Attachment 7:
Operation and Maintenance Procedures
for the Conventional (Gravity) Wastewater Network

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1 PURPOSE AND SCOPE

This document describes the operation and maintenance activities carried out by Watercare Services Limited (Watercare) in performing its duties as the Auckland water organisation[1] to ensure that the performance of the wastewater network (hereafter referred to as the Network) is optimised and potential adverse effects from wastewater overflows on public health, the environment and cultural values are avoided, remedied or mitigated.

The implementation of the procedures described here is supported by a range of systems, documents, forms and specific manuals that are subject to continuous organisational improvement processes and form part of Watercare's normal business procedures. This supporting material is held and accessed by Watercare staff and not part of this document.

The operational and maintenance procedures set out in this document apply to the conventional (gravity) wastewater networks (Network) that may generate the discharges that are authorised by the Comprehensive Wastewater Network Discharge Permit.

Operation and maintenance procedures for alternative wastewater systems owned and operated by Watercare (vacuum sewer systems, Pressure Wastewater Collection (PWC) systems and septic tank effluent pumping (STEP) sewer systems) are not included in the scope of this document, because these systems do not require engineered overflow points. These systems are not subject to inflow and infiltration and therefore do not give rise to wastewater overflows.

The scope also excludes the operation and maintenance of wastewater treatment plants and outfalls.

This document is subject to review on a regular basis.

[1] The Local Government (Auckland Council) Act 2009 defines *Auckland water organisation* as follows:
(a) until 1 July 2015, means Watercare Services Limited; and
(b) on and after 1 July 2015, means—
  (i) the Auckland Council (except in section 61); and
  (ii) a council-controlled organisation of the Auckland Council that provides water supply or wastewater services, or both, in Auckland.

2 ASSET MANAGEMENT AND MAINTENANCE

2.1 Overview

This section identifies the types of assets that collectively make up the Network and describes Watercare's approach to their management and maintenance, with particular emphasis on three types of activities:

- Routine – Carrying out regular (scheduled) maintenance and inspections of Network assets and facilities.
- Reactive – Dealing with the day-to-day operation of the Network, such as responding to complaints about wastewater overflows, blockages, odour, and/or public health issues.
- Proactive – carrying out risk assessments, identifying critical assets, initiating condition inspections, monitoring, contingency planning, dealing with recurring problems in the Network, managing demand (including inflow and infiltration programmes) and providing sufficient capacity for current and future demand.

2.2 Risk Management

Watercare's approach to managing Network assets is based on the following needs and principles:

- Protection of public health.
- Protection of the environment.
- Efficient operation of the wastewater network.
- Self-regulation.
- A high standard of service delivery.
- Commitment to being a minimum cost service provider, consistent with effective operation and maintenance as required by legislation.
- Effective asset management (appropriate investment).
- Proactive wastewater network management.

Watercare uses a risk management framework consistent with the joint *Australian and New Zealand International Standard AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines.*

Watercare's Enterprise Risk Management Framework (ERMF) sets out the management policies, procedures and practices to be applied to identifying, analysing, evaluating, treating and monitoring risk. The ERMF is used regularly to score and prioritise risks across the entire Network.

Where there is a low risk that asset failure may adversely affect public health and the environment, assets are generally managed on a 'run to failure' basis as this is generally the most cost-effective response. Low risk is usually only associated with local network assets.

Assets with a high level of risk (generally transmission assets) are managed differently. A detailed risk assessment based on the ERMF is carried out and a suite of measures is used to monitor and manage the risk effectively. Using the ERMF process, a risk class is assigned to help identify priority for action. The higher risk classes (Class 4 or 5 risks) are classified as Enterprise Risks and managed by the Watercare Board. These risks generally require significant capital expenditure in order to manage them. Examples of such major projects are the Hobson Tunnel and the Central Interceptor.

For major assets such as transmission system pump stations Watercare uses a Reliability-Centred Maintenance (RCM) process for determining maintenance strategies based on reliability techniques. This process encompasses analytical methods such as Failure Mode

Effects and Criticality Analysis (FMECA). The RCM process addresses the following objectives:

- Meeting Health & Safety requirements.
- Meeting environmental requirements.
- Meeting operational requirements.
- Improving asset reliability and availability.
- Minimising costs.

In addition to the ERMF and RCM processes outlined above, Watercare's Wastewater Planning Unit undertakes detailed analyses of wastewater asset criticality. This includes working with Operations staff to identify the most critical wastewater assets and ensuring that they become subject to monitoring and inspection programmes to enable renewals of these critical assets to be scheduled in a timely manner.
Maintenance work is managed with two asset management systems (AMS):

- SAP for transmission system assets, and
- Hansen for local network assets.

The systems are populated with all of Watercare's wastewater assets and are used to record maintenance activities, maintenance costs and condition information against individual assets. They are also used to schedule routine maintenance by generating Work Orders according to a planned schedule.

Because each asset type has different risk management and maintenance requirements, the relevant procedures for each asset category are set out separately in Sections 2.3 to 2.11 below, with particular reference to:

- Asset Description and Risk Assessment
- Inspection and Condition Assessment
- Preventative Maintenance
- Renewal.

Network assets are also subject to external risk, i.e. third party damage, which usually occurs as the result of accidental interference. This risk is managed through the Works Over Approval process described in Section 3.11 of this document.

2.3 Pipelines

2.3.1 Asset Description and Risk Assessment

Pipelines are made from a number of different materials:

- Asbestos cement
- Polyvinyl chloride (PVC)
- Ceramics (earthenware)
- Polyethylene (PE)
- Concrete
- Concrete-lined steel (CLS)
- Concrete-lined mild steel (CLMS).

The most common material used for local network wastewater pipes is asbestos cement, followed by PVC and ceramics. The most common material used for transmission pipes is concrete.

Pipeline failure is generally due to asset deterioration or structural failure. Asset deterioration occurs primarily due to attack by organic and corrosive compounds (e.g. hydrogen sulphide and components of trade waste) within the pipe or ground conditions outside the pipe. Structural failure is mostly due to ground movement or excessive loading. The rate of pipe deterioration may vary due to poor quality of initial construction or specific site conditions (e.g. flow turbulence inside the pipe, changes in ground use in the vicinity of the pipe, etc.).

The degree of risk associated with wastewater pipelines is generally determined by consequence (of failure). For wastewater pipelines, the main consequence of pipeline failure will be the public health risks associated with a discharge, the adverse effects of the discharge to the environment, and the loss of wastewater service for a number of properties. In addition there are the financial, reputation and health and safety risks of a failure event. Generally, the potential adverse effects caused by pipeline failure are related to the size of the network – the consequences of failure in the transmission system are generally more significant than in the local network.

