Standard for Network

Wastewater Pumping Stations

and

Pressure Rising Mains

DP-06

Ver. 1

Date: 15 December 2017

Revision	Description	Released by	Date
0.4	First release - working draft	J de Villiers	29/06/2015
1	First release	J de Villiers	15/12/2017

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Summary of changes

Version	Section	Description of revision
1	1	Redefined definition for networks pumping station standard covered by this standard. Definition allows for cut-off point relating to operational sizes and additional requirements associated with larger pumping stations to be specified elsewhere.
	2	Added references to other Watercare standards that must be adhered to in conjunction with this standard
	3	Separated out the pump station component asset life but groups
	4	Updated reverse sensitivity covenant requirements for adjacent properties. Minor wording changes.
	4.1	Section added to define “contaminant-free” site. Referred to updated Code of Practice for land development and subdivision (ver. 2 and later) for universal understanding.
	5	Minor updates to design process diagram
	6.1.3	Section restructured with sub-sections to identify inlet pipework and wet well sizing separate from general requirements. General requirements amended with minor updates
	6.1.4	Addition for washers to be controlled from RTU
	6.1.6	Minor wording updates. Old standard references removed
	6.2.3	Table removed. Referenced to Watercare material supply standard
	6.2.5	Valve operational from ground level to prevent unnecessary confined space entry
	6.3	Minor wording changes not affecting designers. Internal process changed
	6.5.5	Update to onsite materials handling systems to comply with recognised standard
	6.5.6	Update to lid requirements to meet recognised standard
	8	Minor wording updates. No change in meaning
	9	Included reference to complete commissioning in accordance with Watercare’s code of practice for commissioning
	Appendix A	Replaced with Watercare NDC executive summary. Drawings referenced as a set located in Watercare’s engineering standards framework
	Appendix B and C	Removed and replaced. Previous examples for FAT and I/O test sheets no longer required with release of Watercare’s code of practice for commissioning. Appendix D becomes appendix B. Appendix E becomes appendix C

Table of contents

Glossary: Terms and abbreviations

Accept(ance)	a sign-off by Watercare that it is in general agreement with a proposal. This sign-off does not transfer the designer's liability to Watercare.
ADWF	Average dry weather flow.
BEP	Best efficiency point, typically at about 85% of the pump shut-off head. This is the pump design point.
DN	Nominal metric diameter designation conforming to the International Standards Organization.
ΣDDT	Trichloride-2,2-bis(*p*-chlorophenyl)ethane, synthetic organic compound used as an insecticide.
EDC	Engineered discharge consent.
FD	Functional description completed to Watercare's template
GRP	Glass reinforced pipe.
Head	Measure of liquid surface elevation.
H_2S	Hydrogen Sulphide.
H&S	Health and Safety.
kPa	Kilo-Pascal.
LIM	Land Information Memorandum.
l/s	Litres per second.
MH	Manhole.
NDC	Network Discharge Consent. Watercare's global discharge consent for overflows from its wastewater network in existing urban areas and some planned future urban areas.
NES	National Environmental Standard.
NPSH	Net positive suction head.
ppb	Parts per billion.
ppm	Parts per million.
PS	Pumping Station.
CS1, CS2, CS3, CS4	Watercare engineering compliance statements for design and construction.
PN	Nominal internal pressure that a component can safely withstand.

P&ID	Piping and instrumentation diagram.
Rising main	Pressurised wastewater pipe through which wastewater is elevated to a point of discharge.
SCS	Soil contaminant standard.
VOC	Volatile organic compound.
Wet well or storage tanks washer	Automated wash-down system to clean the wet well or storage tanks.
WGS84	World geodetic system. WGS84 is the latest reference coordinate system used by global positioning systems (GPS).

1. Introduction

Design and construction of pumping stations need to be completed by competent persons to the minimum requirements as set out in this standard.

The pumping station developer needs to consult with Watercare as early as possible to ensure compliance with the process stages outlined in Section 5. Failure to follow this process will delay obtaining Watercare's approval.

This standard covers the planning, design and construction of network wet well pumping stations and pressure rising mains typically up to 78 l/s. The requirements for larger, dry well or Watercare transmission wastewater pumping stations are considered by a separate application and with supplementary requirements.

Privately owned pumping stations are excluded from this standard. Temporary pumping stations in Watercare ownership may be considered on a case-by-case basis, but must still be designed and constructed in accordance with this standard.

The electrical standards and standard pumping control templates are available separately and shall be read in conjunction with this standard. Watercare's telemetry requirements are location based and require input from Watercare to identify the applicable standards and/or site requirement for the proposed site location.

2. General Requirements

Pumping stations will only be considered by Watercare when it can be demonstrated that a gravity solution is unpractical.

Where pumping stations are developed by external developers, pumping stations shall be provided at the full expense of the developer. When properly designed and constructed to Watercare's standard; Watercare will take over the future operation and maintenance after the pumping station has been commissioned and vested in Watercare. Private ownership of pumping stations connected to the public wastewater system is only allowed under a body corporate arrangement or legal instrument. Notwithstanding when the pump station is vested to Watercare, the developer shall be liable for all flushing until there is sufficient volume for self-cleansing of the rising main.

Pumping stations developed by Watercare or a developer shall follow the same process of review and implementation.

For the purpose of this standard, 'developer' shall be interpreted as both an external party developing a pumping station to be vested to Watercare and any party contracted to Watercare to develop a network pumping station.

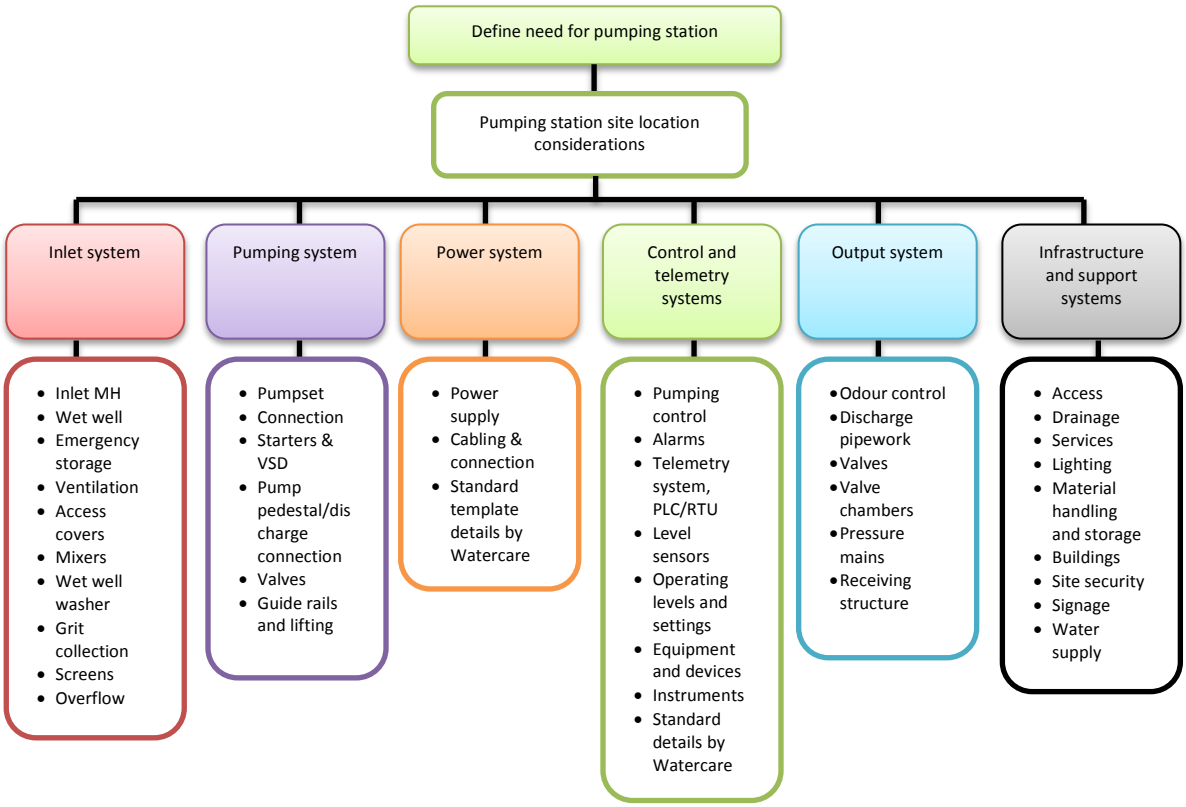
This design standard shall be read with the following Watercare construction and material supply standards:

