than 5.0m deep to the top of the pipe, or where required by the ground conditions, a manhole will need to be constructed on the shallower line. This should be 5m from the deep line and ramped down to it.
Building Over or Adjacent to Pipelines

Building close to or over pipelines is generally discouraged as this practice severely limits Council’s ability to either maintain or duplicate the pipeline if required in the future.

Council does not permit building over or within the specified distances of the following infrastructure.

- Wastewater rising mains and interceptors – 5 metres
- Pump stations and associated infrastructure – 5 metres
- Manholes – 2 metres
- Junction points with connections and mains – 2 metres

Note. Also no part of a lateral connection (downstream of the point of supply – See D5.4) shall be permitted to be under any building footprint. See Figure 5-1: Single Property and Subdivisions.

Alternative options such as relocating the proposed building, decommissioning of/or diverting the pipeline along property boundaries shall be thoroughly investigated by the development before building over a pipeline will be permitted.

In order of preference pipes shall either be.

(a) If practicable pipes may be removed and connections relocated, dependent on usage capacity for the pipe at a cost to the development (Refer to Section 451 of Local Government Act 1974)

(b) Relocated to avoid the construction at a cost to the development (s451 of LGA 1974)

(c) Replaced on present alignment, extending from boundary to boundary (or manhole as appropriate) at a cost to the development (s451 of LGA 1974)

Inspection

Inspections by CCTV shall be required of Council infrastructure before and after the performance of any work which involves building over or within 5m of Council infrastructure.

A CCTV inspection of the subject sewer, in accordance with Section 2 of the New Zealand Pipe Inspection Manual, undertaken by a contractor qualified and with the necessary experience to do so, or by Council at the applicant’s expense.

The results of the CCTV inspection are to be submitted to Council with the application. The inspection may be used as a dilapidation survey.

Building or Engineering plans submitted to Council shall also incorporate the confirmed locations of the main, manholes and connections identified by the CCTV inspection as these factors may dictate the development layout/design.

Pre-inspections are required to confirm the location of the pipes traversing the entire development site, their condition and ensure connections are not built over.

Post inspections are required when any construction involves piling within the 45° influence envelope of the wastewater pipe to ensure no damage has occurred during installation of piles.
No further construction work can be carried out until results are known from the Post Inspection.

5.2.10.3 Structural loads – building over

No structural loads shall be placed on, or be transferred to the pipeline, or other assets. All structural loads shall be absorbed (by means of piles where appropriate) outside of the 45º influence envelope and below the invert level of the wastewater pipe for the first row of piles (refer Drawing D5.6).

The first row of piles shall be located at least 1.5m clear from the outside edge of the wastewater pipe and 2.0 m clear from the outside wall of any public manhole, and be founded at least 1.0m below invert level of pipe.

Subsequent pile rows shall be founded at least 1.0m below the 45º envelope of the influence line of the wastewater pipe at invert level.

5.2.10.4 Building adjacent to

Any building, structure or other development shall be designed and founded so that it will not be adversely affected by public infrastructure and associated trench line, including any future excavation that may be required for the maintenance of the infrastructure. The building, structure or other development shall make provision to allow for any future possible settlement of the public trench line and backfill and consequent reduction in lateral support. CCTV inspection of all wastewater and stormwater pipes is required before and after construction.

5.2.10.5 Pile Ramming

No pile ramming is permitted within 5.0m from the centreline of any public wastewater, or within the 45º envelope of the influence line of the wastewater pipe at invert level. Pile ramming shall include sheet piling.

These piles shall be drilled only.

5.2.11 Pump Stations

Pump stations shall only be accepted if they are incorporated into an approved Integrated Catchment Management Plan. In an area where there is no approved Integrated Catchment Management Plan, specific approval to install a pump station is required from Council. Where topography does not permit gravity connection to the wastewater system, pump stations shall not be proposed for less than 25 lots unless approved by Council. Private pump stations with individual connections (i.e. low pressure sewers) are preferred in these circumstances.

Where a combined rising main is the best option then the extent of public/private ownership is to be agreed with Council.

Collection Manholes shall be considered to protect pumps as part of the design where pump size is less than Xylem brand NP3127 (5.9kw).

5.2.11.1 Minimum Requirements

Pump station design shall ensure that the following minimum requirements are met.

a) Area around the pump station shall be graded to prevent surface water flowing onto or over the pump station cover slabs

b) Free of secondary flow paths for 1% AEP flood level, and the pump station lid levels shall be provided with a minimum freeboard of 300mm above the estimated flood level

c) Pumping systems shall
Section 5 Wastewater

(i) Have a pumping capacity of N+1 with a minimum of two identical pedestal mounted submersible sewage pumps

(ii) Each pump shall be capable of discharging the design peak wet weather flow rate from the catchment

(iii) Include sufficient well volume to operate under normal conditions without surcharge to the incoming wastewater network

d) The station shall be located to ensure that the entire design catchment can be serviced

e) All stations shall be contained within a separate local purpose reserve - drainage title set out to provide safe and easy operation and maintenance of the site without impacting on public activities surrounding the site and is designated in accordance with the relevant District Plan or vested as part of a subdivision

f) The station shall be designed to service the entire catchment area of land beyond the reach of the existing gravity system

g) In staged construction, guidance from the Council is required to ensure the correct sizing of the pump station and associated rising mains and storage facilities meet the short and long term requirements of the catchment

h) A minimum emergency storage capacity of nine hours average dry weather flow, measured between the High Level alarm & the point of overflow.

i) It is recommended that prior to submission of the detailed design, consultation is undertaken with Council to ensure that the design is fit for purpose

5.2.11.2 Pump Station Sizing

A pump station design will document the effluent volumes and associated pump requirements for the fully developed catchment and at commencement of operation.

The calculation of flow will follow the design specifications in Section 5.2.4.2.

These projections will be described as

- Average Dry Weather Flow
- Peak Dry Weather Flow
- Peak Wet Weather Flow
- Peak Daily Flow

If the station catchment is to be fed by other pumping stations then these flows are to be calculated both for the direct gravity catchment as well as direct plus contributing catchment.

These projections will be used as the basis for sizing the various components within the design:

Wet well diameter = Peak Wet Weather Flow at 50 year projection

\[ \phi = 2 \times \sqrt{\frac{900 \times Q}{N}} \]

Where:

- \( Q \) = Pumping Rate L/s
- **N = 15** (maximum number of starts per hour)
  - **d =** minimum operational depth @ 400mm
  - **Ø =** Well diameter in mm
  - The pump selection and physical clearance may necessitate the development of a wider wet well
  - **Storage =** Peak Wet Weather Flow at 50 year projection for direct gravity catchment
  - **Pump Size =** Peak Wet Weather Flow at 20 years projection with contributing catchment.
  - **Rising Main Diameter –** shall be selected to achieve flow velocities of 1-3m/s. Rising mains shall ideally operate in the efficient range of 1.0 to 1.5m/s but may exceed this for the purposes of staging and future flows.

Where connection to an existing rising main is required, a full analysis of all combinations of pumps shall be carried out.

All calculations shall be submitted to Council for approval, all assumptions, design variables etc shall be clearly documented.

### 5.2.11.3 General Layout

The site shall be laid out such as to comply with Drawing D5.7.

The alignment of the pump station shall be set out with reference to permanent land transfer pegs or temporary boundary marks, placed by the licensed cadastral surveyor responsible for the final land transfer pegging.

The site design will include a paved all weather access road, no narrower than 3.5m with the centre line of the parking space being no greater than 4.0m in plan from the distal pump and no greater than a 0.5 m difference in elevation between the parking area and lid elevation.