The likelihood of failure is generally determined by the condition of the asset, which is investigated using the techniques described in Section 2.3.2 below. This information provides the basis for determining which pipelines are critical assets and need to be managed accordingly.

2.3.2 Inspection and Condition Assessment

The primary method for inspecting the condition of conventional gravity wastewater network assets is CCTV (Closed-Circuit Television) surveying. This technique provides condition information about the state of the internal surface of the pipe, pipe joints, and how well service connection junctions have been made. Occasionally data is also obtained by material sampling and mapping concrete reinforcing, although this usually provides only very localised information. It is sometimes possible to extrapolate this information by comparing the relative appearance of the pipe surface over the remainder of the CCTV survey, which may assist in assessing and rating overall asset condition.

Transmission pipelines are inspected using CCTV on a 5-yearly (maximum) cycle. Each section of pipeline is given a risk score based on the results of the inspection. Monthly asset investigation meetings are held to review the risk determination and to make decisions regarding maintenance requirements, frequency of future inspections, and recommendations for rehabilitation or replacement. The asset condition rating used for transmission assets is shown below.

Rating 1: Expected lifespan: 50 – 100 years

- Sound modern pipe, well maintained, no signs of damage.
- Near-new condition.
- No action required - re-survey in 10 or more years.

Rating 2: Expected lifespan: 20 – 50 years

- Sound pipe but showing superficial signs of wear and tear.
- Good condition.
- No action required - re-survey within 10 years.

Rating 3: Expected lifespan: 5 – 20 years

- Functionally sound pipe but with heavy wear and tear and some joint failures. Deterioration is beginning to affect performance.
- Average condition.
- No action required - re-survey (CCTV and/or LLL) within 5 years.

Rating 4: Expected lifespan: 1 – 5 years

- Questionable pipe showing significant failures that is likely to cause a marked deterioration in performance in the medium term.
- Poor condition.
- Possible remedial action required within 3 years, according to condition - re-survey within 1 year.

Rating 5: Expected lifespan: < 1 year

- Unacceptable pipe with no reliable lifespan; likely to fail in the near term.
- Warrants immediate replacement.

Where asset criticality analysis work has identified critical pipeline assets, priority CCTV inspection work can be programmed to obtain urgent condition information.

Reactive or targeted CCTV condition inspection work is carried out on both transmission and local network pipelines when operational issues are being investigated or when confirmation of a past condition assessment is required. The results of these individual inspections are used to decide what course of action is to be taken.

Laser light line is a survey technique which provides a means of more objectively measuring changes in pipes e.g. loss of wall thickness in concrete pipes, ovality in PE/plastic pipes, or deformation due to load cracking in ceramic pipes. Laser light line is normally only used when CCTV surveys have identified potentially significant risk features.

A further means of pipeline condition assessment used for pipelines in coastal areas is monitoring chloride levels in the treated wastewater effluent. High levels indicate the ingress of seawater into the wastewater network, either through the pipeline or manholes. Regular testing is carried out in pipelines that are potentially affected by seawater ingress, for example in Snells Beach or parts of the North Shore.

2.3.3 Preventative Maintenance

Preventative maintenance for wastewater pipelines generally involves scheduled flushing and/or cleaning. This is typically required for pipelines with a very flat or undulating grade where fat or sediment build-up occurs. The frequency of flushing is based on the extent to which fat or sediment accumulates. This is related to the flow rates in the pipeline and its physical characteristics (e.g. size, slope, troughs). The routine flushing of pipelines is managed using scheduled Work Orders generated by the relevant asset management system (SAP or Hansen).

Intrusion of tree roots is an issue for many pipelines and regular scheduled root cutting is undertaken using the same Work Order process. For local network assets the frequency of the scheduled maintenance activities ranges from monthly up to five yearly. Transmission assets are cleaned at least once every four to five years.

The type of pipe material is an important factor in determining the frequency and type of pipeline cleaning. Asbestos cement pipes, for example, can be damaged by high pressure cleaning.

Whether a pipeline remains on a regular cleaning (incorporating both flushing and tree root removal) schedule or not is an economic decision based on long-term maintenance versus renewal cost. In some cases, due to the limited ability to increase the gradient of a pipeline (due to upstream and downstream constraints), renewal of the section of pipeline may not resolve the fat or sediment build-up issue.

Once a pipeline has been identified for renewal, scheduled maintenance is often required in the intervening period between when a decision is made to replace the pipeline, and when the new pipeline is commissioned.

Cathodic protection is used on some transmission steel mains to minimise corrosion of the pipeline.

2.3.4 Renewal

Wastewater pipelines are generally replaced for one or more of the following reasons:

- Condition: the pipeline is in a state of advanced deterioration and/or is structurally unsound, or has a history of failures.
- Performance: the capacity of the pipeline is insufficient for current flows and needs to be upgraded with a larger diameter pipeline.
- Location: pipelines which are unserviceable due to location (depth or alignment) are sometimes renewed along an improved alignment to avoid potential operational issues

(prolonged loss of service and high cost) or when required for development (build-over) reasons.

- Grade: if the pipeline has very flat grades requiring continual cleaning, it may be replaced with a better graded pipe to improve maintenance.
- Damage by third parties: occasionally wastewater pipelines are damaged by third parties to such an extent that renewal is required, for example when concrete from a foundation pour enters a wastewater pipe.

The renewal decision making process utilises the following information:

- SCADA (Supervisory Control and Data Acquisition) or manhole monitoring alarm statistics;
- Overflow frequency;
- Complaint records;
- Planned preventative maintenance programme;
- Flow modelling (undertaken by Wastewater Planning); and
- Condition assessment.

Most of the information identified above is identified and/or reported to Operations staff. A history of repetitive faults or multiple overflows indicate a significant risk and the need for follow-up action. Such action may consist of root cause analysis, investigation, and identifying the most cost-effective remedial action. The outcome may be an operational change, planned corrective maintenance, new or amended preventative maintenance or, alternatively, a capital project such as renewal of the asset.

For local network assets, the Wastewater Planning Unit holds and maintains the Issues and Awareness Register lists and tracks wastewater pipelines with operational issues that potentially require renewal. The Wastewater Planning Unit relies on Operations staff to forward relevant information about individual assets such as pipelines, pipe bridges, siphons and other Network components.

Planned Renewal programmes are developed as part of the wastewater asset criticality work undertaken by the Wastewater Planning Unit. This process identifies the most critical assets in the Network to ensure that there are monitoring and inspection programmes in place for these assets, and to prepare a prioritised renewal programme.

