WASTEWATER CONVEYANCE

Wastewater Pumping Stations and Pressure Rising Mains for Networks

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Watercare

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More information

If you have further queries, please contact the Asset Lifecycle team at standards@water.co.nz

DOCUMENT CONTROL

Document owner	Principal Asset Lifecycle Engineer (Standards)
Review	Manager – Asset Lifecycle

Version history

Version	Description of revision	Published by	Date
1	First release	J De Villiers	15/12/2017
2	Format change, new sections added and; updates to existing content.	W Strydom	07/06/2024

This document takes effect on the date of release and supersedes all prior versions.

Summary of Changes

Version	Section	Description of revision
2	Document	Updated document format and numbering
	Abbreviations	Updated, new abbreviations added
	1.2 – 1.7	Updated general content and included asset creation process.
	2	Updated section content and included pumps expected operational service life
	2.1	Updated other relevant standards and reference documents
	2.2	Updated wording regarding reverse sensitivity covenant, requirements for removable bollards, digital display for control cabinet, and reference to Watercare Organisational Physical Security Standard
	2.4	Updated design process and key documents required
	3	General editing Updated number of pump starts per hour.
	3.1	Updates including minimum diameter of inlet structure and access; removed requirement for grit screens; factors governing depth of wet well; Minimum submergence; Four-sided protection hatches; Minimum factor of safety to prevent floatation; Depth limit of wet well.
	3.2	Added example for calculating hydraulic retention time of rising main. Minimum grade for pump curve Included example illustrations of installations and equipment.
	3.3	Added requirements for radio signal strength survey and updated preferred SCADA platform
	3.4	Included MCPR formula; included Colebrook-White equation and updated roughness values for calculating frictional losses.
	3.5	Section introduction added; Requirements for water supply updated and illustration added; New section added on level monitoring requirements in wet well; Updated sections on lighting, drainage, noise and vibration, materials handling and lifting, security and access lids, signage and site access.
	3.6	Added asset owner approval for discharge, P&ID's, draft O&M manual, functional description, draft asset creation sheet and draft commissioning plan.
	4	Added CCTV footage of pipe
	4.2	General update of section
	Appendix A	Updated map of future urban development
	Appendix B	Removed functional description placeholder – to be superseded with standalone template which will be made available. O&M Manual example sections has been updated to Appendix B.

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Definitions

Acceptance	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.
CS1, CS2, CS3, CS4	Watercare engineering compliance statements for design and construction.
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.
FSP	Four-sided protection
GRP	Glass reinforced pipe.
Head	Measure of liquid surface elevation.
HRT	Hydraulic retention time.
H_2S	Hydrogen Sulphide.
H&S	Health and Safety.
ICP	Installation control point
kPa	Kilopascal.
kW	Kilowatt
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.
$NPSH_A$	Net positive suction head available
$NPSH_R$	Net positive suction head required.
ppb	Parts per billion.
ppm	Parts per million.

PS	Pumping Station.
PLC	Programmable logic controller
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.
SCADA	Supervisory control and data acquisition
RTU	Remote terminal unit
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. Scope and general

1.1 Purpose and scope

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 2.4. Failure to follow this process will delay obtaining Watercare's approval.

1.2 Applicability

This standard covers the planning, design and construction of local network wet well pumping stations and pressure rising mains typically up to 78 l/s with pipe internal diameter less than or equal to 300mm. Larger pump stations shall follow the Transmission Wastewater Pumping Standard in consultation with Watercare.

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.

Where the verbs must, shall and will (or its past tense forms) are used they describe a requirement for compliance with the statement in which it is used.

'Shall' and 'must' expresses a mandatory condition or action. 'Will' is used to prescribe a performance outcome or intent.

1.3 Standard documents overview

1.3.1 Relationship of Watercare Standards

Watercare standards comprise codes of practices, design standards, standard design drawings, construction standards, and asset and material standards.

The Watercare standards set requirements which will complement, and in some cases exceed nominated national standards, international standards and industry best practice or legislative requirements. The overall intent is to ensure long term operability and good asset management practices, which in turn benefit our customers. The mapping of standards and project specifications are outlined below.

1.3.2 Design standards

Design standards set a level of design for particular types of infrastructure based on operational area and associated risk. The design standards provide the minimum criteria for:

- Establishing standard design drawings
- Interface design between standard drawings and specific design
- Establishing the correct sizing of components to meet the baseline parameters of the standard drawings.
- The basis for developing tailored designs.

1.3.3 Design drawings

Standard design drawings support the requirements of the design standard. Minimum and maximum criteria are set, and specific standard details are shown. Below is a list of applicable standard drawings.

- Access structure drawings for water infrastructure (DW06 - ESF-500-DWG-104
- Access structure general drawings for public/non-public areas (DW07 - ESF-500-DWG-301)
- Code of practice for land development – Wastewater drawing set (DW01 – ESF-500-DWG-201)
- Wastewater pumping station drawings for network (DW03 - ESF-500-DWG-202)

1.3.4 Asset and material standards

Asset and material standards describe the requirements for asset creation, asset numbering, asset capture, production of manuals and operational documentation. Material standards describe the minimum compliance requirements of materials supplied for asset acceptance. Often selected materials will have limitations of use and requirements specific to the operating environment and infrastructure classification.

1.3.5 Construction standards

Construction standards prescribe the methods and requirements for workmanship to be employed when constructing works in accordance with the design requirements, standard drawings, and bespoke designs. To achieve the best outcome the construction requirements, focus on proven methods and best practice to ensure quality is maintained to achieve the design life of infrastructure and that maintainability, health and safety and environmental requirements are met. Where construction standards are used or referred to in contracts they form part of the specification of the contract.

1.3.6 Project specific specifications (particular specifications)

These specifications identify site/project specific requirements that are not covered by the normative construction standards or standard design drawings identified during specific design.

1.3.7 Design-build projects

Design-build projects shall follow the minimum requirements set out in the standard documents for design and construction.

1.4 Quality control and quality assurance

1.4.1 Dispensations affecting quality

Any departure from the standards for the works shall not compromise quality, whole of life performance, safety and regulatory requirements. Any proposed departure shall be evaluated by completing an Application for Dispensation against the applicable standard and by demonstrating that the departure complies with the requirements and applicable certification by providing proof of quality documentation.