Where the accessway has to be of a length greater than 30m, a turning point for a light commercial vehicle is to be provided at the well. **The gradient of the access way shall not exceed 1 in 6 and all turning radii comply with light truck tracking curves.**

The control cabinet shall be located with the switch gear facing the wet well and placed no closer than 2.5m to any well or valve chamber lids and no greater than 5.0m this is to provide safe working room between an open lid and the cabinet.

The above ground structures, including but not limited to control cabinet, odour control and RPZ, shall be positioned such that any ‘out of control’ vehicles leaving surrounding public roadways are unlikely to damage these structures. **Protection such as guardrail or posts and rails may be required.**

An area of 5.0m x 5.0m shall be available to accommodate an odour biofilter, either at the time of construction or in the future.

### 5.2.11.4 Collection Manhole

Immediately upstream of the pump station and within the local purpose reserve a single manhole is to be provided with the purpose of the collection of all wastewater flows from the catchment. The collection manhole must be sited to allow ease of access for cleaning purposes.

The collection manhole is to be constructed with a sump to trap gravel, rocks and other solid objects and prevent them entering the pump station wet well. The manhole must be a
minimum of 1200mm diameter and have a minimum depth of 500mm as measured from the invert of the outlet pipe.

The minimum volume of the collection manhole shall be five times the litre per second rate for peak wet weather flow.

5.2.11.5 Pump Station Inlet

The floor of the pumping station shall be set at such a level below the inlet pipe so that the inlet pipe will not surcharge during the normal pump operation cycle, which includes standby pump operation.

5.2.11.6 Wet well

**Diameter**

The minimum diameter of the pump chamber will meet both the minimum separation distances of the pump supplier and provide sufficient operational capacity to meet the maximum number of starts per hour (refer Section 5.2.11.11) but be no less than 1.8m deep.

**Depth**

Sufficient depth shall be provided in the pump chamber such that

- The inlet pipe will have a minimum of 100mm free board to surcharge during operation of the duty pump
- That the minimum distance between duty pump start and stops levels is 400mm
- The design stop level is 50mm above the pump manufacturer’s minimum continuous operating levels

**Structural Stability**

The pump station wet well shall be designed to have negative or zero buoyancy. Accordingly the chamber may require mass concrete in the bottom to counter buoyancy forces. The depth and extent of mass concrete shall be as specified on the engineering plans.

The ground water level shall be assumed to be at ground level unless an actual level is established by geotechnical investigation and accepted as suitable for this purpose by the Council.

The mass of the wet well structure included in the stability analysis shall not include the associated mechanical and electrical components of the pump station nor can the soil friction forces of backfill around the wet well chamber be taken into account. Any additional weight needed shall be added in the form of mass concrete in the bottom of the chamber as indicated in Drawing D5.8. The proposed pump station drawings shall provide dimensions of the extent of mass concrete needed to counter buoyancy of the chamber.

**Valve Chamber**

The valve chamber shall be attached to the pumping chamber. Where the delivery point is within close proximity to the pumping station the valve chamber may be dispensed with and a separate rising main from each pump laid to the delivery point. Where this occurs provision in land allocation shall still occur to cater for any future operational changes.

The layout of the pumping chamber, valve chamber and pipe work shall be similar to that shown on Drawing D5.9.

**Lids**

The lids shall be of a standard design as shown in Drawing D5.70.
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For any well or chamber where the depth is greater than 2.0m secondary lids are required for health and safety purposes.

5.2.11.7 Emergency Storage

Pump stations shall provide for wastewater storage in the event of pump failure through, electricity outage.

Sizing

A minimum 9 hours emergency storage based on average dry weather flow shall be provided prior to emergency overflow occurring. The storage volume should be measured between the high level alarm and the point of overflow.

The required storage volume shall be provided by

- The volume of the wet well, plus
- Any additional ancillary storage chambers, plus
- The volume of pipelines (500 mm below overflow level) draining to the facility at time of commissioning

The wet well volume below the high level alarm level shall be excluded from the calculation of available storage volume.

Layout

A typical storage layout is provided in Drawing D5.16. Specific site design is required.

Preferably the storage volume shall be provided in the pumping wet well structure and upstream pipelines.

Where this is impractical, additional storage can be provided by additional manholes or horizontal chamber(s) made up from large pipes diameters.

Any pipe or chamber (whose sole purpose is for the provision of storage capacity) can be connected directly into the pump chamber and need not connect via the collection manhole and it shall be benched such as to direct all flow to the outlet point.

For all other sole purpose storage facilities the benching shall be at a minimum gradient of 1 in 3 to allow self-draining. A central channel within the storage well shall be at a minimum of 1% gradient.

If the storage chamber is provided with an automated wash down facility following storage use the minimum grade can be reduced to 0.15%.

Where storage is developed within the upstream pipework and normally carries wastewater flow these structures must have the haunching constructed to cater for the normal operation, with a seamless progression to the haunching required for the free drainage post emergency.

Structural Stability

The buoyancy of the storage chambers shall be determined as per the methods used for the wet well.

5.2.11.8 Rising Main

Sizing

The rising main will be a minimum size of DN80 and designed such that the minimum velocity, with one pump operating, is at least one metre per second and the maximum velocity, with all pumps operating, is less than or equal to three metres per second. Where a configuration does
not allow for at least one start per hour, the agreement to the proposed configuration will need to be obtained from the engineer.

Design should ensure that one pump run occurs per hour under dry weather rates. The pump run duration should be designed to ensure that the pipe volume is replaced during a single run. Additional isolating valves will be required on long rising mains.

Where the length of the rising main is such that the volume of effluent exceeds the storage capacity of the wet chamber then additional isolating valve(s) shall be considered and agreed with the engineer.

**Connection to Downstream Wastewater System**

Rising mains shall discharge into a receiving manhole in accordance with the detail on Drawing D5.9.

The point at which the pumping station is connected to the public wastewater system will be governed by the capacity of the network downstream from that point. The capacity of the gravity pipeline system to which the station discharges, shall be designed to accommodate the discharge when all pumps are operating in combination with the peak wet weather flow from the adjoining gravity network.

**Rising Main Layout**

Wherever possible, the rising main shall be designed on a positive gradient avoiding high and low points and therefore minimise the need for air release and scour valves.

To accommodate all out of balance forces on the main its installation and design shall be similar to that of a water main incorporating suitable anchorage at all changes of direction.

**Material Selection**

Refer Approved Materials Section 8

**Isolation**

Downstream from the rising main flow meter, no closer than two diameters to a flow monitoring device, an isolation valve will be installed to allow work to occur on the pumpset without need to drain the entire rising main volume or for high service stations to isolate the rising main in case of emergency bypass.

**Bypass Outlet**

For stations that have a design service level of greater than 20 L/s PWWF or the depth of the well is greater than 4.0m a rising main bypass outlet as shown in Drawing D5.9 shall be provided and located between the flow meter and the rising main isolation valve and no closer than two diameters to the flow metering device. This outlet is to be utilised in the event of a failure either in the downstream catchment or the rising main during which time a temporary line can be installed to divert pump output to transport tankers.

**Air Valve**

Air relief valves shall be fitted as necessary and/or as required by Council for the purpose of automatic relief of gas build up within the rising main.

**Valves solely for the purpose of wastewater applications.**

Each air relief valve is to be housed within a separate manhole structure diameter no less than 1050mm in diameter and located ideally out of the carriageway.

**Scour Valve**
Section 5 Wastewater

Scour valves shall be fitted as necessary and/or as required by Council for the purpose of removing accumulated sediment built up within low lying areas of the rising main that potentially lead to a reduction in flow capacity.

Scour valves shall discharge to a receiving chamber and each scour point shall have vehicle access for tanker truck for the collection of scoured material. Suitable structures for containment of potential spillage are to be provided in the design.