2.4 Pipe Bridges

2.4.1 Asset Description and Risk Assessment

All pipe bridges are identified as critical assets. Pipe bridges are vulnerable components of the Network because they may be subject to:

- Corrosion due to the elements.
- Instability due to stream erosion around piers or bank support.
- Settlement of piers and displaced joints.
- Structural failure of piers and supporting structures.
- Instability due to flooding/washout.
- Third party damage (including vandalism) of exposed sections of pipe.

Pipe bridges are subject to risk assessments based on pipe size, pipe coating and the environment they are exposed to.

2.4.2 Inspection and Condition Assessment

All pipe bridges are inspected on a nominal five-yearly cycle. The frequency of inspection for high risk transmission pipe bridges is once a year. An overall condition grade of between 1 (excellent) and 5 (very poor – replacement required) is used.

The asset criticality work undertaken by the Wastewater Planning Unit identifies the most critical pipe bridges, and these are inspected on a greater frequency (up to a three yearly cycle).

2.4.3 Preventative Maintenance

There is no scheduled preventative maintenance programme for pipe bridges as all maintenance (minor or major), further investigation work or replacement is scheduled on the basis of condition inspections.

Minor maintenance work on pipe bridges generally involves the removal of vegetation and spot rust/corrosion treatment. Major maintenance works are normally required to rectify pipe bridge instability, stream erosion, subsidence of piers and displaced joints.

2.4.4 Renewal

Pipe bridges are replaced as and when required, generally because of major pipe corrosion, or for structural or stability reasons. Replacement is generally independent from the in-ground pipeline either side of the pipe bridge.

The renewal of pipe bridges is managed by the Wastewater Planning Unit through the wastewater asset criticality work programme.

2.5 Siphons

2.5.1 Asset Description and Risk Assessment

All siphons are identified as critical assets. A siphon is a gravity sewer pipe that dips below grade ('sags') in order to pass under an obstruction, such as a stream or harbour. Because there is a low point, there is potential for debris to accumulate in the siphon. For this reason, and the fact that siphons often pass beneath environmentally sensitive streams or harbours, all siphons are considered critical assets. The carrying capacity of the siphon (size and length) is generally the basis for establishing the degree of criticality.

A high proportion of siphons were duplicated when they were originally constructed (or have two or three barrels for high/low flows) due to the risks associated with these assets. This included construction of an inlet structure for the two pipelines to allow each siphon to be flushed or cleaned by waterblasting while the other pipeline remains in service.

Significant transmission siphons which have been duplicated through work projects (i.e. after construction) include:

- Whenuapai Branch sewer (Royal Road MH 14 – MH15);
- Rosebank Branch sewer (MH66A Western Interceptor to MH1 Rosebank Bridge);
- Otahuhu East Branch sewer (MH2 Tamaki Bridge to MH1);
- Regent Street Siphon (Devonport).

2.5.2 Inspection and Condition Assessment

Siphons are "flooded pipes" and therefore difficult to inspect. For this reason, CCTV is not normally a viable option. Some multi-barrel siphons may be isolated, drained and cleaned, and can then undergo internal inspection by CCTV. Internal inspection of siphon pipes using ultrasonic technology is another option, although this technology is not currently readily available in New Zealand.

The wastewater asset criticality work undertaken by the Wastewater Planning Unit identifies the most critical siphons and ensures that there is an adequate and appropriate condition assessment programme for these assets.

2.5.3 Preventative Maintenance

Because there is a low point in the ‘sag’ of a siphon there is potential for debris to accumulate. To flush a siphon, the penstock at the upstream manhole (inlet chamber or flushing tank) is closed and a head of wastewater is allowed to build up. This is then released to give a high velocity flush through the siphon. This process is used for some transmission siphons. Other siphons are cleaned using a hydrojet. Waterblasting is also used on a regular basis to flush siphons.

Flushing of transmission siphons can be carried out remotely by the Operator in the Central Control Room, or manually on-site. All transmission siphons are flushed on a regular basis. The increased flow from a siphon being flushed is a potential health and safety hazard for any maintenance staff working on the downstream Network, and relevant safety protocols must be observed.

Flushing of local network siphons ranges in frequency from six-monthly to two-yearly. The flushing is carried out to avoid the build-up of sediments and to ensure the siphons are in good working order.

2.5.4 Renewal

Renewal of siphons is treated in a similar manner to wastewater pipelines except that the threshold for condition grade for siphon renewal is set at a more conservative level due to the higher risk ranking of these assets.

Asbestos cement pipes require replacing earlier than other pipe materials. For new siphons or siphon replacements PE pipe (with butt fusion welded joints) is used.

The renewal of siphons is managed by the Wastewater Planning Unit through the wastewater asset criticality work programme.

2.6 Rising Mains

2.6.1 Asset Description and Risk Assessment

All rising mains are identified as critical assets, mainly due to their construction materials. Concrete-lined mild steel (CLMS) rising main pipes are the most vulnerable, particularly at bends, because the grit transported in wastewater flows is leading to the wear and erosion of the pipe from the inside. Asbestos cement rising main pipes in the transmission network are also subject to a higher rate of deterioration than pipes constructed with other materials. De-lamination of the pipe wall is a common mode of deterioration which eventually leads to pipe failure.

Rising main pipe work within pump stations, especially when made of cast iron, also presents potential risk due to the corrosion that may occur.

2.6.2 Inspection and Condition Assessment

Like siphons, rising mains are difficult to inspect because they are “flooded pipes”. The pump station needs to be shut down, and the rising main drained, flushed and cleaned before a CCTV camera can be inserted. This requires adequate wastewater storage at the pump station, which is often not available. For this reason CCTV is usually not a viable option for the condition inspection of a rising main.

Obtaining pipe condition data during rising main failures is a more appropriate means of establishing the remaining life of these assets. Asset maintenance history records are an important source of information as they document the number and type of failures. Additional tools for assessing pipe condition are pipe sampling for photographic record and laboratory analysis. Laboratory analysis may include physical and chemical tests on pipe samples to determine both the cause of damage and the likelihood of further failure.

2.6.3 Renewal

All critical rising main steel bends have been replaced, and the remaining CLMS pipes and fittings and critical asbestos cement rising mains in the transmission network are subject to a high priority replacement programme (as in June 2013). All new or replacement rising mains are constructed from PE pipe with butt fusion welded joints.

Other rising mains will be inspected when failures occur and replacement will be scheduled accordingly.

The programmed renewal of rising mains is managed by the Wastewater Planning Unit under the wastewater asset criticality work programme.