1.5 General engineering document submittal requirements

The pre-requisite for progressing the design through to completion and handover include the following key documents prior to acceptance of the project phase:

Planning

- Application form
- Draft design
- Report demonstrating NDC compliance – this requires the asset owner's approval (Healthy Waters) if discharging to the stormwater networks. This also applied to owner approvals (consent) for engineered overflow points located on third-party land.
- Land transfer plan.
- EDC form (engagement)

Design

- All fees paid.
- Auckland Council consent
- Final design report (covering requirements in this standard, i.e. calculations, surge analysis, FD, P&ID's, commissioning plan, schedule of materials)
- Detailed drawings
- Design compliance statement (CS1 or CS2)
- Draft Asset Creation Schedule
- Serviceability limit state & structural design (confirmed with Watercare)
- Engineering Plan Approval (EPA)

Construction

- Construction QA/QC documentation
- Factory acceptance testing (FAT) for pumps
- Prelim as-built drawings
- Draft asset creation schedule

- Electrical certificate of compliance (CoC)
- Signed-off pre-commissioning test results of structures and pipework. Refer Section 4
- Draft Operations and Maintenance Manual. Refer Appendix C
- Factory acceptance testing (FAT) for switchboards
- Commissioning plan
- Construction QA/QC sign-off

Commissioning

Refer to Section 4 below and Watercare's Commissioning Code of Practice

1.6 Materials

1.6.1 Material standards

Materials shall include all equipment, machinery, components or products used to complete the works.

All materials necessary for the work shall be supplied in accordance with Watercare's Material Supply Standard. Materials shall be new and suitable for their intended purpose and performance requirements.

Machinery and equipment shall be in a good, maintained condition and safe.
Where nominated products are not listed, prior approval will be required from Watercare by applying for a dispensation.

Applications for dispensations require that the nominated manufacturing standards are met, and the minimum certification criteria provided as part of the process. This requires prior approval in writing from both Watercare and the pumping station designer.

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.

1.6.2 Recycled and reused materials

Recycled material and material reuse shall not be accepted unless specifically approved by Watercare.

1.7 Asset information

Asset information shall be progressively captured and supplied in accordance with the requirements of Watercare's Asset Recording standards. These standards shall be followed for new, upgraded or decommissioned assets.

2. Pumping planning considerations

It is expected that realistic and pragmatic alternate wastewater servicing options have been identified as part of the feasibility study (concept design planning review). The feasibility study shall consider technical performance, safety, cultural, social, environmental and economic criteria over the entire design life of the system. Since whole of life pumping and maintenance resource (including costs) will cumulatively be more than initial investment, the least resource-intensive whole of life solution shall be demonstrated.

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:

- Network servicing plan compliance at initial commissioning.
- Staging considerations and expandable designs which provide for future development / upgrades. This must ensure that optimal performance can be achieved at each stage.
- Sites shall be above future flood and sea level rise scenarios.
- Full asset life cycle costs – particularly energy and ongoing maintenance costs
- System integration design, where inter-station controls are deemed necessary.
- Upstream catchment growth and system delivery limitations
- Management of 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)
- Structures and equipment shall allow for the following minimum operational service life:
    i. Wet wells and storage tanks 100 years
    ii. Pipework (pressure and gravity) 100 years
    iii. Pumps ≤ 15kw 15 years
    iv. Pumps > 15kw 25 years
    v. Wet well accessories 20 years
    vi. Valves and meters 30 years
    vii. Electrical equipment 25 years
    viii. SCADA and control 15 years

2.1 General Requirements

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

Where pumping stations are developed by external developers, pumping stations shall be designed, constructed and commissioned 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. All assets shall be vested to Watercare through the Asset Creation process which will be completed by the developer before hand-over to Watercare. Private ownership of pumping stations connected to the public wastewater system is only allowed under a body corporate arrangement or legal agreement. 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. The developments staging shall be considered as part of the planning phase and an appropriate operating and flushing methodology shall be presented to Watercare prior to engineering approval. Where applicable a bond may be required prior to construction for flushing until the sewer flows satisfies the required turnover within the maximum retention times.

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

For 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 standards and drawings:

- CoP – 02 Water and Wastewater Code of Practice for Land development and subdivision, Chapter 5
- 7363 – Standard for producing CAD and geospatial drawings
- CG – General civil construction standard
- ME – General mechanical construction standard
- EC – General electrical construction standards
- COP-03 Code of Practice for commissioning
- AI- Data and Asset Information Standard
- ESF-500-STD-407 - Kingfisher RTU – Implementation Standard
- MS – Material supply standard

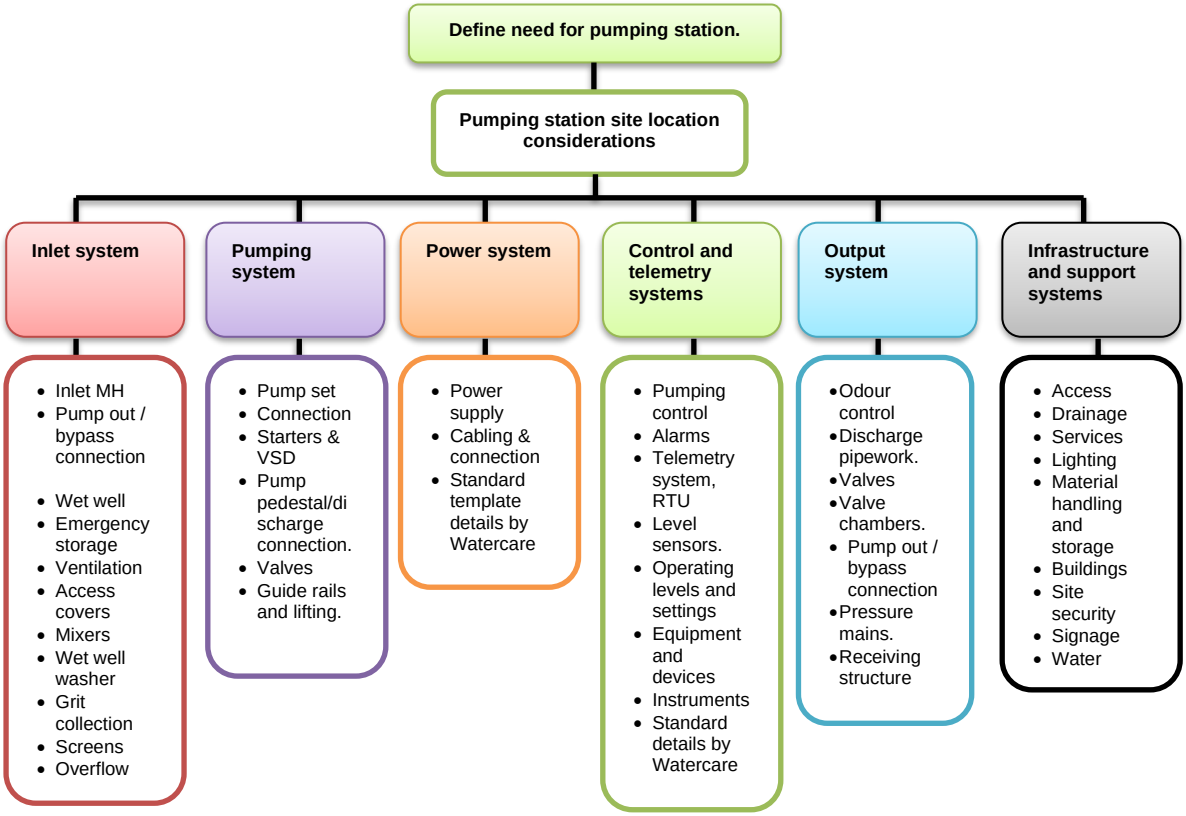
- DW01 – Code of Practice for Land Development and Subdivision – Wastewater drawing set.
- DW03 – Wastewater pumping station drawings for networks.
- DP-09 Electrical design standard
- DW18 – Pump station electrical drawing set
- DW05 – Access structure drawings for wastewater infrastructure
- DW07 – Access structures general drawings for public and non-public areas