- CoP – 02 Water and Wastewater Code of Practice for Land development and subdivision, Chapter 5
- DW01 - Code of Practice for Land Development and Subdivision – Wastewater drawing set
- DW03 - Wastewater pumping station drawings for networks
- DP-09 Electrical design standard
- DW18 - Pump station electrical drawing set
- 7363 – Standard for producing CAD and geospatial drawings

- MS – Material supply standard
- DW05 - Access structure drawings for wastewater infrastructure
- DW07 - Access structures general drawings for public and non-public areas

- CG – General civil construction standard
- ME – General mechanical construction standard
- EC - General electrical construction standards
- COP-03 Code of Practice for commissioning
- AI-03 CCTV inspection of sewers and data collection

The design considerations for review by Watercare shall follow the following output format:



3. Pumping Planning Considerations

It is expected that alternative wastewater servicing options have been identified as part of the concept development and planning process. The feasibility study shall have considered technical, environmental and financial criteria over the entire design life of the system and that pumping is confirmed as the least whole of life cost solution.

When planning and designing for a pumping station; consideration shall be given to pumping station placement; the numbers of pumping stations proposed in the catchment area; the ultimate development of the catchment and demonstrate:

- Servicing strategy at initial start-up and long term
- Consideration of future development / upgrades that will allow the existing infrastructure to accommodate the overall increase in the capacity of the pumping station and staged infrastructure
- Running costs, life-cycle and ongoing maintenance costs
- Impact on existing pumping stations will require a full system integrated design
- Upstream catchment growth and system delivery limitations
- Septicity within the pump station and connected pipework, odour issues and corrosion of equipment and pipes

- Environmental and health and safety risks
- Dry-weather storage capacity either in the wet well or storage tanks (minimum 8 hrs)
- Pumping station structures shall allow for the following minimum design life:
    i. Wet wells and storage tanks 100 years
    ii. Pipework (pressure and gravity) 100 years
    iii. Wet well accessories 20 years
    iv. Valves and meters 30 years
    v. Electrical equipment 25 years
    vi. SCADA and control 15 years

4. Pumping Station Site

Watercare requires that the pumping station has its own dedicated contaminant free lot, provided exclusively for the purpose of housing the station and all related structures and equipment. Where the access is a right-of-way shared with other lots the station site must be of sufficient size to provide a parking space for service vehicles that does not obstruct the right-of-way. Watercare may require the lot to be designated as a utility reserve or similar.

The developer must notify all prospective purchasers' of the lots that are adjacent to the pumping station of its location and associated structures. Examples of such plans could be the development plan (scheme plan) that the developer lodges with council under s223.

A reverse sensitivity (or non-sensitivity) covenant must be placed on the titles of all nearby lots within a range of minimum 20 metres of the subject lot boundary. Factors that determine the covenant distance to be greater than 20 metres shall be based on the nature of the pump station operations, the pump station size and location within the development.

It is important that the developer considers the telemetry serviceability of the pumping station site early in the design process; see Section 5 and 6.3 for more detail. The pumping station general site layout shall have:

a) A level aspect within the boundaries of the pumping station.

b) 24hr all-weather vehicle access, adequate parking and where specified an adequate turning area within the pumping station boundary.

c) Adequate clearance around the wet well, inlet manhole, storage well and valve chambers to allow service vehicle access, lifting of equipment and parts and general serviceability of the pumping station.

d) Odour control system(s) required at the pumping station and as necessary at air valves on the rising main shall be considered as part of the overall design. The odour system for the wet well and storage tank shall have minimum 12m horizontal clearance from the centre of the odour vent system to the adjacent property boundaries.

e) Dedicated underground mains power supply.

f) A freestanding weatherproof control cabinet to house electrical equipment as specified in the Watercare electrical and control standards.

g) Building doors, switchboards, control cabinets and chamber cover-plates are to be provided with adequate clearances for maintenance access.

h) Electrical connection facilities for the provision of a temporary generator.

i) Dedicated electrical and control services trench.

j) Outlet valve chamber.

k) Magnetic flowmeter chamber.

l) Drain-back bypass into the storage tank or wet well.

m) The storage tank shall be buried to finished ground level or below.

n) Where applicable a minimum 1.8m high fence with a lockable gate to Watercare's requirements.

o) Landscaping and planting as required by consent conditions or as otherwise specified by Watercare during the design review.

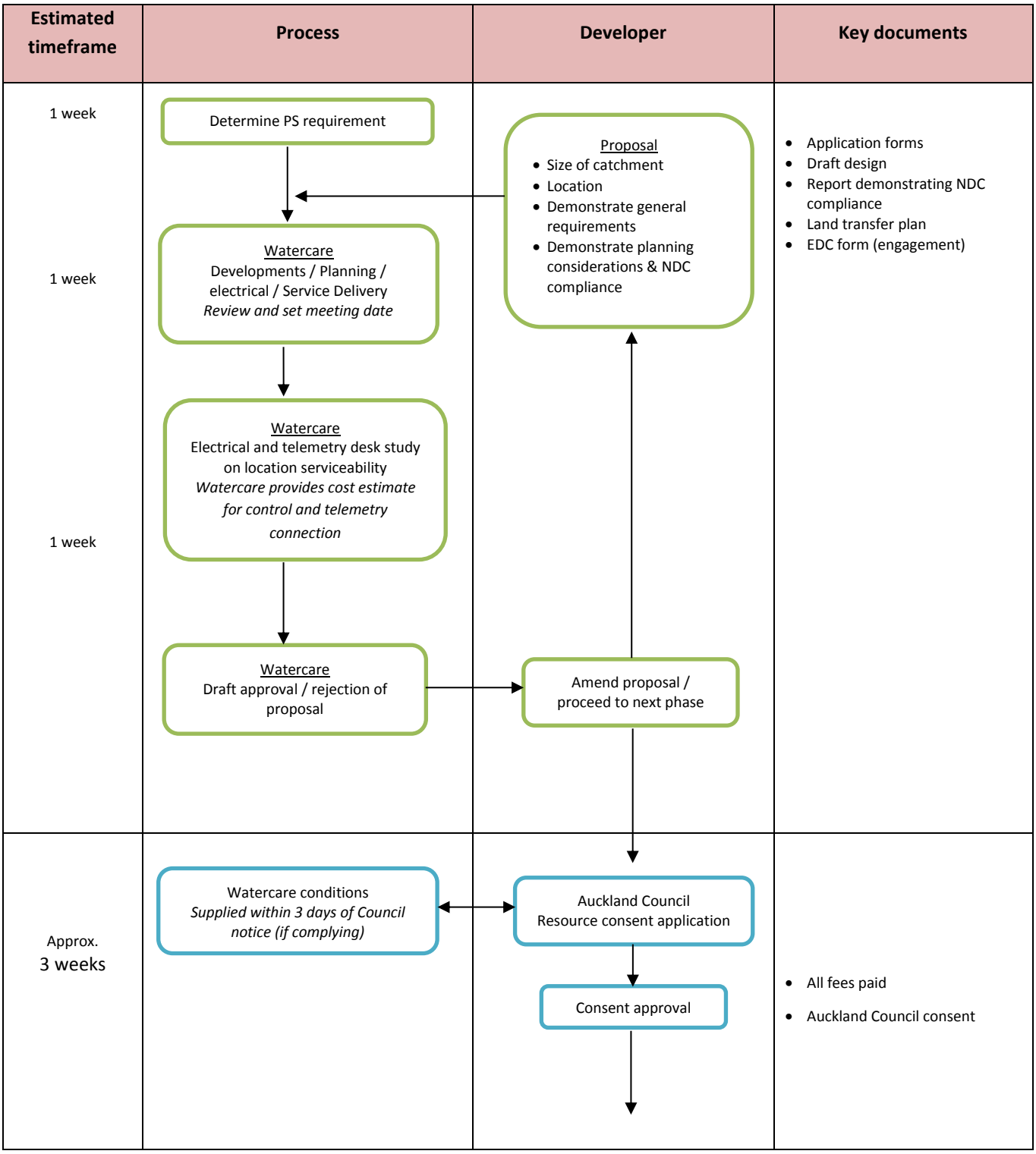
p) Compliance with Watercare's Network Discharge Consent (NDC). The full consent conditions are available from Watercare on request. An executive summary is provided in Appendix A.