**Gross Solids Protection**

The inlet to the overflow pipe shall be baffled to restrict the entry of solid floatable material.

5.2.11.9 **External Services**

The successful operation of the wastewater pumping station relies on the provision of external services and as such these services must be sized correctly for the operation loads experienced at commissioning of the station and where staged development of the station occurs, as a result of final catchment utilisation, that capacity is installed prior to commission or a detailed succession plan is provided including any approvals from service providers for these increases.

These services include, but are not limited to:

- Wash Water
- Power
- Stormwater
- Wastewater (receiving catchments)
- Telemetry wireless pathways

**Wash Water**

All pump stations shall be provided with a water supply. The minimum sizing shall be a standard 63 0D MDPE pipeline as used for water supply rider-mains.

Wastewater pump stations are a 'High Hazard' risk requiring reduced pressure zone type backflow prevention devices installed above ground level. The backflow prevention device is to be positioned adjacent to the electrical control cabinet as shown on Drawing D5.7. The backflow prevention device shall be installed within a separate housing as shown in Drawing D5.74.

The exact size of the water connection is derived from the wash down flow requirement of the emergency storage chambers.

A second water supply connection (including 24VDC solenoid valve) shall be installed on the RPZ outlet to facilitate supply should a wash-down sprayer be installed (refer to Drawing 5.17).

The solenoid valve is to open when the pump well low level float switches the pump off, and remain open for 10 minutes.

**Power**

The Council will only provide the minimum specification for sizing and selecting electrical equipment. It is the responsibility of the designer to determine the suitability and requirement of electrical equipment and connections with the Network Utility Supply Operator, WEL.

**Stormwater/overland flow**

The stations are to be designed with a layout such as to afford free draining of stormwater away from cabinets and well openings.
5.2.11.10 **Electrical and Telemetry**

Upon application, Council will provide up to date electrical and telemetry specifications for detailed design.

Installation of the Council’s standard alarm and operational data control system is required.

Control / Alarm settings shall be as follows:

**Control Levels**

Control/Alarm settings shall be as follows:

<table>
<thead>
<tr>
<th>Control Type</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Level Alarm</td>
<td>Set to activate if the water level drops below cut out level for more than 1 minute.</td>
</tr>
<tr>
<td>Pump Stop Level</td>
<td>50mm above minimum submergence level of pumps</td>
</tr>
<tr>
<td>Duty Pump Start Level</td>
<td>150mm below incoming wastewater invert level</td>
</tr>
<tr>
<td>Standby Pump Start Level</td>
<td>100mm above duty cut-in level</td>
</tr>
<tr>
<td>High Level Alarm</td>
<td>50mm above standby cut-in level</td>
</tr>
<tr>
<td>Critical (Overflow) Alarm</td>
<td>Set at overflow level</td>
</tr>
</tbody>
</table>

**Float Switch**

One float switch shall be installed to monitor levels at the point of loss from the wastewater network typically at or near the pump station. The float switch shall be wired to the telemetry to provide a ‘critical level alarm’ and to override relay to operate the pumps in the event of the level control system failing.

The float is to be positioned at or upstream of the point of overflow from the network. Where the point of installation is separate from the wetwell, the float is to be connected by a 50mm duct to the cabinet plinth. The design of which shall be approved by Council.
5.2.11.11 Pump Design

Pump selection

The pump system shall be an N + 1 system where, one duty pump is required for duty and an identical standby pump is required as a standby backup.

The pumps shall be operated from a three phase electrical power supply system.

Pumps shall be of Flygt small to medium head range submersibles of NP version. Refer Approved Materials Section 8.

The pumping range shall be selected to give greater than 1 and not more than 15 starts per hour.

The pumps are to be connected by way of a ‘duck foot’ discharge pedestal to enable the removal and manipulation of the pump from the top of the wet well.

In selecting the appropriate pumps the operating conditions shall correspond as closely as possible to the point of maximum pump efficiency. However, final pump selection must be approved by the Council in order to facilitate some standardisation of pump model and impellor sizes.

Table 5-9: Criterion for Pump Selection

<table>
<thead>
<tr>
<th>Rank</th>
<th>Criteria</th>
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<tbody>
<tr>
<td>1</td>
<td>Level of Service</td>
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<td>Operations and Maintenance</td>
<td>3</td>
<td>Cost of Investment</td>
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<td>Peak Wet Weather Flow</td>
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<td>Energy Consumption (kW/m³)</td>
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<td></td>
<td></td>
<td>Fleet Compatibility</td>
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<td>Rising Main Diameter</td>
</tr>
<tr>
<td>4</td>
<td>Downstream restrictions</td>
<td></td>
<td></td>
<td></td>
<td>Network Capacity Impact</td>
</tr>
</tbody>
</table>

In calculating the system head losses, the effects of all bends and fittings beyond the pump discharge bend shall be allowed for, together with the rising main friction losses.

The system static head shall be based on the difference in level between the centreline of the inlet face for the pump discharge bend and the highest point on the rising main system.

The rising main system curve is to be modelled using Colebrook White formula. Calculations of friction loss should be carried out based on roughness ‘k’ values of 1.5m and 0.5mm to ensure that the selected pump is capable of operating over this range of duty points.

Risers and Valve sizing

The pumpset riser is defined as all pipework between the discharge bend to the inlet of the rising main isolation valve.

Internal pipework for each pumpset will be at a minimum of that determined by the pump discharge bend. Where there is a difference in the size between the discharge bend and subsequent steel work the reducer is to be immediately post discharge bend and/or prior to isolation valve if needed.

The valve installed along the pump set riser will be of a similar dimension to the pipework.

Isolation valves for each pump set will be of a quarter turn eccentric plug type with ability to lock in either open or close position using a (standard padlock).
Non-Return Valves

The installation of a non-return valve on each pump set is required to ensure the pumps are protected from reverse flow and that flow from a pump is not returned to the well through the standby pump reducing operational capacity.

Where the dynamic head for a pump is less than 15m, as measured at the location of the non-return valve, a ball type valve can be used. For those stations that experience levels greater than 15m a resilient seated rubber flap check valve is to be used. Flap check valves are to be installed with an external indicator arm.

For those stations where the total head is above 30m a detailed engineering design solution is to be provided showing the limitations on the system for water hammer following the controlled shutdown of pumps (excluding power failure).

Flow Meter Sizing

The flow meter shall be an ABB Water Master Potted for IP68 which is required to be factory ‘Finger printed’ and appropriately sized for the rising main.

The Pump Station design must ensure the flow meter is fully charged during non-pump operation.

The transmitter shall be located in the cabinet with analogue and digital information connected to the Council’s telemetry system.

Where the meter is position within the designated site and free of roading or concrete cover then the meter may be buried or otherwise housed within a 1050 manhole with 400mm clear of the invert of the meter. Both installation types are to connect to the cabinet by ducting, where buried the end of the duct is to be sealed such to prevent ingress of soil and moisture.

5.3 Construction

5.3.1 Pipeline Construction

This section covers the installation requirements for all piped wastewater networks.

The installation of pipelines shall be carried out in accordance with the relevant AS / NZS standard.

5.3.1.1 Materials

5.3.2 Refer Approved Materials Section 8. Pipe Embedment and Fill

5.3.2.1 Embedment

The designed trench width shall be the minimum width to allow pipes to be safely laid and all embedment material properly and sufficiently compacted.

Embedment and fill shall keep pace with the excavation and laying of pipes so that not more than 15m of pipes shall be left exposed in open trench where this could represent a danger to road users.