Other relevant industry standards and reference documents include the current versions of:

- New Zealand gravity pipe inspection manual
- AS/NZS 4130 Polyethylene (PE) pipes for pressure applications
- AS/NZS 2566 Buried flexible pipelines, Part 2: Installation
- AS/NZS 2033 Installation of polyethylene pipe systems
- ANSI/HI 9.8 American National Standard for pump intake design
- ANSI/HI 9.6 American National Standard for rotodynamic pumps for pump piping

- ISO 9906 Rotodynamic pumps – hydraulic performance acceptance tests
- PIPA - POP001 Electrofusion jointing of PE pipes and fittings for pressure applications
- PIPA - POP003 Butt fusion jointing of PE pipes and fittings – recommended parameters
- PIPA - POP007 Flanged joints for polyethylene (PE) pipe
- PIPA – POP10A Part1: Polyethylene pressure pipes design for dynamic stresses
- AS/NZS 2845 Water Supply – Backflow prevention devices – Materials, design and performance requirements
- New Zealand Building Code (NZBC)
- Wallingford H R and Barr D I H, Thomas Telford. Design of Pipes, Sewers and Channels, 8th edition, London, 2006

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



2.2 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 new developed 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.

Note: Reverse sensitivity covenant only applies to new lots as part of a development.

It is important that the developer considers the telemetry serviceability of the pumping station site early in the design process; see Section 3.3 for more detail.

The pumping station general site layout shall accommodate:

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

b) 24hr all-weather vehicle access, adequate parking and where specified an adequate and safe turning area inside 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) Removable bollards installed at the site entrances or around the wet well to deter any vehicle movement from entering the access area. Where the wet well area is fenced, bollards may be required at the entrance for service vehicle to access the site. Bollards shall have a minimum height of 900mm with padlock connections for removal.

Figure 1: Example of bollard with padlock connection

e) Odour control system(s) and air valves 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.

f) Dedicated underground mains power supply.

g) A freestanding weatherproof control cabinet to house electrical equipment with digital display as specified in the Watercare electrical and control standards. Single sided boards shall be specified. Where VSD's are installed, and alternative layout may be required and shall be agreed with Watercare.

h) Switchboards, control cabinets and chamber cover-plates provided with adequate clearances for maintenance access.

i) External electrical connection facilities for the provision of a temporary generator.

j) Dedicated electrical and control services trench.

k) Outlet valve chamber.

l) Magnetic flowmeter chamber.

m) Drain-back bypass into the wet well or inlet manhole.

n) The storage tank, buried below ground level. The storage tank levels are dictated by the invert levels of the incoming gravity pipework and the overflow level.

o) Where applicable a minimum 1.8m high fence with a lockable gate to Watercare's requirements (refer to Watercare's Organisational Physical Security Standard).

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

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

2.3 Contaminant-free site

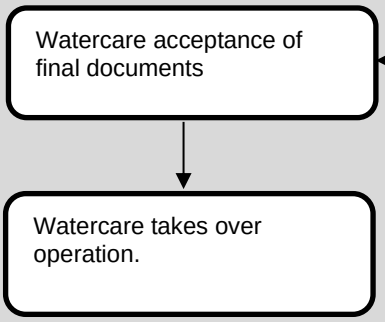
Refer to the Water and Wastewater Code of Practice for Land Development and Subdivision, Wastewater Chapter 5 (document number CoP-02) for the acceptance criteria for contaminant free sites.

2.4 Planning and delivery stages 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 flow chart below is a guideline on the expected timeframes and requirements at each stage of the process.

Estimated timeframe	Process	Developer	Key documents
1 week 1 week 1 week	**Planning** Determine PS requirement. Watercare Developments / Planning / Electrical / Service Delivery *Review and set meeting date.* Watercare Electrical and radio connectivity desk study on location serviceability *Watercare provides cost estimate for control and telemetry connection.* Watercare Draft approval / rejection of proposal	Proposal • Size of catchment • Location • Demonstrate that a pump station is the most feasible option. • Demonstrate general requirements. • Demonstrate planning considerations & NDC compliance. Amend proposal / proceed to next phase.	• Application forms • Draft design • Report demonstrating NDC compliance – this requires the asset owner's approval (Healthy Waters) or pre-approval if discharging to the stormwater networks. This also applied to owner approvals (consent) for engineered overflow points located on third-party land. • Land transfer plan. • EDC form (engagement)
Approx. 3 weeks	**Design** Watercare conditions *Supplied within 3 days of Council notice (if complying)*	Auckland Council Resource consent application Consent approval.	• All fees paid. • Auckland Council consent