4.1 Contaminant-free site

Refer to the Water and Wastewater Code of Practice for Land Development and Subdivision, Wastewater chapter 5 (document number CoP-02) for the acceptance criteria for contaminant free sites.

5. Design Process of Network Wastewater Pumping Stations

There are a number of operational and technical considerations for the developer to discuss with Watercare before beginning the consenting process with Council. The following flow chart is a guideline on the expected timeframes and requirements at each stage of the process:



Estimated timeframe	Process	Developer	Key documents
Minimum 2 weeks	Technical review *Design to be finalised* Watercare acceptance *Design accepted (internal process)*	<u>Complete design</u> • Plans and technical drawings • Design drawings • Calculations; • Discharge plan and reports.	• Final design report (covering requirements in this standard, i.e. calculations, surge analysis, FD, P&ID's, schedule of materials) • Design compliance statement (CS1 or CS2, ref. section 6) • Serviceability limit state, ref. section 6 b) (confirmed with Watercare) • Engineering design approval
		Developer constructs pumping station	• Construction QA/QC
Minimum 2 weeks	<u>Watercare review:</u> Documentation and compliance of construction with approved design. Pre-commissioning site visit. Developer corrects any issues		• Prelim as-built drawings • Electrical certificate of compliance (CoC) • Signed-off pre-commissioning test results of structures and pipework. Refer section 9 • Draft Operations and Maintenance Manual. Refer Appendix C • Factory acceptance testing (FAT). Refer Appendix B • Commissioning plan • Construction QA/QC sign-off
Minimum 4 weeks		Commissioning (witnessed by Watercare) *All pre-commissioning documents finalised and approval received*	• Commissioning plan • Approval to connect
	Watercare acceptance of final documents Watercare takes over operation	Final documentation Final documentation	• Post-construction residual risks register • Operations and Maintenance Manual • Final Functional Description (FD) supplied separately to the O&M manual. Refer Appendix B and C • Electrical Certificate of Compliance • Design drawing sets, as-built drawings and survey data • Asset certificate • Engineering compliance statements (CS3 and CS4) • Agreed to transfer of liability

6. Design

The design of pumping stations shall be carried out by engineers qualified and competent in the relevant field of expertise. Designs shall be certified (Watercare CS1 or CS2) by a Chartered Professional Engineer.

The design shall consider industry best practice for principles of Safety in Design (SiD). The goal of SiD is to integrate hazard identification and risk assessment early in the design process to eliminate and minimise the risks of injury during construction and the life of the pumping station.

The design shall be carried out in conjunction with the standard drawings set DW03, showing the typical layout that is expected for a pumping station. It is expected that the core requirements shall remain unchanged with design outcomes establishing the pipe sizes, fall/grade changes, chamber sizes, wet well size and depth, storage tank dimensions.

The general requirement for pumping station design shall include but not be limited to:

a) Determine system design flows in accordance with the Water and Wastewater Code of Practice for Land Development and Subdivision, Chapter 5.

b) All structural design with specific reference to the wet well and overflow tank shall be in accordance with AS/NZS1170 for structural integrity, seismic actions and support of equipment and tanks. A designation schedule of essential infrastructure for post-disaster operational continuity shall be determined in consultation with Watercare and to determine the appropriate serviceability limit state.

c) Determine the station lifting height requirements, flow losses through pipework and fittings to calculate the total head.

d) Develop a system curve that considers:

- A flow velocity between 0.9m/s and 1.5m/s but not less than 0.9m/s for initial stages of a new subdivision.
- The maximum flow velocity shall be 2m/s, allowing for future expansion such as staged rising main upgrades.
- Static and friction losses.
- Total lifting head.

e) Select pumps where the pump curve intersects with the system curve (Figure 1) allowing an overall inaccuracy factor of 10% for friction losses in the system curve. See Section 6.2 on pump selection.

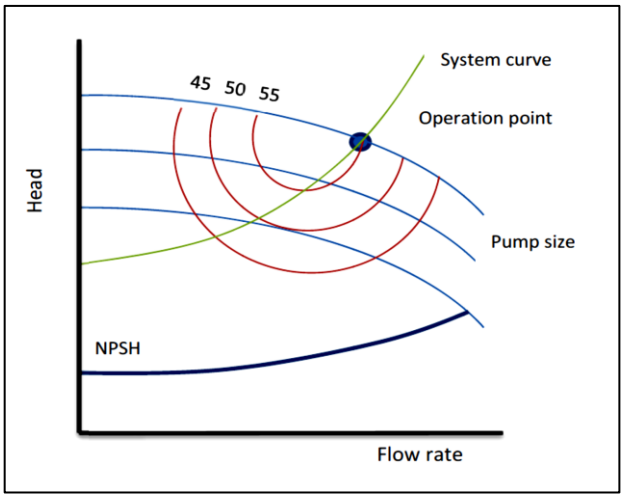


Figure 1: Pump selection by combining system curve and pump curve to determine the best efficiency point.

f) Storage in a tank or the wet well to provide 8 hours average dry weather flow (ADWF) capacity for the ultimate catchment. Overflows shall not exceed the requirements of the NDC at the expected end of life of the asset. Refer Attachment A.

g) Pump stop/start not to exceed more than 6 cycles per hour (for ADWF). Pump duty standby to rotate on each successive pumping cycle.

h) Septicity and odour control measures.

i) Complete geotechnical investigation for the purpose of structural design, construction considerations and land contamination report. All data collected shall be uploaded to the Auckland Geotechnical Database in AGS4 format at: ***https://agd.projectorbit.com***

j) Structural design of infrastructure.

k) A fire alarm is not generally required for network pumping stations unless it is housed in a building and required under the Building Act.

l) Pipework and general arrangements of equipment shall take into consideration best practice to minimise the likelihood of corrosion and the need for ongoing maintenance.

m) The component layout design shall consider safe access and egress, operational ergonomics and minimisation of confined space entry under the expected operational situations.

n) Design of the rising main.

o) All drawings shall comply with Watercare's drawing standards.

6.1 Pumping Station Inlet System

6.1.1 Pumping Station Inlet Structure

The inlet structure / manhole shall be situated wholly within the pumping station site. The design of the inlet structure shall have the following functions and requirements:

a) Collect all wastewater inflow into the pumping station.

b) Provide access or location for grit collection if required.

c) Be able to facilitate bypass pumping or serve as a temporary wet well during emergencies.

d) Allow for an isolation knife gate valve at the outlet of the inlet structure. Alternately, depending on available space the gate valve may be located at the wet well inlet.

e) Gradient through the manhole shall be as for any other gravity manhole (See CoP Wastewater, chapter 5, sections on manholes).