2.7 Manholes

2.7.1 Asset Description and Risk Assessment

Manholes provide access to wastewater pipelines to carry out work such as CCTV inspections or clearing a blockage. Without manholes it would be necessary to excavate access pits to gain access to a pipeline. Once constructed, functional issues with wastewater manholes are minimal. Typical problems with manholes involve damaged lids and covers, broken benching, and leaking (stormwater inflow and infiltration between manhole joints, risers). Manholes on transmission pipelines are generally constructed to a higher standard, and are therefore less likely to fail structurally or be damaged by third parties.

Manholes are not subject to risk assessments as they are sufficiently robust and do not normally present an operational risk. Condition assessments are normally undertaken when adjoining pipes are inspected.

2.7.2 Inspection and Condition Assessment

Manholes are normally checked while other maintenance or inspection tasks are being carried out (e.g. clearing a blockage, CCTV inspection, pipe cleaning). If maintenance services staff detect damage or deterioration in a manhole this is reported to Operations staff, and a detailed inspection is undertaken. Repairs are then undertaken as appropriate on a case-by-case basis. The results of manhole condition inspections are recorded in the relevant asset management system.

Watercare does not undertake a structured programme for manhole inspections, because manholes usually deteriorate at the same or a lesser rate than the sections of adjoining pipework. Manhole inspection and potential renewal is therefore undertaken as part of the pipeline inspection programme outlined in Section 2.3 above.

2.7.3 Preventative Maintenance

There is no planned preventative maintenance programme for manholes. Where a specific fault is identified as the result of a pipeline CCTV inspection or during other maintenance activities, follow-up maintenance works or, where the fault is severe, a capital works upgrade or replacement is carries out.

For local network manholes there is an increasing trend to eliminate rungs, platforms and ladders in some chambers. Current health and safety requirements require the use of a tripod and pulley retrieval system for confined space access and egress, which eliminates the need for ladders and similar structures.

2.7.4 Renewal

Manholes typically deteriorate at the same or a lesser rate than the adjoining pipeline. Manholes are generally replaced when the adjoining pipeline is replaced or rehabilitated.

2.8 Overflow Structures

2.8.1 Asset Description and Risk Assessment

Overflow structures allow for hydraulic pressure to be relieved from the wastewater network when design capacity is exceeded, usually as a consequence of excessive inflow or infiltration of stormwater during or immediately following a heavy rainfall event. All pump stations are equipped with overflow structures, and structures can also be found on sections of the Network independent of pump stations. The combined Network has a large number of overflow structures equipped with screens, some of which are mechanised.

2.8.2 Inspection and Condition Assessment

Overflow points are visually inspected following overflow events and at more frequent intervals (either six-monthly or annually) as part of the planned preventative maintenance programme. Overflow structure pipes associated with the transmission network serviced by the Mangere Wastewater Treatment Plant (WWTP) are also inspected by CCTV as part of the pipeline asset inspection programme.

The overflow structure servicing the Reihana Street Pump Station in Orakei, which is Watercare’s largest pump station, is subject to a more rigorous inspection regime. Diver inspections are carried out annually, and soundings of the sea floor in the vicinity of the outfall are carried out every two years.

2.8.3 Preventative Maintenance

Screens associated with overflow structures are cleaned on a regular basis, in some cases twice weekly. Pump station overflow structures with overflow ‘baskets’ or ‘fences’ are cleaned immediately following an overflow event.

2.8.4 Renewal

Overflow structures are subject to normal renewal processes, meaning they are replaced or upgraded when a particular need is identified during normal inspection and/or maintenance.

2.9 Storage Facilities

2.9.1 Asset Description and Risk Assessment

Storage facilities reduce the risk of wastewater overflows when Network capacity is exceeded as a result of storm events, or at times of pump station failure. Although important assets in an operational context, the storage facilities themselves are not a critical asset in terms of risk.

The major network storage facilities in the region used for flow balancing after a storm event (rather than storage associated with pump station failure) include:

- Silverfield (North Shore);
- Northboro (North Shore);
- Mairangi Bay (North Shore);
- Birkdale (North Shore);
- Swanson Branch Storage Tank (The Concourse, Henderson);
- Hobson Bay Storage Tunnel.

These facilities have all been constructed since 1995.

2.9.2 Inspection and Condition Assessment

As the purpose-built storage facilities (other than those associated with pump stations) are relatively new structures and of concrete construction, there is currently no need for a regular condition inspection programme. Any equipment associated with the storage facility such as penstocks, pumps, valves etc. is subject to a regular maintenance inspection programme.

2.9.3 Preventative Maintenance

The larger storage facilities are cleaned after each use, as confirmed by SCADA. Cleaning is carried out automatically or manually, or through a combination of both. The larger storage facilities have their own flushing systems to prevent the accumulation of solids.

2.9.4 Renewals

The purpose-built storage facilities are relatively new (as in June 2013) and are therefore not part of a renewal programme.

Pump station storage is augmented and renewed when a particular need is identified.

2.10 Pump Stations

2.10.1 Asset Description and Risk Assessment

Pump stations are broadly categorised in terms of their flow rate:

- Pump rate greater than 200 litres/second
- Pump rate between 20 litres/sec and 200 litres/second
- Pump rate of less than 20 litres/second.

As for pipelines, the main consequence of pump station failure is the adverse effects of the discharge on public health and the environment, and the loss of wastewater service for a number of properties as well as the financial, reputation and health and safety risks of an overflow event.

Pump stations are critical components of the wastewater network and its operation. The failure of major pump stations is a key aspect of the Enterprise Risk Management Framework (ERMF) planning.

If a pump station is in danger of overflowing before a fault can be rectified, the on-call duty engineer is responsible for reviewing interim options for managing flow (tankering, generator call-out, etc.) in order to minimise the risk of an overflow.

2.10.2 Inspection and Condition Assessment

All pump stations are subject to a regular inspection programme. Generally, the frequency of inspections is:

- Weekly for transmission pump stations
- Weekly, fortnightly, monthly or six-weekly for local network pump stations.

Pump station inspections include collecting condition information on the pump station key components, and recording and actioning minor maintenance requirements. Other maintenance work is identified using inspection results and scheduled as needed.

The condition of pump units at local network pump stations is not normally monitored as back-up pumps are available and they are subject to a ‘run to failure’ policy. However, infrared testing (for hot spots on switch gear) is undertaken.

Transmission pump station pump units are critical assets and are managed differently. Regular maintenance inspections are undertaken to determine maintenance requirements. SCADA monitoring provides a wide range of pump unit data (such as current and bearing temperature), and vibration testing is carried out on pump units (dry mounted centrifugal pumps) associated with the system servicing the Mangere WWTP to provide early warning of pump failure. The major pump stations are checked every 3 to 6 months.