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. • Commissioning plan	• Final design report (covering requirements in this standard, i.e. calculations, surge analysis, FD, P&ID's, schedule of materials), draft O&M manual. • Draft commissioning plan. • Detailed drawings • Design compliance statement (CS1 or CS2) • Draft Asset Creation Schedule • Serviceability limit state & structural design (confirmed with Watercare) • Engineering Plan Approval (EPA)
	Construction Starts	Developer constructs pumping station.	• Construction QA/QC • Factory acceptance testing (FAT) for pumps.
Minimum 2 weeks	**Pre-commissioning** <u>Watercare review:</u> • Documentation and compliance of construction with approved design. • Pre-commissioning site visit. • Developer corrects any issues.		• Prelim as-built drawings • Draft asset creation schedule • Electrical certificate of compliance (CoC) • Signed-off pre-commissioning test results of structures and pipework. Refer Section 4 • Draft Operations and Maintenance Manual. Refer Appendix B • Factory acceptance testing (FAT) for switchboards commissioning plan. • Construction QA/QC sign-off
Minimum 4 weeks	**Commissioning**	Commissioning (witnessed by Watercare) *All pre-commissioning documents finalised and approval*	• Commissioning plan • Approval to connect.

Estimated timeframe	Process	Developer	Key documents
Minimum 2 weeks	**Handover** 	**Note**: Final documentation shall be submitted to Watercare for review 2 weeks prior to planned commissioning date – failure to submit this in the within the minimum notice period may result in a delay of commissioning and acceptance.	• Post-construction residual risks register. • Operations and Maintenance Manual • Final Functional Description (FD) supplied separately and O&M manual - refer Appendix C • Electrical Certificate of Compliance • Design drawing sets, as-built drawings and survey data. • Accepted asset creation schedule. • Asset certificate • Engineering compliance statements (CS3 and CS4) • Agreement to transfer of liability

3. 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. Where input is required from other disciplines to inform the design (e.g. geotechnical investigations & design) – this work shall be managed, reviewed, and approved by a professional engineer registered according to the practice field.

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 through the pump station and along the length of the rising main.
- Total lifting head.

e) Select pumps where the pump curve intersects with the system curve (Figure 2) allowing an overall inaccuracy factor of 10% for friction losses in the system curve. See Section 3.2.2 on pump selection.

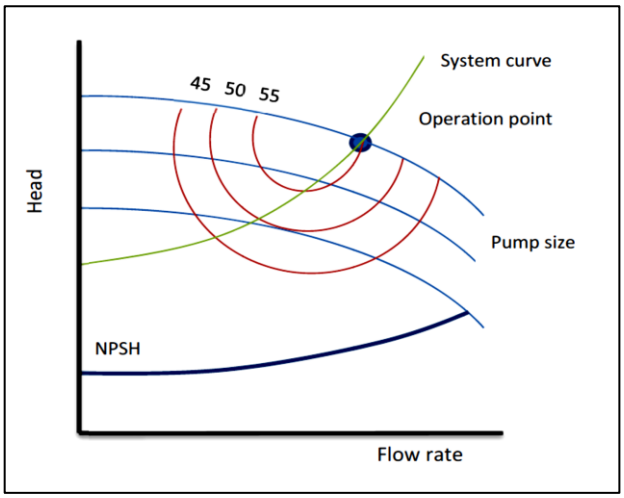


Figure 2: Pump selection by combining system curve and pump curve to determine the best efficiency point.

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 Appendix A. Note additional storage may be required where pump stations are interconnected, i.e. one pump station is dependent on another for storage and overflow prevention.

g) The maximum allowable number of pump stop/starts for individual pumps shall not to exceed more than 12 cycles per hour (for ADWF) for pump motor size ≤ 15kW, and no more than 8 starts for pumps >15kw. This shall be validated with the pump manufacturer's specification. The control philosophy of the pump duty and standby configuration should allow for pumps to alternative between 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 New Zealand Geotechnical Database in AGS4 format at: ***https://www.nzgs.org***

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.

3.1 Pump station inlet system

3.1.1 Pump Station Inlet Structure

3.1.1.1 Location

The inlet structure / manhole shall be situated wholly within the pumping station site.

3.1.1.2 Design

The design of the inlet structure shall have the following functions and requirements:

a) Collect all wastewater inflow into the pumping station.

b) Provide a minimum of opening of 600 mm through the access cover.

c) The access cover shall be an air-tight hinged manhole cover with stainless steel (316) safety grille.

d) Be a minimum of 1200 mm diameter.

e) Where chambers exceed 3m in depth, a ladder shall be fitted for access (for chambers less than 3m deep step rung shall be installed).

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

g) Allow for an isolation knife gate at the wet well inlet.

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

i) The pipe size between the inlet manhole and wet well shall be at least one size up from the upstream pipework that enters the inlet manhole.

3.1.2 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 to prevent septicity, build-up of H_2S and corrosion of the structure and equipment.

d) Benching shall be formed at a minimum 45^{o} 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) The depth of the wet well shall be determined having regard to:

- The invert level of the wastewater connection from the inlet manhole shall be above the high-level alarm.
- The start/stop volume (active sump volume)

- Minimum pump submergence
- Minimum depth below the pump intake specified by the pump manufacturer.

g) The pumps minimum submergence shall be confirmed with the manufacturer to avoid vortices and air entrainment. Where no guidance is provided shall be assumed to be:

$S = D(1 + 2.3F_r)$ where: (*reference: ANSI/HI 9.8 – 1998*)

S = minimum submergence

D = pump inlet diameter

Fr – Froude number

h) 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 positioned on a guide rail and repositioning when doing maintenance. Wet well washer operation shall be programmed in the RTU.

i) Installation of mixers requires approval from Watercare.

j) 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 fall of the outlet of the duct will allow condensation to freely drop back into the well and be at the furthest practical point away from the inlet.

k) 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.

l) 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.

m) All access hatches shall be fitted with four-sided protection (FSP) and a hinged safety grille underneath the lockable access hatch to Watercare standard design. Safety grilles shall be tested to comply with AS3996 class A.

n) 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.

o) Anti-buoyancy design to prevent wet well floatation. A minimum Factor of Safety of 1.25 shall be achieved.

3.1.2.1 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.

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 extending 100mm below the pump stop level).