6.1.2 Grit Collection and Screens

In areas where grit collection or pre-treatment by screening is required by Watercare, the system shall be designed for incorporation into the inlet structure. The system shall be submitted to Watercare for approval.

6.1.3 Wet well

For the purposes of small capacity pumping stations (less than 78 l/s) a single wet well shall be provided. The following general arrangements of the wet well shall be incorporated into the design:

a) Ground conditions and geotechnical requirements (e.g. screw pile foundation) to protect against seismic movement or ground settlement.

b) Prevention of septicity and "dead zones" where solids can accumulate.

c) The maximum retention time of wastewater during normal operation shall be 2 hours.

d) Benching shall be formed at a minimum 45° angle to guide flow towards the pump suction and achieve self-cleaning.

e) Allow adequate clearance from well sides and base to pump inlets in accordance with the pump manufacturer's installation recommendations.

f) A wet well washer connected to the potable water supply with a flexi-hose connection and stainless steel lifting chain. The wet well washer shall be hinged to enable repositioning when doing maintenance. Wet well washer operation shall be programmed in the RTU.

g) Installation of mixers requires approval from Watercare.

h) Ventilation shall be installed for all pumping stations at a level of at least 150mm above the well overflow level and 150mm below the well lid and at least 1m above the pump duty point. The location and angle of the outlet of the duct will allow condensation to freely drop back into the well and be at the furthest point away from the inlet.

i) The vent shall be into a vent stack/shaft of suitable length to diffuse air above the surrounding rooftops. Where natural venting can be predicted to cause odour or health concerns, a suitably sized odour filter shall be installed at ground level. The ventilation system shall be designed to provide adequate ventilation velocity. The filter size and frequency of filter replacement must be presented to Watercare's for acceptance.

j) The access hatch shall provide a full clear opening over the discharge pipe bend and up to the external dimensions of the installed pump set. Watercare standard design details shall be used for all lids, see drawing set DW05. Hatches shall be tested to comply with AS3996 to an appropriate class.

k) All access hatches shall be fitted with a hinged safety grille underneath the lockable access hatch to Watercare standard design. Safety grilles shall be tested to comply with AS3996 class A.

l) A safety harness attachment lug shall be installed in the vicinity of access hatches. The site-specific location shall be determined by a suitably qualified operational health and safety person.

m) Anti-buoyancy design to prevent wet well floatation.

6.1.3.1 Wet well inlet pipework

The inlet pipework into the wet well shall have the following features:

a) An isolation knife gate valve located at the wet well inlet (if not installed on the inlet structure).

b) A pipe inlet arrangement to minimise turbulence that could create H_2S gas generation or poor pump performance and be situated as far as possible away from the pump inlets.

c) A discharge from the inlet pipe that prevents flow directly onto a pump and such that the inflow into the wet well during high flow does not cause eddies (e.g. deflector plate).

d) An inlet fall height that shall not exceed 1m above the bottom operating water level to limit air entrapment.

e) An external flexible connection designed to offset seismic event or ground settlement.

6.1.3.1 Size of wet well

The size of the wet well shall be determined by the following criteria.

a) The wet well operating range shall be a maximum of 1m in height from the base of the pump inlet to prevent settling.

b) Have a minimum free-bore clearance of 1m from the installed pump guide-rails, cables and other components to facilitate maintenance.

c) The volume between pump start and pump stop shall be determined by pump capacity and shall be set to limit the frequency of pump starts (Refer to 6.6 (g)). The pump start level shall take into account the need to prime the pumps.

d) The centre-to-centre clearance between pumps shall be a minimum of 1.5 times the external pump diameter at its widest section.

e) The side clearance from the centre of the pumps to the well walls shall be minimum 0.8 times the external pump diameter at its widest section.

6.1.4 Emergency storage

Additional storage may be required where the minimum ADWF storage for the ultimate catchment of 8 hours cannot be contained within the wet well. The emergency storage shall be maintained between the high-level alarm level and the wet well overflow level.

The storage tank shall be fitted with one or more tank washers as appropriate for the size of the storage tank. Washer function is programmed in the RTU.

The storage to wet well interconnection shall be such as to allow the storage to be used in an emergency for pumps or wet well failure and maintenance scenarios.

The design shall incorporate an anti-buoyancy design to prevent the storage tank from floating when not in service.

6.1.5 Wet well overflow

The wet well overflow shall be determined by the location of the pumping station and the environmental impact assessment and consequently consented conditions. The overflow shall be into an overflow structure with connecting outfall that must be accessible by a sucker truck.

The outlet from the overflow manhole shall be fitted with a stainless steel baffle plate to prevent scum discharge to the environment. Drainage fall shall be away from the overflow manhole to allow draining back to both the wet well and to the outfall that shall be fitted with a non-return flap valve. The outfall shall be constructed with a wing wall and fitted with a stainless steel grid.

The specific design shall take into consideration energy dissipation and erosion control in the receiving environment.

6.1.6 Material selection

All materials shall comply with Watercare's material supply standards. The following special considerations shall be taken into account:

6.1.6.1 Inlet structure

The inlet structure shall be constructed from either concrete with resistance to corrosive attack i.e. calcium aluminate, polymer concrete or be protected with a suitably specified painting system as per Watercare general civil construction standard. GRP and PE manhole solutions are acceptable.

6.1.6.2 Wet wells

Concrete wet wells shall be constructed from either concrete with resistance to corrosive attack i.e. calcium aluminate, polymer concrete or be protected with a suitably specified painting system as per Watercare material supply standard.

GRP wet wells are acceptable.

6.1.6.3 Inlet pipework

Inlet pipework may be selected to the appropriate design class from the materials listed in the Watercare Material Supply standard.

6.1.6.4 Storage tanks

As per section 6.1.6.2.

6.1.6.5 Ventilation stack

All components, fixings and supports shall be fabricated from corrosion resistant materials. Preferred materials include stainless steel 316, PVC and GRP. Galvanised steel is not acceptable. The ventilation stack shall be fitted with a cowl to disperse the ventilated air and prevent wind from affecting the ventilation velocity.

6.2 Pumping System

6.2.1 Hydraulic design

The hydraulic design shall be determined by the following parameters:

a) Invert level of the incoming wastewater

b) Pumping station capacity (initial and ultimate capacity)

c) Internal diameter, length, route and materials of the rising main, including surge and fatigue analysis

d) Levels and profile of the rising main

e) Level of the rising main discharge point

f) High points - to account for possible characteristics controlled by intermediate highpoints along the rising main

g) Detention times for wet well and rising main(s) not exceeding 8 hours

h) Shear velocity to prevent slime build-up in rising mains that will increase flow resistance over time

The system design shall be based on the total pumping head with design flows anticipated at ultimate wet weather inflows and used to develop the system curve. In deriving the system curve the static head shall be based on pump duty start level at 150mm below the invert level of the incoming wastewater pipe.

6.2.2 Pump selection

a) Pump selection shall be within ±5% of the pump best efficiency point (BEP)

b) The pump efficiency is influenced by the type of impeller selected for the specific pumping application. The minimum overall pump efficiency shall not be less than 50%. Lower efficiency may be considered in the following exceptional circumstances:

   i. Where pumping stations are very small, or

   ii. The pump curve is very flat thereby consuming less power at intermediate flows, or

   iii. The anticipation of excessive impeller clogging and the associated maintenance outweighs the energy saving costs of selecting a more efficient impeller type.

c) Pump head curves with very flat head flow characteristics can make the pump difficult to control. Small changes in system resistance can create large changes in flow rate or cause ‘hunting'. The use of variable speed drives (VSD) in these scenarios shall require prior approval from Watercare.

d) Consideration to pump wear over the pump maintenance cycle to achieve flow design criteria.

e) 100% standby capacity i.e. one duty pump and one standby pump. The pumps shall be of the same size, make and model and be accepted by Watercare.

f) Net positive suction head (NPSH) analysis is not required for wet well pump design, but shall be a minimum of 1m over the wet well operating range.

g) Refer to Watercare electrical standards for VSD and starter requirements.