The foundation shall be able to support all design loads placed on it for the duration of the lifecycle of the pipeline it supports. Where the bottom of the trench will not provide adequate support for the pipe the designer shall be contacted to provide a suitable means to stabilise trench foundation. Acceptable methods include:

a) Groundwater drainage
Section 5 Wastewater

5.3.2.1 Wastewater Trench Foundation

a) Use of geotextile fabric
b) Cement stabilisation or
c) Removal of unsuitable material and replacement with compacted selected material

No embedment material shall be placed or pipes laid before the trench foundation has been inspected and accepted by Council.

The various zones comprising the embedment depth shall be laid in ascending order. Each zone shall be laid in accordance with the approved design. Each zone shall contain the specified selected material and compacted to the required density.

Where pipelines have protruding projections such as sockets, flanges or couplings, a suitable recess shall be provided, in the supporting material, to ensure the pipeline is fully supported along the pipe barrels.

Pipes made of plastic materials shall be laid with product labelling uppermost in the trench.

5.3.2.2 Fill

General

The trench or embankment fill material, shall be as specified. Where reuse of previously excavated material is proposed its use shall be approved by the designer. Under no circumstance shall the density of the fill material be less than that of the material prior to excavation. When compacting in layers the depth of each layer shall be as specified by the designer.

Mechanical compaction of the fill material directly above the pipe shall not be commenced until the depth of cover above the top of the pipe is adequate to prevent damage.

Compaction equipment which can produce horizontal or vertical earth pressure on the pipeline, which can cause damage or excessive distortion of the pipeline, shall not be used.

Fill outside a Transportation Corridor and other Trafficked areas

Trench or embankment fill shall be compacted in layers to the specified finished level. The designer shall specify a testing regime to verify the compaction effort meets the density specified.

Fill in a Transportation Corridor and other Trafficked areas

Trench or embankment reinstatement shall conform to the requirements shown on Plan D3.2.3 ‘Trench Reinstatement’ contained within the Transportation Section of this document. Trench or embankment fill shall be compacted in layers to the specified finished level. The designer shall specify a testing regime to verify the compaction effort meets the density specified to support the designed traffic loading.

5.3.2.3 Tolerances

Pipes shall be accurately laid to the lines, levels and gradients shown on the Drawings using pipe-laying laser equipment.

The permissible deviation of the alignment and gradient of pipelines shall be the lesser of ± 5% of the nominal diameter of the pipe or ± 20mm from a straight line between the inverts of successive manholes, with all such deviations being gradual. There shall be no steps at the junctions between successive pipes and no point in the pipeline shall be lower than any downstream point.

Where the variation exceeds the tolerance Council may order the removal and relaying of any affected pipes.
Invert Levels

The permissible deviation from the designated level of the invert at each manhole or structure shall be ± 50 mm, provided that the fall between successive manholes or structures shall be at least 90% of that specified.

Horizontal Alignment

The permissible deviation of the horizontal alignment between manholes or structures shall be ± 100 mm.

Gradient

For straight gradients, the permissible deviation from the specified gradient shall be ± 50 mm from a straight line drawn between the inverts of successive manholes, provided that no point in the pipeline is lower than any downstream point.

5.3.3 Trenchless Construction

5.3.3.1 General

Trenchless technology may be preferable or required as appropriate for alignments passing through or under

a) Environmentally sensitive areas
b) Built-up or congested areas to minimise disruption and reinstatement
c) Railway and major road crossings
d) Significant vegetation
e) Vehicle crossings

Trenchless construction shall only be used for applications in which the specified tolerance can be achieved.

Pipes used for trenchless installation shall have suitable mechanically restrained joints, specifically designed for trenchless application, which may include integral restraint, seal systems, or heat fusion welded joints.

Any trenchless technology and installation methodology shall be chosen to be compatible with achieving the required gravity pipe gradient — refer to manufacturer's and installer's recommendations.

5.3.3.2 Installation Methods

Trenchless installation methods for new pipes include

a) Horizontal directional drilling (HDD) (PVC with restraint joint/fusion welded PE)
b) Uncased auger boring/pilot bore microtunnelling/guided boring (PVC with restraint joint/fusion welded PE)
c) Pipe jacking (GRP/ reinforced concrete)

5.3.3.3 Pipe Detection Tracer Wire

When a pipe is installed by a directional drilling technique or bored through the ground, the pipe shall have a 'Tracer Wire' attached. This wire shall take the form of a continuous 2.5 mm² multi strand (polythene sleeved) cable, strapped to the pipe wall by means of a minimum of two complete wraps of heavy duty adhesive tape, at a maximum of 3.0m intervals.
5.3.4 Joints

5.3.4.1 General

Specification of joints shall be as follows.

a) All pipes shall have flexible joints of an approved type, such as RRJ

b) Steel pipes shall be flexibly jointed (gibault ‘denso’ wrapped and sealed with approved outer wrapping or approved rubber ring)

c) Joints shall be provided adjacent to manholes to the requirements of AS/NZS 2566 with the exception of PVC where proprietary connections may be used

5.3.4.2 Rubber Ring Joints

Rubber ring joints shall be installed strictly in accordance with the manufacturer’s instruction. Care should be taken to ensure that the rubber rings are located evenly around the joint with no twists in them. The pipe shall be pushed up firm and tight to the joints.

5.3.4.3 Site Mortar Joining of Pipes into Manholes

All mortar used for the ‘on-site’ jointing of drainage components shall be Expocrete ‘UA’ or an approved equivalent. The surface priming, mixing of components, application and cure period are to be in accordance with the manufacturer’s directions.

5.3.4.4 Butt and Electrofusion Welded Jointing

Electrofusion welded jointing shall only be carried out by experienced certified PE welders. The certifying organisation shall be acceptable to the Council’s Engineer. In addition, welders may be required to carry out satisfactory test welds for each joint type and to stamp the welder’s number on each joint. Butt welds shall be, at least, 90% of the tensile strength of the parent pipe material, when tested in accordance with ISO 13953:2001. All internal weld beads shall be removed in an approved manner, to be smooth and flush with the pipe inner surface, without compromising the strength of the pipe joint.

5.3.4.5 Jointing by Electrofusion Welding

Couplers shall be of the same rating of the pipe or superior. Use manufacturer approved scraping tool to uniformly scrape the pipe ends all around the pipe barrel. Hand scraping is not permitted. The welder shall mark witness marks on each end of the pipes to be jointed. The distance from the end of the pipe to the witness mark shall be half the length of the coupler. The pipe insertion to the coupler shall be achieved by manufacturer approved pulling and clamping equipment. Bending the pipes up for insertion into the coupler and then pushing back is not permitted. Once the jointing is complete, the witness marks should be only just visible.

5.3.5 Manholes

5.3.5.1 Channels and Benching

A semi-circular channel shall be formed in the concrete floor of the manhole. The benching shall rise vertically from the horizontal diameter of the pipe to the height of the soffit and then be sloped back at a gradient specified in Drawings D5.4 – D5.3.

The flow channel shall be formed so that it presents an evenly curved flow path through the manhole. The cross section of the flow channel shall be uniform. In wastewater pipelines the main channel shall be lined with ceramic half pipes.
Ceramic half pipes shall be saw cut to form mitred joints around bends. Benching shall be floated to a dense, smooth hard surface using 3:1 sand cement mortar and a steel float. Side branches shall be similarly formed with a smooth bend into the main channel.

For larger manholes and pipelines greater than 600mm in diameter the benching shall have step recesses as shown on Drawing D5.2. A U3 standard of finish as specified in NZS 3114:1987 shall be achieved.