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.

3.1.2.2 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 guiderails, 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 (g)). The pump start level shall consider the need to prime the pumps ($NPSH_R$ and $NPSH_A$).

d) The centre-to-centre clearance between pumps shall be the greater of

- the manufacturers requirements; or
- 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.

f) The depth of the wet well shall not exceed 6m without prior approval from Watercare. The depth is limited by maintenance and the capability of vacuum tankers to clean the wet well.

3.1.3 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 only. 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. A minimum Factor of Safety of 1.25 shall be achieved.

3.1.4 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.

3.1.5 Material selection

All materials shall comply with Watercare's Material Supply Standard. The features listed below require the following consideration:

3.1.5.1 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 also acceptable.

3.1.5.2 Wet wells and storage tanks

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's Material Supply Standard.

GRP wet wells and storage tanks are also acceptable.

3.1.5.3 Inlet pipework

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

3.1.5.4 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.

3.2 Pump system

3.2.1 Hydraulic design

The hydraulic design shall be determined by the following parameters:

a) Invert level of the incoming wastewater

b) Pumping station capacity / flow rates (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) Hydraulic retention times (HRT) for wastewater entering the wet well and transported through the rising main shall not exceed 8 hours.

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

Example: Retention time for wastewater transported through the rising main

- Inflow (ADWF) = 2.3 L/s (8.28 m^3/h)
- Pump Duty = 16.90 L/s (60.84 m^3/h)
- Wet well Diameter = 2.5 m
- Depth difference between duty pump stop and duty pump start = 0.4 m
- Active wet well volume = $(\frac{\pi \times 2.5\text{m}^2}{4}) \times 0.4\text{m}$ = 1.96 m^3
- Time taken to fill active wet well volume = 1.96 m^3 / 8.28 m^3/h = 0.23 h (14.22 minutes)
- Time taken to empty active wet well volume = 1.96 m^3 / 60.84 m^3/h = 0.03 h (1.93 minutes)
- Total cycle time = 0.27 h (16.16 minutes)
- Volume of rising main = Pipe area x length = $(\frac{\pi \times 0.147\text{m}^2}{4}) \times 1900\text{m}$ = 32.25 m^3
- Cycles to empty rising main = 32.25m^3 / 1.96 m^3 = 16.42 cycles
- Time to empty rising main = 16.42 cycles x 0.27 h = 4.42 h (< 8 hours, OK)

Note: where benching or sloping extends into the active sump volume, the calculation shall take into account this reduction in volume.

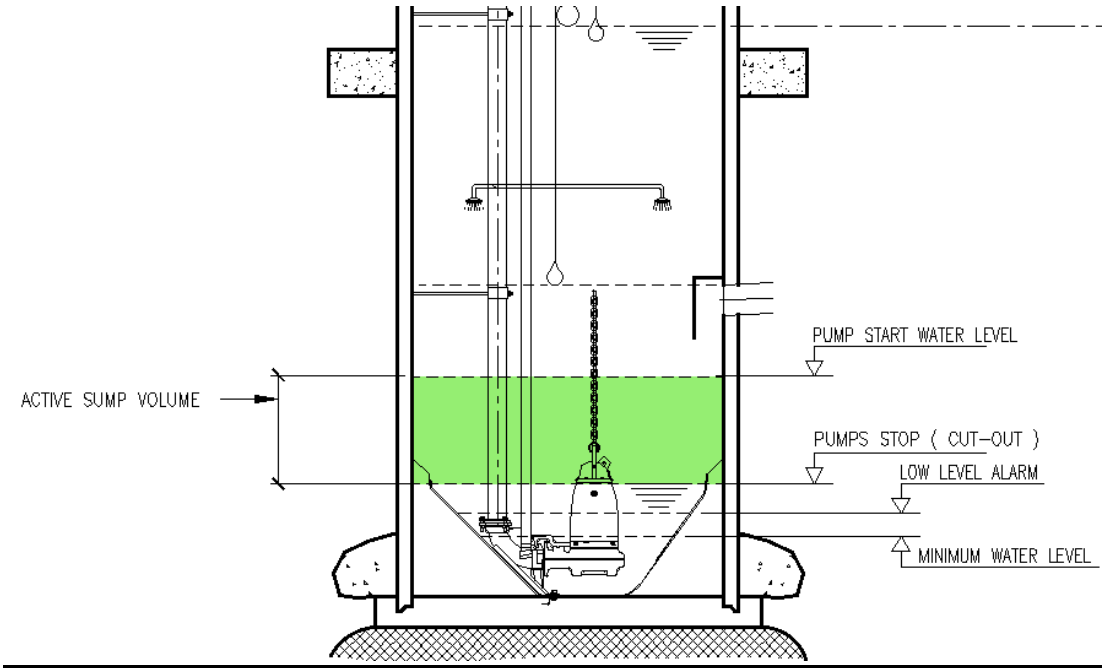


Figure 3: Wet well active sump volume

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.

Where staged development is expected, it shall be demonstrated by the designer that the system curve during these stages can be delivered efficiently by the selected pump, or alternatively demonstrate that the detention time between pump starts and stops are acceptable.

3.2.2 Pump selection

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

b) Pump curves shall have a minimum gradient of 15% to avoid “hunting” for the duty point.

c) 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 ragging, and the associated maintenance outweighs the energy saving costs of selecting a more efficient impeller type.

d) 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. VSD’s are generally only used for flow modulation when required in these scenarios.

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

f) 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.

g) 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.

h) Refer to Watercare Electrical Design Standard for VSD and starter requirements.

3.2.3 Pump product requirements

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

3.2.4 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 exceeding 25 years. Suitable materials include stainless steel, ductile iron with suitable polymer coating or polyethylene sleeve, or polyethylene pipe.

3.2.5 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 in-line pipework it is 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.

3.2.5.1 Non-return valves

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

3.2.5.2 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.

3.2.5.3 Air release valves

Air release valves shall be double acting and as accepted by Watercare – refer to Material Supply Standard. The air valves shall be 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.

Figure 4: Example of valve arrangement on discharge side of wet well.

3.2.5.4 Knife gate valves

Knife gate valves are required at the inlet of 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.

Figure 5: Example of knife gate valve at the inlet to the wet well including extension spindle.

3.2.6 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.

3.3 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.