2.10.3 Preventative Maintenance

Maintenance requirements for the transmission pump stations are identified using the process summarised below:

- Failure mode and effects analysis identifies the critical plant failure modes in a systematic and structured manner.
- Examination of each critical failure mode determines the optimum maintenance policy to reduce the severity of each failure.
- Selection of a maintenance strategy takes into account:
- Cost, safety, environmental and operational consequences.
- Effects of redundancy, spares costs, maintenance labour costs, equipment ageing and repair times.
- Optimal maintenance policies are recorded
- The following outputs are provided:
- System performance predictions and costs.
- Expected spares requirements.
- Maintenance labour manning levels.

2.10.4 Renewal

Pump units are generally replaced when the pump unit fails. Stand-by pumps are normally available to provide continuity of service and SCADA alarms alert Operations staff to the failure. At major pump stations, SCADA alarms initiate a warning prior to failure of the pump unit.

Components such as valves, fittings, ladders, landings and piping within a pump station are renewed when condition requires it. Where the internal environmental conditions at the pump station have caused structural degradation, the structural elements are renewed.

3 OPERATIONS

3.1 Overview

This section identifies the systems and procedures essential for the day-to-day operation of the Network, specifically:

- Network monitoring and control (SCADA)
- Alarms and alarm management
- Real time control
- Management of trade waste
- Incident response
- Management of storm events, electrical outage and natural disaster or civil emergencies
- Management of inflow and infiltration
- Management of repeat overflows
- Contingency planning
- Complaint procedures
- Works over approvals
- Linkage to wastewater network planning.

3.2 Network Monitoring and Control

Monitoring in real time is provided through SCADA. It allows information about how the network is operating at any given time to be monitored and recorded. Monitoring, particularly wastewater flow monitoring, is also necessary to inform maintenance and wastewater network improvement planning.

3.2.1 SCADA System

Watercare's telemetry network, the SCADA system, is a centralised control and data-collection system for all wastewater network, water network and treatment facilities. All major pump stations and most local pump stations are monitored by the centralised SCADA system.

SCADA communicates with control rooms at the three operational hubs at Mangere, Newmarket and Rosedale, where the information received triggers the appropriate operational response.

All SCADA data is stored and retained in the centralised system at Newmarket where it is used for reporting, planning and monitoring of network performance.

The SCADA system includes:

- Continuous telemetry links with remote sites to receive data and send control signals
- Alarm, monitoring and control functions
- Data collection and storage of information received from remote sites
- Remote control and data access for on-call and stand-by maintenance staff.

Monitoring parameters include wastewater levels and pump operation. The types of alarms that may be triggered are described in Section 3.2.4.

3.2.2 Flow Monitoring

In addition to the normal monitoring of the main facilities, wastewater flow is measured at key locations. Data from all flow meters is transmitted to the SCADA system.

There are two main types of flow meter in use: open channel flow meters and pressure pipe meters (usually magflow).

3.2.2.1 Open Channel Flow Meters

The three open channel flow meters currently in use are located in the transmission network servicing Mangere WWTP. Operation of the flow meters, including annual calibration tests statistical analysis of data, and call-out response is outsourced.

The instrumentation calculates flow based on a Doppler instrument that measures the flow velocity, and an ultrasonic level instrument that determines the cross-sectional area of the fluid in the pipe based on a measured depth. The two instruments are mounted in the wastewater pipe at or near a manhole.

3.2.2.2 Magflow Meters

Magflow meters are installed at 65 % of the transmission pump stations associated with the Mangere WWTP collection network (90 % of system pumped flows are measured), and all of the other transmission pump stations.

3.2.3 Manhole Monitoring and Alarms

Some manholes, especially those where overflows could potentially occur, are equipped with a manhole alarm (digital or analogue level sensor).

3.2.4 Alarms and Alarm Management

The SCADA system captures data recorded by monitoring instrumentation installed at key facilities in the wastewater network. If an item of data differs from set values, the SCADA system will generate an alarm. Alarms may be received in the control room, or sent directly to maintenance staff (in-house or term maintenance contractor staff) for action.

SCADA alarms are managed according to risk. Most alarms require an immediate response 24/7. Some SCADA alarms have time delays to enable the system to verify that the alarm is valid and not caused by a brief sensor or signal interruption. Control room operators respond to all transmission system SCADA alarms.

Alarms are assigned a priority and if necessary, incidents are responded to in accordance with the Wastewater Overflow Regional Response Manual.

Protocols for the Central Control Room operation have been developed to:

- Capture consistent, useful information from alarms and initiate alarm response
- Facilitate communication between all personnel especially during shut-downs
- Minimise the potential for accidents and incidents
- Record and respond to complaints from site neighbours and the public.

The main types of alarm are:

Wet Well High Alarm:	Indicates that the wastewater level has risen beyond 150 mm above the programmed pump start level in a pump station. This usually indicates that there is a problem with the pumping set (partial blockage, loss in efficiency, etc.).
High Flow Alarm:	For pump stations with flow meters where a threshold flow rate is exceeded.
Overflow Alarm:	An Overflow Alarm at a pump station indicates that the wastewater level has risen to a level at which wastewater is about to overflow. All transmission overflow structures also have an alarm to indicate that an overflow is actually occurring.

Standby Pump Started:	Indicates that there is a high wet well condition, that the duty pump(s) are not achieving the required output and that a stand-by pump has started. The alarm generally applies to pump stations where there is limited storage and therefore a limited time to respond before an overflow may occur (at average flow conditions). In this case, the reason for the reduction in the first duty pump output needs to be investigated and rectified as soon as possible.
Urgent Pumps Unavailable: (transmission only)	Indicates that a critical number of pumps are unavailable at a pump station. At specific sites, individual pump trip/ unavailable alarms may be raised from low priority to high priority when this occurs. This alarm allows for a response to be initiated before a high wet well level is reached, giving more time to reset the affected pumps and minimising the risk of an overflow. The elevation of low priority to high priority for individual pump trip/ unavailable alarms applies to those pump stations where there is limited storage, and therefore limited time to respond before an overflow might occur.
Security Alarm:	If any Watercare security system alarm is triggered, the alarm is received by the SCADA system and displayed at the Central Control Room. The Control Room operator initiates a security call-out procedure.
Siphon, Flow Meter, Overflow Site, and Biofilter Alarms	Siphons, flow meters, overflow sites, and biofilters can generate a number of alarms to alert Operations staff to a malfunction.