6.2.3 Pump product requirements

The pump shall comply with the standards as listed and amended in Watercare's material supply standard.

6.2.4 Outlet pipework in the wet well

Outlet pipework from the pumps to the first flange inside the outlet valve chamber, shall in addition to internal corrosion protection, have external corrosion protection to withstand H_2S levels of up to 50 ppm with a high abrasion resistance rating in excess of 25 years. Suitable materials include stainless steel, ductile iron with suitable polymer coating or polyethylene sleeve, or polyethylene pipe.

6.2.5 Valves

Valve installations shall be constructed with an adequate support that will allow the valves to be freestanding, should any other component be removed. Dismantling joints shall be provided to allow removal of components. Isolation and non-return valves shall be the same diameter as the pipework being installed on.

The isolation valves with non-return valves shall be housed in a chamber adjacent to the wet well. In the case of the valve chamber being integrated with the wet well (preferred), the chamber shall be isolated from the wet well to prevent H_2S gas collecting in the valve chamber. The valve chamber shall be self-draining to the wet well through a check valve and trap arrangement.

Isolation valves shall be operable from ground level.

6.2.5.1 Non-return valves

Non-return valves shall be swing check type with a rubberised steel disc and as accepted by Watercare.

6.2.5.2 Isolation valves

Valves shall be metal seated gate valves. Isolation valves shall be installed on each pump discharge line downstream of the non-return valves.

6.2.5.3 Air release valves

Air release valves shall be double acting and as accepted by Watercare. The air valves shall be located in an accessible chamber that is vented and fitted with either an activated carbon filter or vent stack with no noticeable odour at the nearest property boundary. H_2S shall be less than 0.004ppm measured at the filter outlet.

6.2.5.4 Knife gate valves

Knife gate valves may be required on the inlet structure or the wet well. Knife gate valves shall be approved on a case by case basis and be specific for the application head and flow rate.

6.2.6 Guide rails and lifting

Guide rails shall be stainless steel grade 316 to suit the standard dimensions for the pump pedestal. A double guide rail shall be supplied for each pump to allow free sliding and correct seating for the specific pump model.

All mounting brackets and fixtures shall be stainless steel grade 316. The spacing of mounting brackets shall be such as to avoid deflection. Minimum top and bottom fixing are required.

Lifting chains shall be stainless steel grade 316 and installed for each pump and the well washer.

6.3 Electrical, Control and Telemetry

Electrical, control and telemetry design and installation shall comply with the Watercare electrical and control standards and template drawing set DW18 for pumping stations.

6.3.1 Electrical

The developer shall provide all equipment and wiring to complete the electrical connection. The following requirements for establishing electrical power on site shall also be met:

- Sites owned by Watercare shall be coordinated for connection through Watercare.
- Where mains electricity is not available at the site a new installation point (ICP) will be provided by the developer
- Mains electricity shall be of sufficient capacity taking into account future expansion
- Information required for the ICP include: supply phase; maximum demand load in amps; physical address of connection; name and contact of the electrical contractor undertaking the works

6.3.2 Control System and Telemetry

The developer shall provide and install all telemetry equipment, data radio, aerial, mounting equipment, power supplies, relays and cabling, including the field or control devices shown in the drawings. Watercare will provide a cost estimate for connecting to Watercare's network.

Watercare will complete a connection suitability study at the cost of the developer, per suggested location, to establish the telemetry requirements for the proposed pumping station site. The developer shall supply the GPS coordinates to WGS84 at the centre of the proposed site. A desk study will determine if there is an available connection for the location.

If a connection is possible, the desktop study is followed by a site check to establish the signal to noise level ratio to ensure a good quality signal is available.

Should there be no communications available or the signal strength is less than -82dB a specific design will be required. The cost of additional supporting infrastructure and design (if any) is the responsibility of the developer. An alternative location may be suggested to relocate the proposed pumping station to meet the telemetry requirements. These options will be communicated to the developer for consideration.

The telemetry and radio system shall be in accordance with Watercare’s standard and approved materials list. The installation shall be carried out by a Watercare approved contractor.

The developer shall obtain a facility code from Watercare that is used to provide the tag information used to configure the control system. The information required to obtain the facility code is:

- GIS location of the site
- The physical address associated with the site
- Lot number or Land Registry identification

The SCADA software shall be developed and implemented by Watercare at the cost of the developer to allow connectivity to the Watercare systems.

Watercare has five different control systems that operate in various areas, they are:

- Emerson DCS
- In Touch SCADA
- IFIX LNT SCADA
- Citect SCADA
- Abbey Systems Powerlink

In order for Watercare to complete the SCADA, the following will be supplied by the developer:

- A Level 1 Functional Description (FD), to be reviewed and accepted by Watercare before software programming commences.
- Process and instrumentation diagrams (P&IDs).
- Bill of materials.
- Confirmed Input and Output lists (I/O).

Refer to Section 9 for commissioning and handover.

6.4 Pumping Station Outlet System

6.4.1 Discharge pipework (rising main)

6.4.1.1 Pipe Material

The minimum internal diameter of the rising main shall be 100mm. Smaller pipe sizes shall only be considered where a future extension of the catchment is not foreseeable. Pipe material shall comply with the Watercare material supply standard.

The minimum pipe pressure rating shall be PN12 and any other component valve or fitting shall have a minimum pressure rating of PN16. Air release/vacuum valves with a pressure rating of PN10 may be considered when in close proximity to the discharge structure.

The maximum pressure design shall consider pipe and fittings to be pressure de-rated based on the material maximum cyclic pressure range (MCPR). The maximum operating pressure shall be less than the MCPR.

6.4.1.2 Hydraulic design

The rising main pipe shall be designed to:

- The minimum and maximum allowable flow velocities
- Dry weather and wet weather flows
- Length of the main and allowable detention time
- Maximum allowed number of pump starts
- The working head
- Withstand surge pressures not less than 200kPa
- Withstand a transient pressure of at least 80kPa below atmospheric pressure

The maximum flow velocity shall be 2m/s. The minimum flow velocity shall be between 0.9m/s and 1.5m/s. The minimum flow velocity shall be calculated at the expected start of the service life. The design shall be carried out on the basis of full bore flow.

Head loss shall be calculated using the Darcy-Weisbach equation with frictional coefficients determined using the Colebrook-White equation. See the Watercare Code of Practice for Land Development and Subdivision, Chapter 5, for a guideline to the roughness values of various pipe materials.

Head losses through fittings shall be determined using the component manufacturer's value with a 10% inaccuracy factor.

Pressure surges shall be within the amplitude of the acceptable limits throughout the system. The surge analysis shall take into account the material fatigue of the selected pipe material and the derived maximum allowable operating pressure. The design shall identify solutions for Watercare's approval to mitigate the surge effects.

Possible solutions may include options such as surge control devices, pipe diameter, pipe material and pumping control.

6.4.1.3 Rising main layout

The main shall, wherever possible, rise continuously from the pumping station and terminate at its upper end into the receiving structure. Rising and falling mains (complex rising mains) shall be considered as exceptional circumstances. Where constructed in the road corridor the minimum cover shall be 900mm to the top of the rising main or as otherwise specified by the road corridor manager. The minimum rising or falling grade shall be 0.5%.

Where a continuously rising main is not achievable the following shall be provided for:

a) Peaks and low points shall be minimised

b) Peaks shall be constructed with a double acting air release valve structure. The air release chamber shall be fitted with a ventilation stack to release air above the level of the surrounding rooftops or on approval into a surface mounted filter designed for the expected air flow

c) Low points shall be prominent and fitted with a scour arrangement that allows for a safe discharge location accessible by a sucker truck

d) Scour valve and air release valve chamber access shall be located in the back berm of the road corridor where practicable (the first 1m width of the road berm adjacent to the road carriageway is defined as the front berm)

Rising mains in private properties must be avoided. Clearance from buildings, structures and other infrastructure shall be as specified in the Watercare Code of Practice for Land Development and Subdivision, Chapter 5. No structures shall be constructed over rising mains or planting of any native species tree or shrubs with a maturity height over 1m tall.