3.3.1 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 control point (ICP) will be provided and paid for by the developer
- Mains electricity shall be of sufficient capacity considering 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.

3.3.2 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. Works will be carried out by Watercare or an approved contractor.

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 desktop study will determine if there is an available connection for the location.

The desktop study shall be followed by a physical radio survey to determine the viability of the radio signal strength and connectivity. The preferred connection is via UHF radio to Watercare’s Trio radio network. An LTE (4G) signal check should also be carried out.

Should there be no communications available 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's SCADA system of choice is the AVEVA System Platform.

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 – The FD shall be completed using Watercare's template which will be made available.
- Process and instrumentation diagrams (P&IDs).
- Bill of materials.
- Confirmed Input and Output lists (I/O).
- Electrical drawings

Refer to Section 4.2 for Testing and handover.

3.4 Pumping station outlet system

3.4.1 Discharge pipework (rising main)

3.4.1.1 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 PN12.5 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 close 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 (refer to PIPA – POP10A Part1: Polyethylene pressure pipes design for dynamic stresses).

$$MCPR = \frac{PN}{10} \times f$$

Where
PN = pipe pressure class
f = fatigue cycle factor

3.4.1.2 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 based the static head and the systems' losses which considers:
    - Flow rate.
    - Inside diameter of the rising main
    - Roughness of the pipe (see roughness factors below)
    - Length of the rising main
    - Frictional losses through fittings
- 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 based on full-bore flow.
Head loss shall be calculated using the Darcy-Weisbach equation with frictional coefficients determined using the Colebrook-White equation.

$$\frac{1}{\sqrt{f}} = -2log_{10}\left[\frac{k}{3.71D} + \frac{2.51}{R_e\sqrt{f}}\right]$$

Where:
f = Frictional coefficient
k = hydraulic absolute roughness value (m)
D = pipe diameter (m)
R_e = Reynolds number

The hydraulic roughness value *(k)* for all pipe materials shall consider slimming and be determined based on the expected rising main velocity as shown in Table 1 below.

Table 1: Absolute roughness values for pipes (reference: Wallingford & Barr, 2006)

Rising main velocity	k-value (mm)
0.75 m/s	1.5
1 m/s	0.6
1.5 m/s	0.3
2 m/s	0.15

Note: 0.75m/s in only included in Table 1 above to allow for interpolation, the minimum acceptable velocity is 0.9 m/s

Where velocities are expected to be between the values shown in Table 1, the value shall be interpolated accordingly.

Frictional losses through fittings shall be determined using the component manufacturer's value or published pipework and fittings tables with a 10% inaccuracy factor using the formula:

$$h_f = \frac{Kv^2}{2g}$$

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.

3.4.1.3 Rising main layout

The main shall, wherever possible, rise continuously from the pumping station and terminate at its upper end into the receiving structure discharging to the gravity network. 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 positioned 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 are not allowed. 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 trees or shrubs with a maturity height over 1m tall.

The rising main shall be metered with a magnetic flowmeter situated within a chamber at the pumping station site. A dismantling joint shall be installed alongside the flowmeter. An electrical duct shall also be provided from the flowmeter chamber to the pump stations electrical control panel, allowing the for the meter to be connected to the pump station's SCADA system and field digital display installed on the controller.

3.4.1.4 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*.

3.4.2 Receiving structures (Discharge Manhole)

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 to keep the pipe as full as possible during pump stops. The rise into the receiving structure shall be minimum 3m long. No other connections shall be made into the discharge manhole.

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^{o} out of alignment.

3.4.2.1 Odour control

Odour control and air relief shall be provided 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.

Figure 6: Example of an odour control system installed and treating wet well odour.

3.5 Infrastructure and support systems

All infrastructure and support systems shall be designed with consideration to future adjacent residential property schemes, as anticipated by the developer, and shall not introduce nuisance / annoyance / non-compliance with respect to current or future residents.

3.5.1 Water supply

A metered water supply with reduced pressure zone backflow preventer (RPZ) shall be installed in a compliant location, accessible for testing, 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. The cabinet shall be installed aboveground and allow for free-draining conditions. See Watercare's Code of Practice for Land Development and Subdivision – Chapter 6: Water and Clause G12/AS1 of the Building Code, for the methods and devices required to comply with Watercare's requirements.

The cabinet shall be located just downstream of the meter, away from the wet well access hatch and include solenoids for well washers and storage tank washers, and a rolled-up hose for general wash-down.

Figure 7: Example water supply cabinet.

3.5.2 Level monitoring in wet well

A radar level sensor shall be installed as the primary level measurement device. A secondary device shall also be installed to provide redundancy for the radar level sensor. The appropriate technology for the secondary sensor shall generally be radar in an alternative location but shall be confirmed by Watercare's Instrumentation Team based on the installation. Float switches shall be installed for the "Low", "Hi" and "Hi-Hi" levels within the wet well.

3.5.3 Lighting

Site lighting shall be provided at all sites for operational safety. The developer must confirm the requirement and location with the responsible Watercare contact during the design stage.

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 intentionally designed to prevent unnecessary light pollution / nuisance to the adjacent properties – current or future. The light switch shall be situated inside the control cabinet.

Figure 8: Example of lighting provided at a pump station over the operational area.

3.5.4 Drainage

The site shall have adequate drainage and fall away from the wet well, chambers, storage tanks and cabinets to prevent standing or ponding water and prevent inflow to these assets. Overland drainage shall not affect neighbouring properties and will require a storm water system to be installed for discharge to a suitable location.

3.5.5 Noise control and vibration

Noise generated by the pumping station shall be no more than that specified by Auckland Unitary Plan requirements. 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.

3.5.6 Materials handling and lifting equipment

Adequate access shall be provided for the entry and manoeuvring of mobile lifting plant such as a truck loader crane – spatial provision shall consider vehicle turning circles and stabilising outriggers of lifting plant.

Where it is demonstrated that no feasible access is available for truck loader cranes, a rotating lifting arm or davit pole shall be specifically designed and fitted over the wet well for lifting material in and out, and over fencing onto service vehicles. 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 also be provided for mobile lifting plant around the pumping station installation to transfer lifted equipment onto a service vehicle. The lifting device shall comply with AS4991.

3.5.7 Security and access lids

Watercare's Organisational Physical Security Standard shall be followed in conjunction with this section. 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 secured with an approved lock. 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.