5.3.5.2 **Flexible Joints**

All pipe lines shall have a flexible joint adjacent to the manhole on all incoming and outgoing pipes not more than 600mm away from the manhole wall. The upper part of the pipe inside the manhole shall be cut back to the wall, the reinforcement cut out and the ends plastered with a cement mortar to a neat finish. Where the pipe is cut using a power saw the ends of the steel reinforcement shall be protected from corrosion by the application of epoxy before rust has a chance to develop. **Sealing of Manholes**

Where precast manhole units are used, the joints of abutting units shall be sealed against ingress of water with Expandite BM100 ‘Sealastrip’ and with epoxy mortar on the inside and outside of the joints.

5.3.5.4 **Manhole Steps**

Bolt through Type Manhole Steps

The steps shall be bolted through the walls using properly formed and recessed bolt holes. The step shall have a washer welded to it on the appropriate angle to seat flush against the inside of the manhole chamber.

Prior to tightening, BM100 shall be placed around the stainless steel shank both inside and outside the manhole riser. After the steps have been tightened in place the outside recess which houses the nut shall be sealed with Expocrete ‘UA’ or acceptable equivalent in accordance with the manufacturer’s directions. plastering of the recess will not be accepted. The sealant is to be applied at least 48 hours before the manhole risers are required for construction.

5.3.5.5 **Concrete**

All concrete shall have a minimum crushing strength of 20.0 MPa at 28 days, unless otherwise specified or detailed by Council.

5.3.6 **Connections**

All connections shall be sealed by removable caps until such time as they are required. All connections and disconnections to or from Council pipes and all works outside the property boundary shall be undertaken by Council.

Connections shall be constructed as per drawing D5.4

5.3.7 **Backfilling and Reinstatement**

Backfilling shall keep pace with the excavation and laying of pipes so that not more than 15m of pipes shall be left exposed in open trench where this could represent a danger to road users.
5.3.7.1 Outside of Transportation Corridor

Bulk backfill shall be placed in layers and mechanically compacted. The degree of compaction shall be such as to produce an in-situ density which shall not be less than that of the material prior to excavation. To establish the criteria for compliance, Scala Penetrometer tests shall be carried out along the line of the trench prior to excavation.

There shall be not less than one test per 50m of trench length. Compaction tests (or substituted Scala Penetrometer tests) shall be carried out for the full depth of the trench to within 300mm of the pipeline (subsequently referred to as the ‘test area’). There shall be at least one test area per 50m of trench length, or, at least one test area per 50m³ of trench backfill, whichever method returns the greater number of test areas.

Compaction test results (or substituted Scala Penetrometer tests) shall be submitted to Council for approval, refer Section 3 Transportation.

The area shall be reinstated as near as possible to the original condition.

All drains, fences and other structures shall be replaced or reconstructed to their pre-construction standard and in their original place.

5.3.7.2 In Transportation Corridor

Pipe trenches shall be backfilled using an approved hardfill placed immediately above the pipe embedment and reinstated as specified by Drawing D3.2.3. The depth of the basecourse and type of finishing seal coat shall conform to the standard of the existing road construction.

Compaction test results (or substituted Scala Penetrometer tests) shall be submitted to Council for approval refer Section 3 Transportation.

5.3.8 Pump Stations

5.3.8.1 Wet Well and Valve Chamber

The Pumping Station chamber shall be constructed from flush jointed Class 4 reinforced concrete pipes installed as shown on Drawing D5.8. Care shall be exercised to ensure that the pump chamber is vertical and set to the correct levels before the station floor is poured. A precast base may be used, provided flotation of the chamber is prevented.

Pipe joints shall be sealed and made water tight using ‘Expocrete UA’ or an acceptable equivalent.

Stations that incorporate a Flygt TOP system for the base of the wet well are to incorporate and install the systems as per the manufactures requirements.

5.3.8.2 Foundations

Once excavated to a firm foundation free of any organic soil, the wet well pump station foundation shall be prepared with a layer of compacted GAP40 no less than 250mm thick followed by a capping of site concrete no less than 100mm thick.

5.3.8.3 Painting and Lining

Any block work mortar joints shall be pointed inside and outside and all cores filled with grout. The outside of the block work shall be painted with two coats of ‘Mulseal’ or acceptable equivalent in accordance with the manufacturer’s specifications.

The internal walls of the well and valve chamber are to be painted using Sika Guard 62 and applied by a licensed Contractor.
5.3.8.4 **Top Slab**

The top slab shall be cast as shown on Drawing D5.10. The placement of reinforcement shall be carefully controlled to ensure adequate cover. The lids and frames shall be carefully set into the concrete upstands so that they fit flush with the finished upstand level. All concrete shall be ordinary grade 21 MPa crushing strength.

The lid and frame specified on the drawings shall be constructed as shown on Drawing D5.70. All reinforcing steel bars shall be grade 300 deformed bars complying with AS/NZS 4671:2001. All nuts, bolts and washers shall be grade 316 stainless steel with an appropriate releasing agent applied prior to setting any nut. Where concrete is to be poured around high density polyethylene pipe, the pipe shall be first wrapped with 1.5mm thick butynol sheeting.

5.3.8.5 **Well and Chamber Lids**

The primary covering lids are to be constructed as shown in Drawing D5.14 as appropriate for the pump size selected at full development.

a) All stainless welds are to be AS/NZS 2980:2007, pickled to prevent corrosion. All metal to metal fasteners are to be coated with an appropriate releasing agent before installation

b) All fasteners are to be 316 stainless steel

c) All edges are to be made clean of burs or sharp edges

d) Secondary Safety Lids required where depth is greater than 2.0m

5.3.8.6 **Cable Bracket**

The float and motor cables shall be secured by a grade 316 stainless steel bracket with ceramic insulators. The bracket shall be mounted in such a position as to be easily accessible from the lid opening as shown in Drawing D5.8.

5.3.8.7 **Pump Discharge Bends**

The pump discharge holding down bolts shall be grouted in place and accurately positioned so that the 50mm dia. pipe guide rails stand vertically between the guide rail brackets and the discharge connection. Care is to be exercised in grouting in the bolts to ensure that they will not vibrate loose with use.

5.3.8.8 **Guide Rails**

Guide rails are to be fixed to the edge of the well, using stainless fittings with the guide rails installed vertically using the Flygt guide rail bracket. The guide rails are to be 316 schedule 10 stainless steel tube and each guide rail is to be of a single continuous pipe run with no joins, unless pre-approved by Council.

5.3.8.9 **Riser**

Each pump installed shall be fitted with an individual riser manufactured from 316 schedule 10 stainless steel tube, all welds are to be to AS/NZS2980: 2007, pickled to prevent corrosion. All flanges are to be of Table E.

Where a flange is installed on a horizontal pipework, the two bolts are to be placed so they are level at the top, on vertical sections the two bolts are to be perpendicular to the discharge bend inlet coupling base.

The riser for each pump consists of three major components, these being:

- The pump lift
- Valve wall penetration
5.3.10 Pump Lift

The pump lift component consists of a vertical section of pipe from the bellows located on the discharge bend to the valve set elevation. The section is to contain a single 90 degree bend.

If the design requires that the pump lift component is to be connected to a discharge bend of a smaller diameter, this is to occur by way of a reducer fabricated into the base of the vertical riser and the bellows sized to meet the discharge bend.

Where the pump lift component riser is greater than 3.0m, additional support brackets are to be installed, as shown in Drawing D5.8 at 2.0m intervals, measured down from the centre line of the valve wall penetration.

5.3.11 Valve wall penetration

A flange is to be installed prior to entering into the valve chamber wall, no closer than 200mm to the wet well wall facing. The penetration through the valve wall shall be horizontal and centred vertically over the pipe discharge bend. No partial bends for realignment shall be used without specific authorisation from Council.

Where the pipe penetrates the valve wall, a square stainless steel flange shall be welded to the pipe and bolted to the wall with dimensions at least 2.5 times the external pipe diameters and fixed with M16 stainless steel Chemset studs. The penetration hole for the riser to pass through shall be approximately 20mm larger than the external diameter of the pipe and extend a sufficient length to the cut off to fully allow the gibault connection to slide fully onto this length of pipe work to release all downstream pipework.