3.2.5 Real Time Control

Real Time Control (RTC) is a management procedure that can be implemented during rainfall events to redirect wastewater flows, usually to available storage facilities. RTC is also referred to as Inter-Station Control. In some sections of the network, especially the North Shore, this practice is a normal part of operating the system. ISC is used to maximise system storage and direct flows to preferential overflow points where the receiving environment is less sensitive or better able to assimilate an overflow.

In other parts of the network, predominantly the transmission system on the Auckland Isthmus, RTC is based on a linkage between some pump stations and level measurements in the downstream pipe. If the flow level in the pipe rises above a certain level, the pump station output is restricted so that potential overflows occur from the pump station overflow structure rather than from a manhole along the pipe. This approach minimises potential public health effects and flooding from uncontrolled overflows.

3.2.5.1 Real Time Control of Pump Stations

All networks operate with capacity constraints at some stage. To maximise the conveyance and storage within the network and to minimise overflows, many pump stations are operated in a Real Time Control environment that interlinks the operation of certain pump stations and storage facilities. This management approach is mostly used in the transmission system, although some local pump stations are also included. An example is the Hibiscus Coast Network. During a significant rainfall event, the system is operated to reduce flows from pump stations, or shut them down altogether. This is carefully sequenced to maximise the use of the storage facilities at Orewa, Tindalls Bay and Stanmore Bay pump stations before overflows occur.

3.3 Management of Trade Waste

Trade waste is any liquid that discharges to the wastewater network from a trade or industrial process. Trade waste discharged directly into the wastewater system in an uncontrolled manner poses a high risk of harm to the wastewater system and treatment plant processes, the health and safety of wastewater personnel, and the environment.

The potential system risks associated with trade waste discharges include:

- Damage to the infrastructure e.g. Corrosion of network pipes;
- Blockage or choking of the network system e.g. Fat blockages;
- Harm to the treatment processes e.g. Toxic effects on biological processes or physical blinding of inlet screens;
- Harm to maintenance personnel e.g. Toxic gases or vapours;
- Harm to the environment e.g. Discharge of toxic compounds.

Watercare's Trade Waste Unit regulates trade waste discharges to the wastewater system in accordance with one of four trade waste bylaws, depending on the area (Auckland, Franklin, North Shore or Rodney).

Those discharging trade waste are required to hold a trade waste consent. In conjunction with the relevant trade wastes bylaw, trade waste consents detail the rules and conditions that must be adhered to by the consent holder. These may include contaminant limits, pre-treatment requirements, maximum flow rates, incident management plans, and self-monitoring and reporting requirements. A risk assessment is carried out for each trade waste consent application which assists in determining the conditions that are applied to a consent.

A comprehensive monitoring programme measures wastewater quality from the source of the discharge through to where the waste is received at the wastewater treatment plant. Monitoring programmes include:

- Self-monitoring – undertaken by the customer and reported to Watercare.
- Audit monitoring – undertaken by Watercare to verify discharges meet the terms of the bylaw and consents and to verify self-monitoring results.
- Remote sewer monitoring – remote sewer monitors measure parameters such as pH, temperature and conductivity on a 24/7 basis. If measurements go outside pre-set ranges then an auto sampler is automatically triggered to collect samples of the wastewater. The wastewater is then sent for analysis to assist in determining the source of the incident.
- Catchment investigations - investigations targeted to specific catchments to characterise the waste discharged in the catchment to identify any issues that may exist.
- Incident investigations – initiated in response to an incident such as the triggering of a remote sewer monitor or a reported incident from network staff. These investigations seek to track the incident back to source.
- Wastewater treatment plant monitoring – monitoring of influent at the inlet works to the treatment plants is carried out to determine the wastewater quality as it enters the plant.

In 2010/2011, Watercare administered approximately 1,600 trade waste consents. Around 14,000 individual tests were undertaken in the same time period as part of the above monitoring programmes to verify the quality of wastewater received in the wastewater system.

When a trade waste discharge is found to be non-compliant, a non-compliance notice is raised against the customer consent and the customer is required to investigate and explain the cause of the non-compliance, what has been done to correct it the steps put in place to ensure that the non-compliance does not recur.

Generally, working with customers to resolve the issue is sufficient. In some circumstances, additional measures such as prosecution and/or cancellation of consent may be required, as provided for by trade waste bylaws.

Education is an effective tool in controlling trade waste discharges. This includes:

- Site tours of the wastewater treatment plant to demonstrate the effects on the treatment plant of non-compliant discharge.
- Information brochures.
- Assignment of a compliance advisor to the consent holder.
- Free access to a wastewater technical specialist.

3.4 Incident Response

Watercare's response to both dry and wet weather overflows is set out in the *Wastewater Overflow Regional Response Manual*. These requirements are part of all maintenance contracts to ensure that all wastewater overflows are managed consistently.

Generally, wet weather overflows are treated as Level 1 Incidents unless significant and extensive flooding occurs or multiple properties are involved, with significant potential for property damage. During severe weather when wet weather overflows can be reasonably expected, maintenance contractors attend known significant wet weather overflow locations and initiate the appropriate response.

Generally, incident response involves the following steps, in the order set out below:

(1) Securing public health and safety.
(2) Determining appropriate containment options.
(3) Containing the overflow.
(4) Repairing the fault and/or removing the blockage.
(5) Clean-up and recovery.
(6) Reporting.

3.5 Management of Storm Events, Electrical Outage and Natural Disaster or Civil Emergencies

3.5.1 Storm Events

In the event of a severe weather warning, Watercare prepares for the event and alerts its term maintenance contractors to enable appropriate preparations.

During and immediately following storm conditions, Watercare carries out 'trouble spot' checks on the transmission system. This includes an inspection of specific manholes known to have been affected by previous significant storm events, to check for overflows and clean up after any overflows.

3.5.2 Electrical Outage

Electrical power outage is one of the most significant risks to the operation of the wastewater network due to the large number of wastewater pump stations in continuous operation. To minimise overflows in the event of a power failure, most pump stations can store wastewater for a period of time. Emergency storage at wastewater pump stations varies from site to site. The small pump stations have relatively large storage (up to 24 hours of dry weather flow), but the large pump stations have only one or two hours storage on site, due to the cost and space requirements to provide a large storage volume.

In order to mitigate the risk of electrical outage, Watercare has the following measures in place:

- Fixed generators: Fixed generators are provided at selected high risk critical facilities to provide alternative power during an electrical outage.
- Mobile generators: Watercare has several mobile generators located in specific locations and that can be moved to service pump stations in the event of a prolonged power outage.
- Generator hire: Watercare has a formal service level agreement with a major power generation supplier who provides for the urgent deployment of suitably sized generators to wastewater pump stations. Under the service level agreement the required response time for a generator to be deployed on site is one hour during normal working hours and two hours outside normal working hours. All wastewater pump stations have generator connectability.
- Dual power feeds: Critical pump stations have dual power feeds.