Figure 9: Example 1.8m fence around the pump station facility

3.5.8 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 on the pumping station perimeter fence and control cabinet.

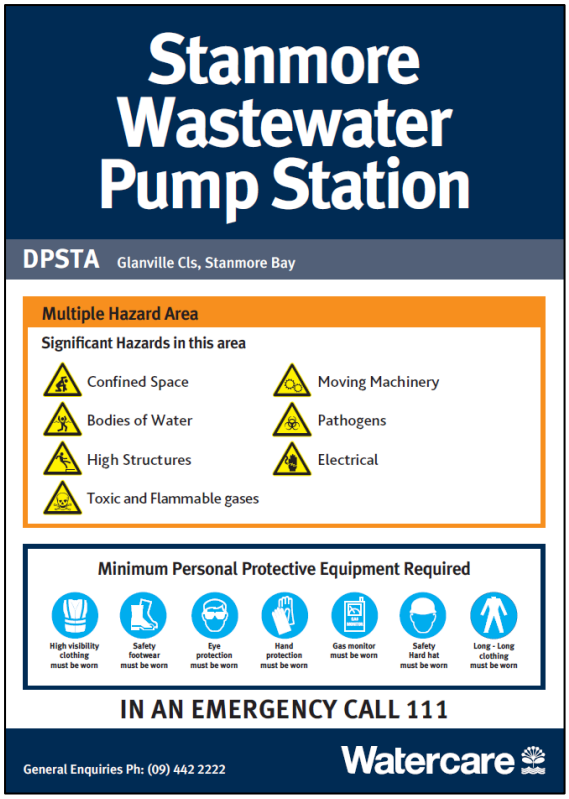
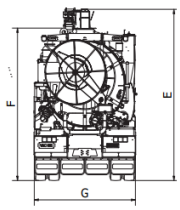
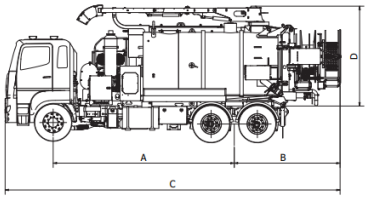
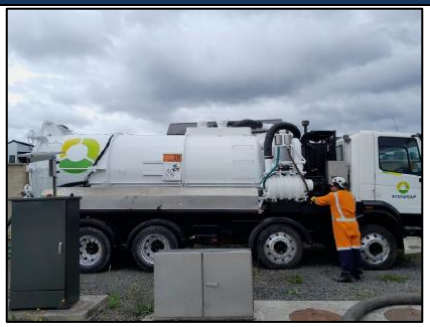


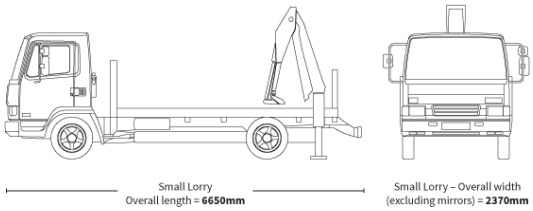
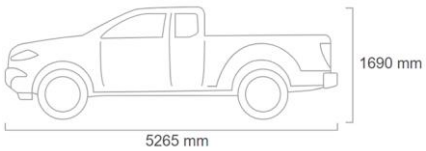
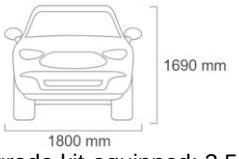
Figure 10: Example signage for wastewater pump station facility.

3.5.9 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 with a minimum turning radius of 12.5m shall be provided within the site. The access road shall have a load bearing capacity suitable for accommodating service vehicles and have a sealed width of at least 3.5m. Access areas should also consider the spatial requirements of service vehicle outriggers to stabilise plant used for lifting pumps.

Table 2: Types of vehicles that require access to pump station sites.

Vehicle type and purpose	Approximate dimensions and weight	Illustration
Vacuum tanker Servicing and cleaning wet well Emergency overflows	  [A] Wheelbase: 5210mm [B] Rear Overhang: 2440mm [C] Overall Length: 9030mm [D] Unit Height: 2870mm	

	[E] Overall Height: 3940mm [F] Overall Height – no boom: 3940mm [G] Overall Width: 2490mm Gross vehicle mass (GVM): 30,000 kg	
Service Vehicle General maintenance and lifting of medium sized pumps (350kg – 500kg)	 Overall Length: 6650 mm Overall width (excl. mirrors): 2575mm Overall width (incl. mirrors): 2850mm Gross vehicle mass (GVM): 18,000 kg	
Standard Service Vehicle General maintenance and lifting of smaller pumps (up to 350kg)	  GVM upgrade kit-equipped: 3,500 kg	

3.6 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
- Asset owner's approval (Healthy Waters) if discharging to the stormwater networks.
- Route selection
- System components, layout and configuration (including wet well retention times at initial start-up and available storage) 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 selection, transfer points and long sections.
- Piping and instrumentation diagrams (P&ID)
- Details of air release/vacuum and scour points

- 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 including maintenance and expected timeframe for replacement of equipment.
- Compliance with referenced standards and best practice
- Draft O&M manual
- Functional description
- Draft asset creation sheet and draft commissioning plan

4. Construction

The developer undertakes and finances the complete works in accordance with the approved design drawings. The contractor completing the physical works shall be suitably qualified to author a construction compliance statement (CS3) prior to final acceptance.

Construction monitoring shall be as determined under the Watercare compliance statement guidelines and construction monitoring compliance statements (CS4) shall be provided by the designer 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. CCTV footage shall also be provided of the internal pipe bore.

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

e) Material supply standard

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

4.1 Pumping station assets

This section shall be read with Watercare's asset information standard. Apart from capturing the linear assets on the pipelines, Table 3 lists the level of assets to be captured for the pumping

station specifically. An asset creation template can be requested from Watercare to complete the asset capture during design, and which needs to be completed and accepted prior to commissioning.

Table 3: Assets to be captured at pumping stations.

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 (if applicable)	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
	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

Functional Location	Asset Name	Description
	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
	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
	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

4.2 Testing and handover

4.2.1 Commissioning

This section shall be read with Watercare's Code of Practice for Commissioning (CoP-03). The Commissioning plan and strategy shall be developed during the pump station design.