The rising main shall be metered with a magnetic flowmeter situated within the pumping station site.

6.4.1.4 Combined rising mains

Watercare will not accept the connection of a new rising main into an existing pumping rising main.

Under exceptional circumstances, parallel pumping will only be considered where the design basis is for a completely new parallel system or where the existing systems are redesigned and replaced. The replacement and upgrade of any existing infrastructure to enable a parallel connection into an existing system shall be at the cost of the developer.

The operating points for parallel pumping stations shall be considered for the full system to set individual pumping points based on the pumping head for each pumping station on the common rising main. The combined output shall be graphically determined using the individual geodetic heads; head loss components for each pumping station to the discharge point and then combined onto a single graph.

Where the common rising main is a complex rising main the graphical determination shall be supported by modelling software. Watercare prefers that the modelling information is provided in *InfoWorks*.

6.4.2 Receiving structure (Discharge MH)

The rising main shall discharge into a purpose manhole structure that will dissipate the energy of the rising main for transition into the gravity system. The rising main shall discharge into the discharge MH on a rising gradient. The rise into the receiving structure shall be minimum 3m long. No other connections shall be made into the discharge MH.

The fall through the chamber between the top of the rising main pipe entry and the outlet pipe shall be minimum 150mm. The rising main and MH outlet shall not be more than 30° out of alignment.

6.4.2.1 Odour control

Depending on the length, flow rate and energy dissipation, odour control and air relief may be required at the receiving structure.

Odour control shall be achieved by an appropriate filter or stack to disperse exhaust ventilation air over the rooftops of the surrounding buildings. The ventilation system shall be designed to provide an appropriate ventilation velocity. The capacity design for filter replacement frequency shall be considered site specifically for Watercare's acceptance.

6.5 Infrastructure and support systems

6.5.1 Water supply

A metered water supply with reduced pressure zone backflow preventer (RPZ) shall be installed to allow for wash-down and connection of the wet well and storage tank washer systems. The supply shall be fitted with a tap connection with ¾" BSP thread to allow fitting of a hose. The water service connection shall be minimum DN32 terminating in a stainless steel lockable cabinet adjacent to the wet well. See G12/AS1 of the Building Code, for the methods and devices required to comply with Watercare's requirements.

6.5.2 Lighting

Where considered an operational requirement or for safety reasons, site lighting may need to be specified. The developer must confirm the requirement and location with the responsible Watercare contact.

The position must be such as to provide adequate lighting over the wet well at a level that will not have obstructive and obtrusive effects. The lighting shall be adequately controlled to prevent annoyance to the adjacent properties. The light switch shall be situated inside the control cabinet.

6.5.3 Drainage

The site shall have adequate drainage and fall to prevent standing or ponding water and prevent inflow into the station and cabinets. Overland drainage shall not affect neighbouring properties and may require a storm water system to be installed for discharge to a suitable location.

6.5.4 Noise control and vibration

Noise generated by the pumping station shall not exceed the Council permitted levels. The design shall include measures to reduce noise appropriately. Where the maximum noise level has not been specified in the resource consent the maximum level shall be 45 dB $L_{Aeq\ (15min)}$ measured at the pumping station boundaries.

Strong and long term vibrations can cause soil settlement in certain soil types as well as long-term structural problems. Apart from the effects on physical structures vibration may also cause discomfort to adjacent property occupiers. The vibration velocity level shall not exceed 1mm/s measured at the pumping station wet well.

6.5.5 Materials handling and lifting equipment

A rotating lifting arm or davit pole shall be specifically designed and fitted over the wet well for lifting material in and out. In some locations, it may be required to install a removable davit arm. In this case, a lifting pole socket shall be provided. The lifting pole shall be of sufficient minimum load rating to be used as a retrieval device for personnel entry. The maximum lift rating shall be imprinted on the davit arm. Adequate access shall be provided for mobile lifting plant around the pumping station installation. The lifting device shall comply with AS4991.

6.5.6 Security and access lids

The site fencing shall have a lockable gate. All cabinets and access manholes shall be lockable. Cabinets and the wet well shall be fitted with an alarm that will signal unauthorised access through the SCADA system. Access lids shall be to the standard Watercare details and supplied with 'universal' padlocks and locking bolts. These shall be replaced by Watercare at the cost of the developer after commissioning of the pumping station. Access lids shall be tested to comply with AS3996.

6.5.7 Signage

Signage shall be provided that identifies the pumping station as the property of Watercare (requirements to be specified by Watercare) as well as the informative operational, health and safety signage that shall be installed at the pumping station perimeter.

6.5.8 Site access road

The site access road shall comply with Watercare's general civil construction standard. Where required (typically at the end of a right-of-way) an adequate vehicle turning area shall be provided within the site. The access road shall have a load bearing sealed width of minimum 3.5m.

7. Design review

Once the design has been completed the designer shall undertake a review to ensure compliance with this standard. The design shall be signed-off by a suitably qualified Chartered Professional Engineer. The following minimum criteria shall be submitted to Watercare with the CS1:

- Health and safety considerations identified during the design covering construction, normal operation, maintenance and emergency operations
- Community and environmental impact assessment
- System components, layout and configuration meet this standard and are in accordance with the typical pumping station standard details in drawing set DW03
- Pump selection
- Plans indicating layout covering pipe size, grade, material types, transfer points and long sections
- Details of air release/vacuum and scour points
- Route selection
- Easements as appropriate
- Geotechnical data and considerations taken into account during design
- Provisions for future extension as appropriate, including upgrade staging and triggers
- Life cycle cost
- Compliance with referenced standards

8. Construction

The developer undertakes and finances the complete works in accordance with the approved design drawings. Construction monitoring shall be as determined under the Watercare compliance statement guidelines and construction monitoring compliance statements (CS4) shall be provided at completion.

The connection of the inlet and rising main outlet shall be after confirmation from Watercare that all work has been satisfactorily completed.

Each section, the inlet with emergency storage, the wet well with pumps and the outlet system shall be individually tested prior to connection.

Construction practices for components shall comply with the following Watercare standards as applicable:

a) General civil construction standard

b) General mechanical construction standard

c) Electrical construction standard

d) Data and asset information standard

As a minimum, redline mark-ups will be accepted for commissioning in anticipation of the final CAD versions being provided at handover.

8.1 Pumping station assets

This section shall be read with Watercare's asset information standard. Apart from capturing the linear assets on the pipelines, the following table lists the level of assets to be captured for the pumping station specifically:

Functional Location	Asset Name	Description
Pumps	Pump 1	Each pump (including motor if submersible pump) including guide rails, cabling, plug and socket
	Pump 2	Each pump (including motor if submersible pump) including guide rails, cabling, plug and socket
	Macerator	Pump station macerator (if separate from pump)
Buildings and Structures	Wet well	Main wet well structure including associated equipment such as lids, hatches, access ladders and platforms
	Wastewater Storage Tank	On-site wastewater storage tank including all associated equipment
	Safety Grille	Wet well and Storage tank safety grilles
	Wash-down System	Automated wash-down system for wet well or storage tank
	Drywell	Main underground (drywell) structure including associated equipment such as lids, hatches, ladders platforms and sump pumps
	Building	Main structure above ground including all building components, plumbing, lighting, ladders, platforms, wash-down hose
	Inlet Chamber	Inlet chamber (if separate from wet well) including associated equipment such as lids, hatches, ladders platforms
	Outlet Chamber	Outlet chambers for non-return valves and pump station/rising main isolation valve