If a power outage affects both water and wastewater services then generally water sites will take first priority. Under these circumstances, communication with the Duty Controller (or Networks team during working hours) must occur. Proposed mobile generator deployment routes have been prepared for some areas.

The ranking of transmission wastewater sites in terms of criticality is available in the SCADA system, so that this information is readily available during an incident.

3.5.3 Response to Natural Disaster or Civil Emergencies

Watercare is a member of the Auckland Engineering Lifelines Group (AELG), a group of key Auckland utility operators who have agreed to work together to formulate an integrated and prioritised response to a significant regional natural disaster or civil emergency. Projects undertaken by the AELG include response to tsunami, volcanic activity and an extreme weather event. Watercare is also involved with the National Engineering Lifelines Group.

Watercare has an Operations Incident Management Plan for use in a natural disaster or civil emergency.

3.6 Management of Inflow and Infiltration

Inflow and Infiltration (I&I) occurs in all wastewater systems to varying degrees. It is defined as follows:

- **Inflow** is the direct entry of stormwater into private drains[2], either through a downpipe from the roof connected to the gully trap, or a low gully trap that allows water from the hard stand to flow into it. In some rare case, inflow can also occur into the public wastewater system through low-lying manholes.
- **Infiltration** refers to the water (groundwater) that enters the wastewater pipe system through cracks, joints, broken or poorly constructed pipes.

Generally, inflow occurs in private drains (with minor exceptions) while infiltration is a “shared” issue, occurring both in the private and public section of the network. A common water industry estimate is that 50-65% of I&I occurs in the private system.

Management of I&I is an important contributor to reducing wastewater overflows. I&I reduction programmes are normally implemented at catchment level as they may not always represent the most effective, financially sound, or easily implemented option.

2 Private drains are private pipes that convey wastewater from buildings to the public wastewater system.

3.7 Management of Repeat Overflows

3.7.1 Dry Weather Overflows

Within each of the wastewater network operational areas a planning engineer has responsibility for regularly checking for repeat overflow occurrences and examining the history of the occurrences to establish the cause of the overflows. Where necessary, investigative work such as a CCTV inspection of the pipe is carried out to ascertain the cause. Following consultation with the network manager, appropriate remedial action is identified and implemented. This may include one or more of the following:

- Carrying out a spot repair on the pipe.
- Renewing or rehabilitating the pipe, which requires action by the Wastewater Planning Unit.
- Cleaning and/or including the pipe in the regular flushing programme.

Transmission pipelines are generally unlikely to block due to their size and flow rates. However, repeat overflows can potentially occur due to pumps being stopped by debris or other materials, and are investigated as above.

3.7.2 Wet Weather Overflows

Repeat overflows caused by storm events are generally managed as follows:

- The network in the vicinity of the repeat overflows is checked to ensure that all pipes are operating at full capacity and that there is no pipe failure or network blockage.
- If an individual property is affected, consideration is given to installing a non-return valve on the private drain to prevent reverse flows from the network causing overflows on the property (gulley trap). In difficult cases, a private pump station may be installed so that the property can be disconnected from the wastewater network at this point, and pumped into the network at an alternative location via a rising main.
- If the repeat wastewater overflows are more widespread, the matter is formally reported to the wastewater planning unit for investigation. The first stage will be an assessment of whether inflow and infiltration work in the catchment is appropriate, and/or whether network capacity issues need to be addressed with a capital project such as upgrading a pipeline or installing a storage facility.

Because stormwater management is an essential factor in minimising wastewater overflows, different units within Watercare regularly meet with the Auckland Council Stormwater Section.

3.7.3 Uncontrolled Overflows

Uncontrolled overflows are discharges at locations not specifically designed as an overflow point. They generally occur in the local network, when lack of capacity or partial blockages cause constraints during wet weather. However, some uncontrolled overflows may also occur from the transmission network.

Management of uncontrolled wastewater overflows is undertaken in two ways:

(1) Short-term response in accordance with the overflow response and management procedures set out in the wastewater overflow regional response manual.

(2) Investigation and remediation. Overflow incidents are recorded and reported in accordance with the procedures set out in the wastewater overflow regional response manual. Through this process, watercare determines whether an uncontrolled overflow presents a public health risk, and whether it does so on a recurring basis. Where an unacceptable public health risk is confirmed, remedial action will be initiated.

3.8 Contingency Plans

As part of its risk management approach Watercare has prepared a range of contingency planning responses for failures within the network. These comprise:

- Generic response plans (procedures) for incidents and emergencies in the network (emergency management plans, standard operating procedures).
- Logistics plans for interceptors, siphons, rising mains and large pump stations.
- Specific plans for high risk assets or events.

3.8.1 Generic Contingency Response Procedures

Generic contingency response procedures describe key steps for response to the failure of pipeline assets such as rising mains or gravity sewers. The procedures are largely based on those already in place for dry weather overflow response. However, they elaborate on specific key elements of a response, such as short-term and permanent repair options, and liaison with site neighbours.

3.8.2 Logistical Plans

Logistical plans focus on minimising the flow to the failed asset by managing pump station operation and available storage. Logistical plans are in place for a number of wastewater pipes, interceptors, siphons, and rising mains.

3.8.3 Specific Contingency Plans

Specific contingency plans describe the response to the failure of specific higher risk assets. These are normally prepared to cover the period during which a short term ‘high risk’ exists, either during a critical phase of a construction project or following discovery of a highly deteriorated asset, until the asset is repaired or replaced. For major pump stations, specific contingency planning involves ensuring that there are critical spares available at short notice for the pump station, such as pump units, switching equipment, valves and pipework.

3.8.4 Support for Contingency Plans

All contingency plans are supported by:

- Plant redundancy in pump stations (stand-by pumps).
- 24 hour/7 day manned control room.
- Maintenance staff stand-by roster.
- Operations staff on-call roster.
- Inventory of watercare-owned safety/operational equipment.
- Service agreement with generator supplier.
- Contact lists for key service providers – vacuum suction tankers, bypass pump systems, excavators/trucks, hire plant and equipment.
- List of (preferred) civil contractors.
- Inventory of pressure pipe repair clamps.

3.9 Customer Complaint Process

A key aspect of managing a wastewater network is dealing with day-to-day complaints and service requests.

Complaints are normally received by the Customer Service Centre and given a problem code relating to the type of issue reported. Responses to complaints are tracked using the asset management system, and Key Performance Indicators (KPIs) are used to monitor overall performance in dealing with customer complaints. KPIs typically cover response times (depending on the level of urgency of the issue) and repair times (to restore service). A summary of the complaint process and response is shown below.