A non-return valve connector is to be fitted with a length no less than 100mm plus 60% the overall length of the gibault. It shall be fitted with a Table E flange and welded as per the required specifications and a 15mm BSP threaded socket welded to the centre line of the pipe with a stainless steel plug no closer than 50mm to valve flange.

5.3.12 Non Return Valve and Riser Isolation Valves

The non-return and isolation valves shall be installed as per the manufacture’s requirements, post isolation valve.

5.3.13 Collection Manifold

The individual riser is to be joined together by a collection manifold which continues through the exterior valve wall including puddle flange over each pipe. On leaving the valve chamber, the individual risers are to be joined together using 45 degree connections. On collection of all individual risers the manifold is to proceed with a minimum straight length, free of fittings, of no less than 5 diameters prior to termination in a flange, for connection to the flow meter. The downstream section of the flow meter is to continue in stainless steel without fittings for at least 2 diameters, until either a rising main bypass tee fitted or the isolation valve.

All fastening bolts are to have a releasing compound applied prior to installation.

5.3.14 Storage

The Emergency Storage chamber shall be constructed from Skid Ring Jointed minimum Class 2 reinforced concrete pipes installed as shown on Drawings D5.17 and D5.18.

The entire storage tank shall be painted as per the requirements of the wet well.

Any washing fixtures are to be constructed using 316 Stainless Steel pipe and fixtures.
5.3.8.15 **Miscellaneous**
Reference shall be made to Section 3 – Transportation for design and construction requirements for kerbing and vehicle crossings and Section 7 – Landscaping for fencing requirements.

5.3.8.16 **Odour Control**
At present Council is not installing odour control on new pump stations. However provision of space free of services must be provided as shown in Drawing D7.6.

5.3.8.17 **Reinstatement**
Refer Section 5.3.7.

5.3.8.18 **Electrical Cabinet Plinths**
The electrical cabinet plinth is to be constructed as per Drawing D5.72.

5.3.8.19 **Direct Buried Cable**
Where specified cables are laid directly in the ground, they shall be located not less than 0.6m below ground on a 50mm thick bed of clean sand. The trench shall be backfilled with a 75mm thick layer, measured from the top of the cable, of clean sand. Lengths of ‘Mag-Slab’ cable cover shall then be laid end to end to provide cable protection. The trench shall then be further backfilled with clean sand or soil, free from rock, stones or other debris, to a level 200mm below the surface. Orange PVC signal tape shall then be laid and backfilling completed, the surface being restored to Council’s satisfaction.

5.3.8.20 **Cable Ducting**
The following cable ducts are required
- One pump cable duct and one control cable duct of 100mm dia. shall be installed from the base of the electrical control cabinet concrete plinth to the pump station chamber
- One 100mm duct will be installed in the plinth for the mains cable
- A 50mm duct will be installed from the electrical control cabinet concrete plinth to the flow meter
- A further 50mm duct will be installed for each of the emergency storage spray wash control solenoid and/or a distal float overflow if fitted

Each cable duct is to be fitted with a pull cord for future cable repair works and is to be sealed, to restrict corrosive fumes entering the electrical cubicle, by way of expanding foam encased in a plastic liner to allow ease of future removal.

5.3.8.21 **Electrical Cabinet Supply**
Due to the strategic nature of the electrical cabinets to the successful operational performance Council will supply a fully constructed and bench tested electrical cabinet at the Developer’s cost.

A six week lead in time is required in order for Council to supply the standard two pump cabinet. Contact Council to arrange. Payment is required in advance.

The cabinet will be supplied with a Certificate of Compliance for the cabinet.

This will leave the Developer/Contractor the responsibility of provision of connection to the electrical network and installation of power meter and connection of the external fittings, including but not limited to:
- Pumps control and protection
Section 5 Wastewater

- Floats (as provided by Council)
- Level sensor (as provided by Council)
- Any wash solenoids or odour controls as required by the site design

5.3.9 Testing and Inspections for Pipelines

All wastewater mains and branch pipelines, including extended connections, shall be inspected during construction. On completion of all other engineering work within the subdivision, there shall be a final test conducted.

Council requires a Council observer present during the test. A minimum of 24 hours notice is required to be given to Council before the test is carried out, so that arrangements for an observer can be made. The Developer/Contractor shall provide all fittings and materials to carry out the test.

5.3.9.1 Inspections

The Developer/Contractor needs to ensure that inspection and subsequent approval is granted before continuing with the installation, failure to follow this process may mean that the Developer/Contractor is required to remove items or excavate work to allow inspection of standards of installation. These inspections include:

- Set out
- Excavation and bedding
- Backfill
- Pre-pour Form and Reinforcing
- Pre-Cover Installation
- Water Tightness
- Rising Main Pressure Test
- Electrical Inspection

5.3.9.2 Pipeline Leakage Tests

The materials and workmanship used shall pass one of the following tests.

- Low pressure test
- High pressure air test

All tests require the pipeline to be sealed with suitably restrained plugs at both ends and at branch connections. Because porous pipes such as those of ceramic or concrete materials absorb water and can transmit air through their walls, they should have the voids filled by soaking prior to testing.

**Low Pressure Air Test**

a) Introduce air to the pipeline till a pressure of 300mm of water is reached. (This shall be measured by a manometer such as a 'U' tube, connected to the system)

b) Wait until the air temperature is uniform (indicated by the pressure remaining steady)

c) Disconnect the air supply

d) Measure pressure drop after five minutes

e) The pipeline is acceptable if the pressure drop does not exceed 50mm
High Pressure Air Test

a) Pressure pipelines to 25 kPa or 3 PSI
b) Wait at least 2 minutes to ensure temperature stabilisation
c) Disconnect air supply
d) Hold pressure for five minutes
e) The pipeline is acceptable if it holds 25 kPa or 3 PSI for five minutes

Manhole Leakage Tests

The materials and workmanship used shall pass one of the following tests.

- A Low pressure test or High pressure air test as described in 5.3.9.2, for manholes up to 3.5m depth only.
- Or a Vacuum Test

Vacuum Test

The vacuum test creates differential pressure between the inside and outside of the manhole. This test shall be completed with the manhole completely backfilled and the lid in place.

Procedure

a) Clean manhole thoroughly
b) Seal openings using properly sized or inflatable plugs
c) Connect seal plate to manhole opening
d) Draw vacuum of -254mmHg (or -338.6mbar) and isolate valves
e) Hold test time according to the manhole sizes as listed in the table below:

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<td>6.7</td>
<td></td>
<td>31</td>
<td>46</td>
<td>55</td>
<td>64</td>
<td>72</td>
<td>89</td>
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<td>7.3</td>
<td></td>
<td>33</td>
<td>51</td>
<td>59</td>
<td>68</td>
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<td>113</td>
<td>135</td>
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<td>63</td>
<td>74</td>
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<td>98</td>
<td>121</td>
<td>145</td>
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<tr>
<td>9.5</td>
<td></td>
<td>46</td>
<td>69</td>
<td>81</td>
<td>94</td>
<td>105</td>
<td>129</td>
<td>153</td>
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<tr>
<td>10</td>
<td></td>
<td>49</td>
<td>74</td>
<td>87</td>
<td>98</td>
<td>113</td>
<td>139</td>
<td>165</td>
</tr>
</tbody>
</table>

f) Release the vacuum and remove the test gear and plugs
Acceptance

a) For the duration of the test the vacuum did not drop below -228mmHg (or -304mbar).
b) There are no visible wet patches or “sweating” at any of the pipe penetrations, seals or riser joints.