Functional Location	Asset Name	Description
	Flow Meter Chamber	The main flowmeter chamber structure
	Overflow	The overflow structure including chambers, pipework and fittings
	Field Cabinet	Field cabinet containing electrical, control and communications equipment (Montrose box)
	Access Way/Hard Stand	All access ways, roads, footpaths and hard standing areas
	Fences	Fences gates and bollards
	Retaining walls	Seawalls or retaining walls
	Pole	All poles (excluding poles owned by other utilities i.e. Vector's power poles)
Valves	Inlet Valve/Penstock	Outside (if installed)
	Non-Return Valve Pump 1	Including actuator, if installed
	Non-Return Valve Pump 2	Including actuator, if installed
	Rising Main Isolation Valve	Pumping station/rising main isolation valve including actuator if installed
	Water Back Flow Prevention Device	Internal water backflow prevention device (excludes existing site's water meter and backflow prevention device)
Pipework	*Pipework is captured in portions typically separated by, function (water supply vs. wastewater), wastewater gravity inlet pipework, pressure (rising main) outlet, pump manifold pipes including fittings and equipment isolation valves. The following may need to be expanded or reduced based on the site specific layout*	
	Wet well pipework	Pipework from the pumps through to the outlet of the wet well
	Storage tank pipework	Pipework between the wet well and the storage tank
	Inlet pipework	Pipework between the inlet structure and the wet well
	Outlet pipework	Pipework between the wet well and the discharge valve chamber (if longer than 500mm)
	Overflow pipework	Pipework from the wet well overflow to the outfall point

Functional Location	Asset Name	Description
	Valve chambers pipework	Any additional pipe within the discharge valve chamber or leading up to the magflow meter
	Water supply pipework	Site water supply for cleaning and flushing
Electrical	Switchboard	Main electrical switchboard including motor cells, power factor correction, generator connection
	Generator	Generator and associated equipment and proprietary controller
	Motor 1	Motor for each pump (if separate from pump) including cabling
	Motor 2	Motor for each pump (if separate from pump) including cabling
	DOL Motor Starter 1	Pump's direct on line (DOL) starter (if installed)
	DOL Motor Starter 2	Pump's DOL starter (if installed)
	Soft Starter Pump 1	Pump's soft starter (if installed)
	Soft Starter Pump 2	Pump's soft starter (if installed)
	VSD Pump 1	Pump's variable speed drive (if installed)
	VSD Pump 2	Pump's variable speed drive (if installed)
Controls	Control System	Control system (PLC, RTU, DCS) including cabling
	Communications	Communications equipment includes radio, aerial, mast and cabling
	Flowmeter	Pumping station flowmeter
	Level Control	Includes all level switches and instrumentation i.e. ultrasonic, probe and float switches
	Power Backup	Uninterrupted Power Supply (UPS), batteries and charger (typically 24V)
Odour Control	Fan	Extraction fan or fan associated with the odour control unit
	Ducting	Ducting associated with odour control unit
	Filter or Biofilter	Odour control structure/equipment including filter media

Functional Location	Asset Name	Description
	Vent Stack	Odour vent stack
	Ozone Generator	Ozone odour control system
Lifting Equipment	Lifting Equipment	Includes all lifting equipment i.e. monorail, lifting davit
	Fall Restraint	Fall restraint connection
Fire & Security	Fire Protection	All fire protection equipment including smoke detection, fire extinguishers, fire hose reel
	Security System	All security system components

9. Testing and Handover

9.1 Commissioning

This section shall be read with Watercare's Code of Practice for Commissioning.

The inlet, outlet systems and wet well shall be tested in accordance with the testing requirements in the construction standards. All pre-testing shall be completed before commencing with commissioning.

Once the individual sections have been tested the final connections are made ready for commissioning of the pumps.

Commissioning work shall proceed after the following documentation has been provided and accepted:

- Preliminary as-built drawings
- Electrical certificate of compliance (CoC)
- Signed-off pre-commissioning test results of structures and pipework
- Draft Functional Description
- Process and instrumentation diagrams (P&ID)
- Draft Operations and Maintenance (O&M) Manual
- Factory acceptance testing (FAT) completed, see Watercare Code of Practice for Commissioning
- Redline mark-up drawings
- Commissioning plan
- Applicable construction quality control signed off

The developer's commissioning plan shall include, but is not limited to:

- HAZOP study
- Testing of all control system inputs and outputs (I/O's), see Watercare Code of Practice for Commissioning
- Wet well level sensors and height adjustment
- Alarm status
- Pump control units

- Data logging and analysis
- Remote control and data transmission (RTU and PLC checks)
- Pump flow rates and rising main performance
- Noise and vibration levels during operation
- Odour control testing (following operational time)

Following the commissioning of the pumping station, the odour control systems shall be tested. A minimum of 4 weeks of operation shall have passed from the date of commissioning before testing H_2S levels at all venting locations. Any faults shall be corrected and retested after a further 4 weeks of bio-acclimatisation. H_2S concentration shall be measured to be less than 1 ppb at the perimeter of the pumping station, measured under still atmospheric conditions.

Any non-conformance with this standard shall be corrected and re-tested.

9.2 Rejection of materials or products

All materials supplied shall be accepted or standardised equipment as applicable. Where products are not listed on any of the materials lists, prior approval will be required from Watercare.

Materials supplied shall comply with the nominated standards and the minimum certification criteria provided as part of the handover process. Where substitutions of any materials or products are deemed necessary during the construction of the pumping station, approval in writing from both Watercare and the pumping station designer is required.

Materials not accepted by Watercare shall be replaced at the cost of the developer before Watercare takes over the pumping station or any of its operational components.

9.3 Handover documents

Watercare shall take over the pumping station when all of the below documentation are finalised and supplied:

a) Post-construction residual risks register
b) Signed construction quality control sheets
c) Operations and Maintenance Manual, see Appendix C
d) Final Functional Description (FD) supplied separately to the O&M manual, see Appendix B
e) Electrical Certificate of Compliance
f) Design drawing sets, as-built drawings and survey data
g) Asset certificate (as per Section 8.1), including other linear assets
h) Engineering compliance statements

All component, products and material warranties and guarantees shall be transferred to Watercare when vested. Power and water are transferred to Watercare once the pumping station is fully compliant.

10. Appendix A: Watercare Network Discharge Consent (NDC) executive summary

Introduction

This summary provides a high-level overview of the considerations for complying with the wastewater network discharge permit in the Auckland region.

The consent authorises the discharge of wastewater from Watercare's wastewater networks to land, freshwater and coastal receiving environments in accordance with section 15(1)(a) and (b) of the Resource Management Act 1991, during times of dry and wet weather flow.

The overflows may occur as a result of network blockages and failures; network damage by third parties; failure at pump stations or storage facilities and capacity constraints. Once a pumping station is in operation overflows must be minimised, continuously monitored and inspected.

Existing networks area:

- Discharge from any new engineered overflow point within the existing network is allowed provided that the discharge frequency is not more than two (2) *Wet Weather Overflow Events* per year and the location of the proposed overflow point is not in a Class 1 Recreational Receiving Environment.
- Should the above not be achievable then the Best Practical Option (BPO) methodology and an improvement strategy may be considered to determine an alternative overflow frequency and/or overflow location. This option must be acceptable to Watercare before submitting to Auckland Council. The acceptance does not guarantee approval by Auckland Council
- No discharge is allowed to a *Tangata Whenua Management Area* as identified in the *Regional Plan: Coastal*, or an equivalent area in the Unitary Plan where discharges are a prohibited activity.