Call logged by Customer Service Centre ↓	• Each complaint/request receives a service request number. • Each complaint/request receives a problem code.
Maintenance staff respond ↓	• Response time to urgent requests is normally within 1 hour. • Response is undertaken as per relevant documented procedures. • Any overflows are contained and removed. • Blockages are cleared and/or the fault is repaired.
Operations staff follow-up ↓	• Repeat overflows or problems are investigated. • If necessary, regular flushing is programmed through the relevant asset management system. • Spot repairs are programmed if required. • Renewal is considered and a brief prepared.
Wastewater Planning Unit ↓	• Pipe capacity is assessed if a replacement is necessary. • Design requirements are determined. • Inflow & infiltration programmes are considered. • Detailed design is commenced to facilitate replacement.
Projects Unit	• Construction of the new asset is initiated. • As-built information is received from contractor. • As-built information is recorded in GIS. • Completion of project is communicated to Operations and Maintenance staff.

In addition to the measures outlined above, Watercare has customer service level standards that are set out in Watercare's Customer Charter (available on Watercare's website).

3.10 Works Over Approvals

Third party damage is one of the most common causes of asset failure. Due to the risk of third party damage, Watercare has a specialist team to monitor and control third party activity in close proximity to its assets.

There are two types of activities Watercare is concerned with - construction activities within private property and construction activities within road or public reserves. Each is managed through different but related processes. If the works are inside the clearance distances from Watercare's networks, a Works Over Approval is required before they can proceed.

Clearance distances are:

(1) For water and wastewater pipes 300mm in diameter and greater (including connected manholes and structures):

For general excavation	10 metres
For Piling	10 metres
For Blasting	15 metres

(2) For water and wastewater pipes less than 300mm in diameter (including connected manholes and structures):

For general excavation	2 metres
For Piling	2 metres
For Blasting	15 metres

Watercare does not normally give permission to build over a water main or a wastewater pressure pipes. To accommodate a building, these pipes need to be relocated at the customer's cost, and the proposed diversion must be approved by Watercare prior to starting the relocation.

The Works Over Approval process for construction activities within private property requires the completion of a Works Over Application Form, which is available on Watercare's website. The process of granting permission may require a CCTV inspection of the pipes on the property, and generally takes a minimum of 13 working days (more if the pipe requires cleaning before a CCTV inspection can be carried out). Building consent is only issued by Council if the applicant can provide a Watercare Works Over Approval.

The Works Over Approval process for construction activities within road or public reserves is different in that it is undertaken through the BeforeUDig service. This is a national online service where registered contractors obtain information about the presence of underground pipes and cables. Any request for plans is automatically directed to the asset owner/utility services. The BeforeUDig response is generated within 48 hours, and will confirm whether Watercare assets are in the vicinity of the proposed works and if Works Over Approval is required.

3.11 Linkage to Wastewater Network Planning

The Wastewater Planning Unit has an important role in minimising network discharges. Its responsibilities include:

- Arranging for the timely design, construction and commissioning of network renewal projects, as requested by operations. These projects are typically generated as a result of network operational issues, asset investigations and asset condition assessments. For network renewal projects it is important that network capacity is assessed to ensure the new pipeline is adequately sized for current and future (50 year) design flows.
- Ensuring that new infrastructure is designed appropriately. Design objectives include the operability and maintainability of the installation. Inherent flaws in the design can cause higher maintenance costs and result in higher potential for overflow. The design should also meet the desired life expectancy objectives.
- Planning for growth. Auckland is experiencing steady growth through intensification and greenfield development. Watercare plans for this growth to ensure greenfield areas are serviced in a timely manner and that the network has sufficient capacity for the increased customer base.

4 DATA MANAGEMENT

4.1 Approach

A comprehensive dataset of assets is essential for the successful operation and maintenance of a wastewater network. Watercare has both a Geographical Information System (GIS) system and an asset management system to meet data requirements. The GIS database is available to all on-line users within Watercare and provides for the following:

- Accurate spatial identification of all assets, including but not limited to pipelines, manholes, pump stations and overflow structures.
- Key attributes of the assets such as size, material and age (date installed) to facilitate maintenance and repair work.
- Information showing if the assets are currently in service, decommissioned or abandoned).
- Ability to record asset condition and criticality against individual assets.

The asset management systems record maintenance history against individual assets (and the cause of problems), the inspection history of individual assets, and maintenance costs against each asset, and schedule regular inspections or preventative maintenance work for individual assets.

For transmission assets, engineering and asset condition assessment reports and photographs relating to specific facilities or assets are stored in the appropriate vault in the Document Management System (Projectwise). Where appropriate, links are set up between the Document Management System and GIS. This allows information to be accessed via the GIS system.

4.2 GIS and As-Built Data

In Watercare's asset management system each asset is assigned a unique identifier (Equipment Code). Assets are grouped into facilities and described in the GIS database, which contains physical attribute information on every asset in the wastewater network. This information is mostly represented in map form, showing the physical location of each asset as well as the surrounding geography, infrastructure and buildings. Additional information is available in data form (for example material, diameter, length). Separate map layers are also available, depicting inspection data, condition, and pipe condition rating (risk) information. GIS maps are routinely created in either hard copy or electronic form for:

- Providing CCTV contractors with sufficient information to provide quotes.
- Cost estimates for inspection work.
- Accurate location of manhole entry/exit points for inspection work.
- Presenting inspection, condition, and risk information for analysis and reporting.
- CAPEX requests.

Maintenance of as-built plan records ensures that accurate, up-to-date information relating to the location, nature, and configuration of assets is always available to Operators and Maintenance staff.

4.3 Network Data Improvement

Network data is continually improved to facilitate more sophisticated asset management planning practices, such as identifying trends in operational statistics and asset deterioration and performance.

Maintenance contractors are required to have the technology to interface with the GIS and asset management systems to ensure that relevant asset information such as pipe diameter, pipe material, pipe condition and cause of blockage is captured and recorded when maintenance work is being carried out.

4.4 Overflow Database

Wastewater overflows are recorded in a Microsoft Access database using the following parameters:

- Type of overflow - from a pump station, network relief point or manhole.
- Facility - name of pump station, facility code, branch trunk sewer, or local network area (northwest, central, south).
- Manhole - the number or location of the manhole which overflowed.
- The cause of the overflow - heavy rain, power failure, mechanical/maintenance failure (plant failure) or other.
- The date of the overflow.
- The start time of the overflow.
- The duration of the overflow.

The information is used for reporting and planning purposes. Repeat overflow occurrences are monitored and investigated as required (refer Section 3.8).