5.3.10 CCTV Inspections

CCTV inspection shall be carried out on 100% of all new systems and shall be completed once the road surface is to a finished level and prior to any road surfacing.

CCTV inspections and deliverables shall be in accordance with The New Zealand Pipe Inspection Manual, Third Edition.

All defects are to be fixed to the satisfaction of Council. Where faults are found and repaired the section of pipe shall be re-filmed to ensure that there are no further problems.

5.3.10.1 Particular Specification

Slope corrections shall be carried out where the pipe alignment is out of tolerance.

The pipe shall not be in service during the CCTV inspection. The pipe shall however be flushed with water prior to CCTV. In addition, the CCTV camera shall travel upstream with a small flow of water travelling down the pipe towards the camera. Still images of all severity ‘L’ and ‘M’ defects shall be provided.

5.3.10.2 Deliverables

The following deliverables are required.

a) Computer generated log sheets
b) CCTV inspection record Digital Video format
c) Electronic data in Hansen format for Council
d) CCTV footage needs to be referenced to ensure manhole names and DDTS ID’s link footage to as-builts
e) Still images in electronic format and hard copy
f) CCTV summary sheets in electronic format and hard copy

5.3.10.3 Header Information Required

The Developer shall provide the following header information with each inspection record.

a) Name of main Contractor
b) Name of CCTV Contractor
c) Name of Operator
d) Date and time of inspection
e) Location (e.g. street name)
f) Upstream manhole number notated with Council’s manhole asset ID
g) Downstream manhole number notated with Council’s manhole asset ID
h) Material type and diameter
i) Pipe function
5.3.11 Pump Station Commissioning

All pumping stations shall undergo a series of inspections and tests during construction including:

Table 5-10: Pump Station Test Schedule

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre Installation</td>
<td>Electrical Cabinet Inspection and Testing</td>
</tr>
<tr>
<td>On-site</td>
<td>Civil Inspections</td>
</tr>
<tr>
<td></td>
<td>Telemetry</td>
</tr>
<tr>
<td></td>
<td>Pump Station Tests</td>
</tr>
<tr>
<td></td>
<td>Post Cabinet Installation</td>
</tr>
<tr>
<td></td>
<td>Station Set Up</td>
</tr>
<tr>
<td></td>
<td>Final Sign Off</td>
</tr>
<tr>
<td>Post-Installation</td>
<td>Commissioning Tests</td>
</tr>
<tr>
<td></td>
<td>Rising Main Test</td>
</tr>
</tbody>
</table>

5.3.11.1 Pre-Installation Inspections

Electrical Cabinet Inspection and Testing

All testing of the electrical cabinet will be completed by Council.

5.3.11.2 Onsite Inspections

Civil Inspections

Civil inspections by Council will occur throughout the civil construction of the pump station. This will cover areas such as the wet well, valve chamber and storage construction, the station inlets, the rising main, discharge manhole, any other associated pipework with the station and the odour bed if this is to be installed.

Telemetry

To be completed by Council.

Pump Station Tests

Once installed, the equipment is to be adjusted where necessary and placed into operation as near as possible in the manner, and under the conditions it will operate in practice. Tests are made to ensure all protective devices, and controls are fully operational.

Performance tests will also be made to verify the designed performance under operational conditions.

The pump station will not be commissioned / deemed operational until all the following documentation (electronic format) has been provided.

a) Plant data sheets
b) As-built drawings for Civil, Mechanical and Electrical (SPS and RM)
c) SCADA program
d) Job Safety analysis for all routine maintenance tasks to be performed at the pump station
e) Operational and maintenance manuals inclusive of pump system curves
f) Copy of concrete compressive strength and slump test results

g) Copies of Rising Main Pressure tests

h) Contingency Plan for bypass pumping

i) Factory pump test results

j) Switchboard factory and site acceptance test certificates completed and signed.

Additional requirements:

a) Council representatives must attend the station commissioning.

b) The pre-commissioning record sheets shall be completed and lodged with Council five working days prior to the planned commissioning date.

c) Notification of the upcoming commissioning must be made to Council 14 days in advance, to ensure that SCADA is set up, and the SCADA must be pre-commissioned in consultation with Council to ensure that all alarms are being received by the Council’s Telemetry System.

d) Pumps should not be accepted if the maximum flow delivery rate is substantially above the specified limits. Such excess flows can have adverse hydraulic effects at the Wastewater Treatment Plant or at other downstream elements in the system.

e) Prior to the start of the pump station tests, the site is to be inspected for suitability of running of the pumps and is to include, but not be limited to the following.

   i. Lifting chains are attached and secured to the holding brackets

   ii. The electrical cable is free of the pump and any excess cabling is coiled and secured at the top of the well and free of the pump path along the guide rail.

   iii. All tests and checks required for provision of certificate of electrical compliance by a registered electrician

   iv. Receipt of factory test certificate for the pumps and present for sighting at site by Council representatives

   v. Ensuring all pumps are clear of all debris and tools

   vi. Checking signals from all level control equipment to ensure safe operation and to ensure the pumps will not run dry

Following the clearance of the site for pump operation, each piece of equipment can singly and in their possible combinations be operated to confirm system and component performance.

This will involve but not be limited to the following.

<table>
<thead>
<tr>
<th>Table 5-11: Pump Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pump Test</strong></td>
</tr>
<tr>
<td>Impellor clearance</td>
</tr>
</tbody>
</table>
| Pump rotation          | This is to be confirmed by running the pump out of the well using a standard bump test  
Check the pump travel up/down the guide rails is free with no adverse sticking |
Section 5 Wastewater

Pump Test

Testing of duty equipment and performance

- Measurement of duty pump performance is to be made immediately prior to the duty stop level
- Measurement of each pump individually
- Measurement of:
  - Current Draw, CT
  - Current Draw, as read by analogue display
  - Flow
- Pump seating correctly with no flow pass from discharge coupling
- Pumps open NRV valves
- NRV close on completion of pumping and do not allow draining of the rising main to the well

Testing of Duty and Standby equipment and performance

- Measurement of duty pump performance is to be made immediately prior to the combined stop level
- Measurement of:
  - Current Draw, CT
  - Current Draw, as read by analogue display
  - Flow

Critical alarm float activation of pumps without the aid of the PLC controls and shutoff at low level float return

Both pumps start when the critical alarm float is tipped

Vibration checks

No adverse vibration is detected on the pump system, pipe work or movement is detected on the pipe work at cessation of the pump operation

Where any of the above fail to satisfy the requirements of the specification or Council, the Developer must correct the defect and retest.

On the successful completion of the pump test the station is to be left in automatic float level operational mode.

Post Cabinet Installation

The commissioning of the electrical components will be on the mains supply to the cabinet and the external downstream electrical connections.