Future networks area:

- Discharge from any new engineered overflow point which is zoned for urban activity under the relevant Resource Management Act statutory document, and is within a future network is allowed provided that:
    - The overflow point is located within 500m of a predetermined proposed overflow location as shown on the relevant indicative future urban area map or of a similar location (see map attached below)
    - The overflow point is designed and managed to achieve the discharge frequency of no more than two *Wet Weather Overflow Events* per year, and the location of the proposed overflow point is not in a Class 1 Recreational Receiving Environment
    - A minimum of four (4) hours storage at *Dry Weather Flow* is provided at or near the o*verflow point. Note: Watercare requires additional four (4) hours storage for operational purposes.*
- Discharge from any new engineered overflow in the *Indicative Future Urban Area* but not identified in the below map as a predetermined proposed overflow location requires certification from Auckland Council. Watercare's agreement and guidance are required before making the application and should be based on the following criteria:
    - The potential overall risk of the discharge is very low or low. This is to be determined by the applicant using Watercare's Methodology for the Assessment of Effects of Wet Weather Wastewater Overflows. The methodology is available from Watercare
    - The overflow point is designed and managed to achieve the discharge frequency of no more than two (2) *Wet Weather Overflow Events* per year, and the location of the proposed overflow point is not in a Class 1 Recreational Receiving Environment
    - The Best Practical Option (BPO) methodology and an improvement strategy may be considered to determine an alternative overflow frequency and/or overflow location. This option must be acceptable

to Watercare before submitting to Auckland Council. The acceptance does not guarantee approval by Auckland Council.

- Direct discharges to the coastal marine area shall be avoided unless an assessment using the BPO methodology demonstrates that this is the most suitable location, taking into account cultural and ecological factors.

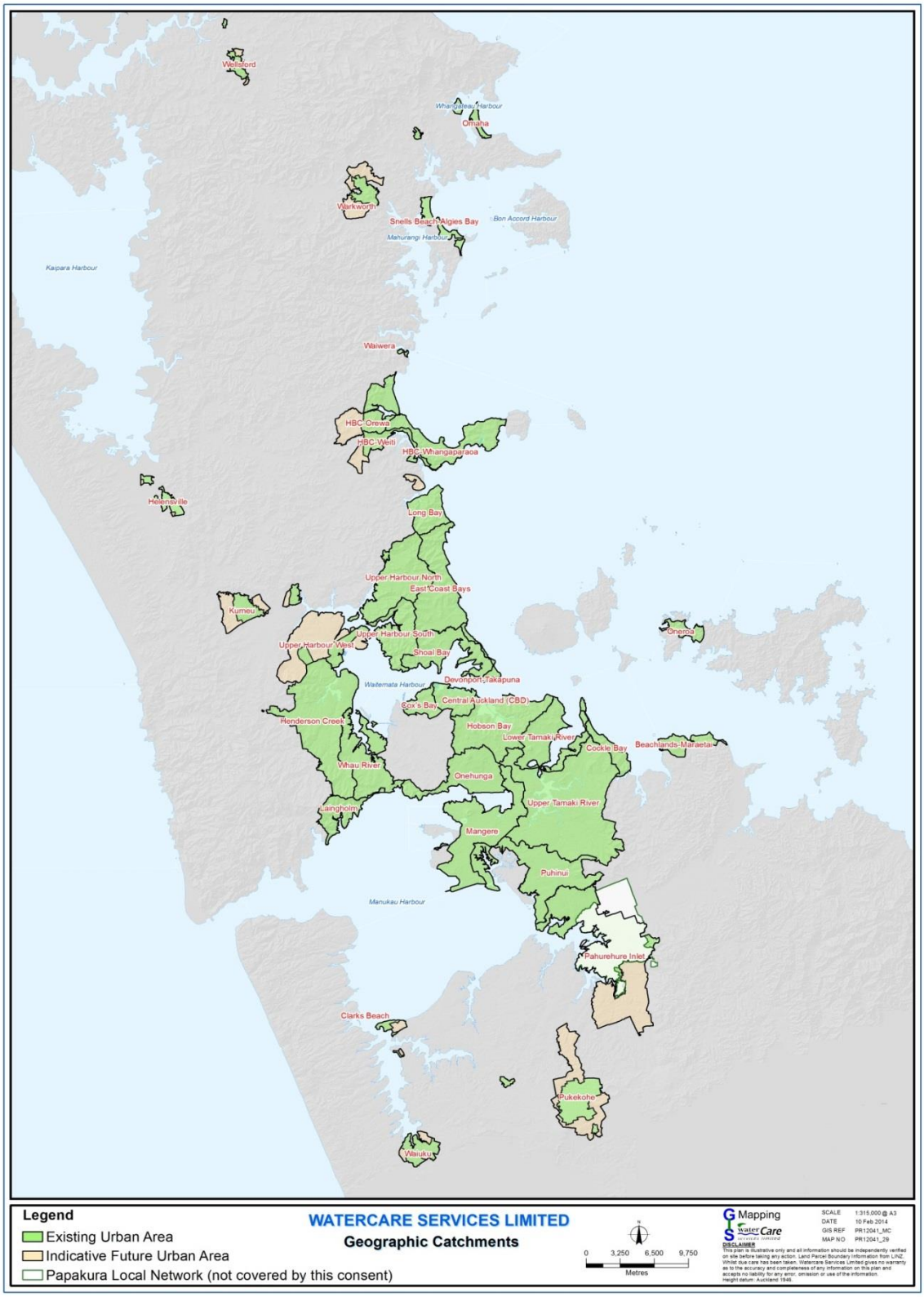
- No discharge is allowed to a *Tangata Whenua Management Area* as identified in the *Regional Plan: Coastal,* or an equivalent area in the Unitary Plan where discharges are a *Prohibited Activity.*
- No overflow point shall be located on private property without the written consent of the property owner and other affected parties that they agree to the location of the overflow point.

Future networks outside mapped areas:

Where a discharge application is outside any of the identified areas of the map, the statutory assessment of the application should be based on providing the same conditions of the existing statutory assessment for the NDC with the following criteria:

- Watercare requires that the applications use Watercare's *Methodology for the Assessment of Effects of Wet Weather Wastewater Overflows*, the Best Practical Option (BPO) methodology and an improvement strategy may be considered to determine an alternative overflow frequency and/or overflow location. The methodology and templates are available from Watercare
- For the purpose of gaining consent with Auckland Council, additional considerations may be required under the Auckland unitary plan and if applicable existing regional plans
- Stakeholder reports demonstrating consultation with Watercare, Auckland Council, local boards, Auckland Regional Health Services and Iwi.

Map: Existing network and indicative future urban areas. Up-to-date detailed area maps showing the *Future Network* are available from Watercare on request.



11. Appendix B: Template for Functional Description (FD) – level 1

Please request the latest template from Watercare.

12. Appendix C: Example of an Operations and Maintenance Manual – index pages

Table of Sections

Revision	Description	By	Date

Section 1

Operations

Table of contents

Section 2

Hazards and controls

(Hazards and controls register)

Section 2

Maintenance

Maintenance tables

1. Table of weekly tasks
2. Table of monthly tasks
3. Table of two monthly tasks
4. Table of four monthly tasks
5. Table of six monthly tasks
6. Table of annual tasks
7. Table of two yearly tasks
8. Table of three yearly tasks
9. Table of five yearly tasks

Section 3

Pumps, valves and instruments

Cross referenced to P&ID drawing(s): XXXX

Item	Size	Description	Serial No./ model code	Supplier
FIT1	*300*	*Magnetic flowmeter*	*MagMaster*	*ABB*

Section 4

Control System

Table of contents

1. Introduction
2. Electrical
3. Instrumentation
4. Control
5. SCADA

Annexes:

A. Design declaration of conformity

B. PLC description

Section 5

Testing and commissioning records

(Electrical, I/O's, Pumps, rising main performance, odour control, vibration, noise)

Section 6

Equipment data sheets

(Contains information specific to equipment, including supplier literature on operation, maintenance etc.)

Section 7

Consents

Land Transfer and Title

Easement

(Copies of final documents)

Section 8

Drawings

(As-built drawing sets for civil, mechanical and electrical & control)