All equipment's and structures of the inlet / outlet systems and wet well shall be tested in accordance with the testing requirements in the construction standards and COP-03. All pre-testing shall be completed before commencing with cold commissioning.

Once the individual sections have been tested, the station shall be commissioned on water (Cold Commissioning) and once approved the final connections are made ready for hot commissioning of the pump station and rising main.

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

- Commissioning plan using the Watercare template.
- Equipment supplier documentation and O&M manuals.
- Equipment calibrations including Wet well level sensors and height adjustment.
- Final asset creation sheet
- Electrical certificate of compliance (CoC)
- Signed-off mechanical completion and pre-commissioning test results of all equipment, 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
- Site acceptance testing (SAT) 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:

- Testing of all instruments, control system inputs and outputs (I/O's), and control logic. See Watercare Code of Practice for Commissioning
- Alarm status.
- Pump logic control, and performance testing including four hour run testing.
- Data logging and analysis
- Remote control and data transmission (RTU)
- Noise and vibration levels during operation
- Odour control flow balancing and performance 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.

4.2.2 Handover documents

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

a) Post-construction residual risks register.
b) Project Snag list register and close out plan
c) Signed construction quality control sheets.
d) Commissioning Completions dossier as per COP-03
e) Operations and Maintenance Manual, see Appendix B
f) Final Functional Description (FD) supplied separately.
g) Electrical Certificate of Compliance (CoC)
h) Design drawing sets, as-built drawings and survey data.
i) Approved asset creation sheet (as per Section 4.1.1), including other linear assets.
j) Engineering compliance statements (CS1, CS3 and CS4 – CS2 on request only)
k) Transfer of title
l) Transfer of warranties
m) Transfer of power and water
n) EOP approval from asset owner

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.

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.*

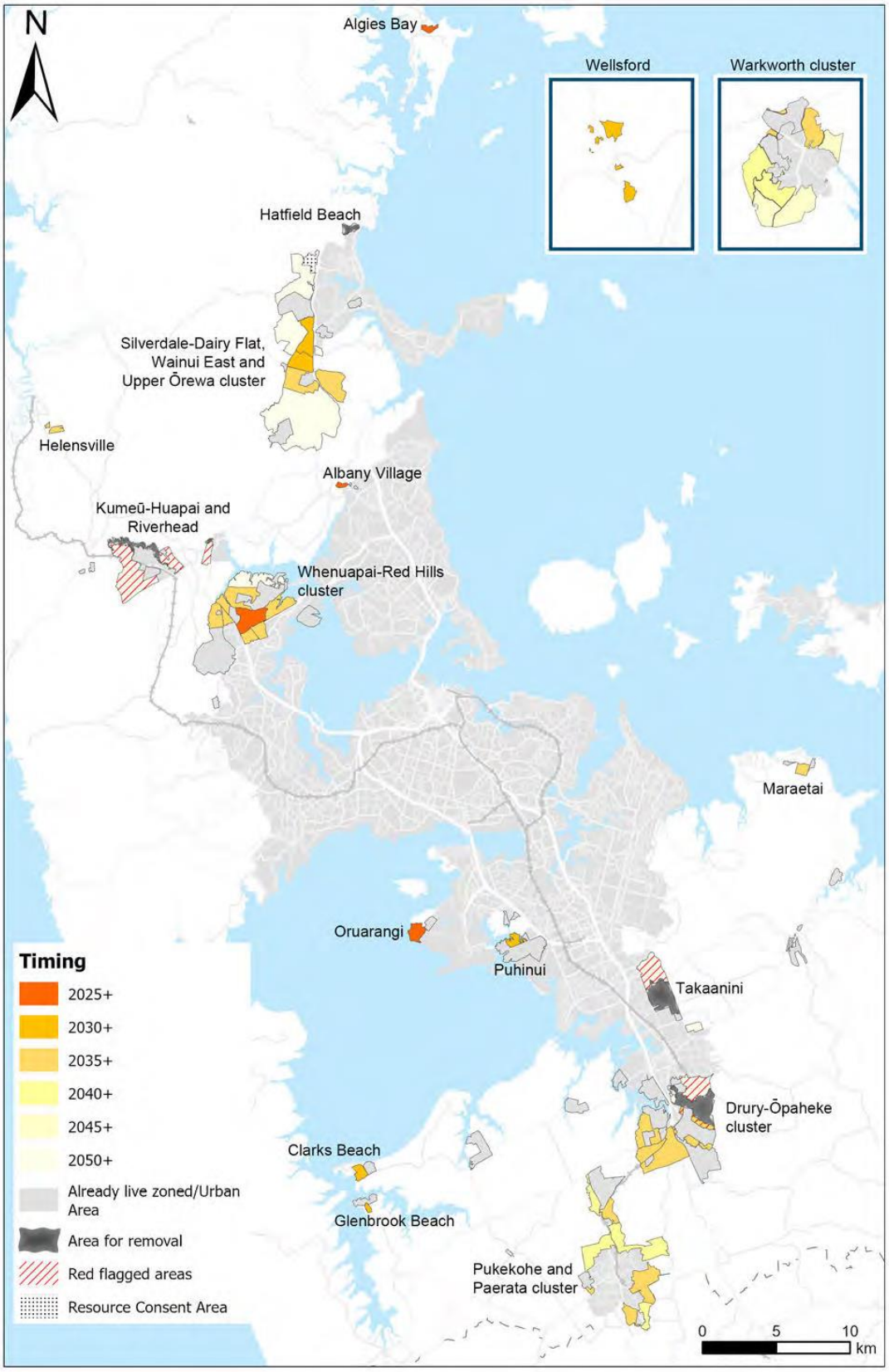
- Discharge from any new engineered overflow in the *Indicative Future Urban Area* but not identified in the below map as a predetermined proposed overflow location requires certification from Auckland Council. Watercare's agreement and guidance are required before making the application and should be 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.



(Reference: Auckland Council: Auckland Future Development Strategy 2023 – 2053)

Appendix B: Example Operations and Maintenance Manual index pages

Operations and Maintenance manual xxxx
CODE - Pumping station Name

Table of Sections

Revision	Description	By	Date

Section 1
Operations

Table of contents

1. Introduction (including catchment serviced by the pump station)
2. Overview
3. Pumping station elements
4. Pumping station operation (standard operating procedures)
5. Catchment yields
6. System curve and flow tests
7. Functional description – level 1

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)