Table 5-12: Telemetry Connection and Electrical Cabinet Commission Test Schedule

<table>
<thead>
<tr>
<th>Test Required</th>
<th>Specific Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mains supply</td>
<td></td>
</tr>
</tbody>
</table>
| Generation Connection| Phase Rotation
As no standard rotation direction can be specified for the connection to the supply mains, should there be a difference between the mains supply and the generator rotation, differences are to be rectified at the generator supply connection. |
### Test Required
<table>
<thead>
<tr>
<th>Specific Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Phase Fail relay</td>
</tr>
<tr>
<td>• Spill inhibit</td>
</tr>
<tr>
<td>• Final US calibration</td>
</tr>
<tr>
<td>• Digital Controls</td>
</tr>
<tr>
<td>o Critical level</td>
</tr>
<tr>
<td>o Standby Start</td>
</tr>
<tr>
<td>o Duty Start</td>
</tr>
<tr>
<td>o Common Stop</td>
</tr>
<tr>
<td>o Wash Solenoid(s) (if installed)</td>
</tr>
<tr>
<td>• Analogue Controls</td>
</tr>
<tr>
<td>o Analogue High</td>
</tr>
<tr>
<td>o Duty Start</td>
</tr>
<tr>
<td>o Standby Start</td>
</tr>
<tr>
<td>o Stop</td>
</tr>
<tr>
<td>o Storage in Use</td>
</tr>
<tr>
<td>o Storage @ 50%</td>
</tr>
<tr>
<td>o Storage full</td>
</tr>
<tr>
<td>o Pump 1 Amps</td>
</tr>
<tr>
<td>o Pump 2 Amps</td>
</tr>
<tr>
<td>o Flow</td>
</tr>
</tbody>
</table>

- **Pump operation on Manual**
- **Pump operation on Automatic**
- **Pump Duty Change over**
- **Mini-CAS**
- **Overload settings**
- **Soft-Start settings (if fitted)**

At the successful completion of the above electrical tests, the Developer’s electrical representative is to complete the site’s Electrical Certificate of Compliance. Provision of this document to Council will mark the successful completion of electrical and control commissioning.

### Station Set Up

On completion of the Developer’s installation of the electrical cabinet at site, the final radio connection to the Council telemetry network will be carried out by Council or their nominated agent.

On completion of the network connection the station will be available for final electrical commissioning which will be carried out by Council’s current service supplier in conjunction with Council as well as the Developer for the mechanical and electrical installation. Two weeks advance notice shall be given of the programmed commissioning date.

### Final Sign Off

This is to cover mechanical, electrical and telemetry aspects. On completion and acceptance of performance the Developer can apply for the station to undergo a Commissioning test.
Council representatives shall be present at the test and a minimum of 5 working days’ notice shall be given to Council prior to commissioning taking place.

Any defect, found or non-conformance to agreed standards, shall be rectified prior to acceptance of the pump station by Council.

Commissioning

As a follow on from electrical testing, the Developer shall allow for a full commissioning of the switchboard, associated pumps, soft starters, control, alarms, and measurement instrumentation and telemetry system and commissioning of the filter and extractor fan if installed.

Included with this requirement is the commissioning by standby generator of the switchboard and interconnections. Full operational checks and pump running shall be carried out on the Standby Power generator supply.

A fully scheduled pre-commissioning and commissioning program shall be derived and submitted to Council. This shall include (but not necessarily be limited to) defining all activities to be undertaken after the testing is completed. Such pre-commissioning checks and commissioning shall allow co-ordinating with the Council’s operational staff and allow for their input.

Commissioning in the regard to the confirming of operational safety and reliability only after all non-livened tests have been completed. Full written records of all operational set points, readings of all dials, instrument digital displays for the whole range of operational equipment, alarm indications etc., shall be taken at the time, on site, and presented in a tabulated and written/typed form to Council.

- Site Installation of Electrical Cabinet
- Plinth
- External Wiring to Auxiliary Units
- ~3 phase Supply
- Pumps
- Floats
- Ultra-sonic
- Wash Solenoids
- Flow meter

5.3.11.3 Rising Main Test

The following procedure may be used only for the testing of polyethylene pipelines. Whilst the normal procedures followed and precautions taken for hydrostatic pressure testing of completed pipework apply equally to polyethylene systems, some variations are necessary because of the mechanical properties of polyethylene (PE).

The rising main shall be tested to a pressure not less than 2.5 times the calculated dynamic pumping head and the test water temperature is below 20⁰C.

The test method involves calculating the rate at which the test pressure decays and is used for large diameter or long lengths of pipe.

The duration of the test should be limited to one hour. Stabilize before the test procedure begins. Pressure should be applied at a constant rate and the time (tL) taken from the start of
pressurization to attainment of test pressure must be recorded. Readings of pressure decay at time intervals in minutes must be taken and recorded. The first such reading P1 is taken at a decay time t1 equal to or greater than tL. The second reading P2 is taken at a decay time t2 equal to or greater than 5 x tL.

Calculate \[ N1 = \frac{\log_e P1 - \log_e P2}{\log_e t2 - \log_e t1} \]

which shall be between 0.04 and 0.12. If \( N1 > 0.25 \) an unacceptable leak is indicated.

The third reading P3 is taken at a decay time t3 equal to or greater than 15 x tL.

Calculate \[ N2 = \frac{\log_e P2 - \log_e P3}{\log_e t3 - \log_e t2} \]

If \( N2 > 0.25 \) an unacceptable leak is indicated. If the ratio is less than 0.8 an unacceptable leak is indicated.
### Appendix A

**Forms and Checklists**

Table 5-13: Forms and Checklist Register

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>F5.1</td>
<td>Quality Assurance Design Certificate</td>
</tr>
<tr>
<td>F5.2</td>
<td>Pipe Laying Checklist</td>
</tr>
<tr>
<td>F5.3</td>
<td>Manhole Checklist</td>
</tr>
<tr>
<td>F5.4</td>
<td>Trench Backfill Compaction Test</td>
</tr>
<tr>
<td>F5.5</td>
<td>Final Inspection</td>
</tr>
<tr>
<td>F5.6</td>
<td>Pump Station</td>
</tr>
</tbody>
</table>
### Table 5-14: Drawing Register

<table>
<thead>
<tr>
<th>Drawing No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>D5.1</td>
<td>1050 dia. to 1350 dia. Manholes</td>
</tr>
<tr>
<td>D5.2</td>
<td>Typical Dimensions for Manholes Greater than 1350 dia.</td>
</tr>
<tr>
<td>D5.3</td>
<td>Shallow Manholes</td>
</tr>
<tr>
<td>D5.4</td>
<td>Lateral Connection</td>
</tr>
<tr>
<td>D5.5</td>
<td>Anti-Scour Blocks</td>
</tr>
<tr>
<td>D5.6</td>
<td>Building Over and Adjacent Pipelines</td>
</tr>
<tr>
<td>D5.7</td>
<td>Wastewater Pumping Station Site Plan Layout</td>
</tr>
<tr>
<td>D5.8</td>
<td>Wastewater Pumping Station – Cross Section</td>
</tr>
<tr>
<td>D5.9</td>
<td>Standard Wastewater Pumping Station For Flyght 3085, 3102 and 3127 Pumps</td>
</tr>
<tr>
<td>D5.10</td>
<td>Wastewater Pump Station Upper Section</td>
</tr>
<tr>
<td>D5.11</td>
<td>Wastewater Pump Station Lid Frame</td>
</tr>
<tr>
<td>D5.12</td>
<td>Wastewater Pump Station Lid Frame Detail 1</td>
</tr>
<tr>
<td>D5.13</td>
<td>Wastewater Pump Station Lid Frame Detail 2</td>
</tr>
<tr>
<td>D5.14</td>
<td>Wastewater Pump Station Lid Details</td>
</tr>
<tr>
<td>D5.15</td>
<td>Wastewater Pump Station Wet Well Secondary Lids</td>
</tr>
<tr>
<td>D5.16</td>
<td>Wastewater Pump Station Storage Plan</td>
</tr>
<tr>
<td>D5.17</td>
<td>Wastewater Pump Station Storage Section</td>
</tr>
<tr>
<td>D5.18</td>
<td>Wastewater Pump Station Storage End Elevation and Details</td>
</tr>
<tr>
<td>D5.19</td>
<td>Wastewater Pump Station Flow Meter and Control Cabinet Plinth</td>
</tr>
<tr>
<td>D5.20</td>
<td>Wastewater Pump Station Backflow Prevention</td>
</tr>
<tr>
<td>D5.21</td>
<td>Wastewater Pump Station Backflow Prevention Cage</td>
</tr>
</tbody>
</table>