University of Southern Queensland

Faculty of Engineering and Surveying

Asset Management for Tamworth Regional Council's Sewer Network

A dissertation submitted by

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ABSTRACT

Some sections of Australian sewers are more than 100 years old and their condition is declining as networks age and effluents become more hostile, that is they contain materials the sewers were not designed to carry. In Australia during the past two decades the rehabilitation of existing civil infrastructure has become increasingly important. The rehabilitation of existing sewer assets has become prevalent since the 1990's as existing infrastructure has reached its useful life and is beginning to fail.

Tamworth Regional Council is located in North West New South Wales and provides sewer services to approximately 50,000 customers through four sewer networks. The current sewer asset portfolio is estimated to be 187 million dollars and includes approximately 500 kilometres of sewer pipe network.

This research project examines the current industry methods used for sewer asset management including asset assessment and rehabilitation. The study completes a benchmark analysis by comparing current asset management practices being undertaken by Tamworth Regional Council against industry best practice. The findings of this analysis were used to develop a sewer asset management strategy for Tamworth Regional Council and ongoing works program and budget. The project considered all aspects of sewer asset management to improve Tamworth Regional Council's sewer network performance for aspects such as blockages, overflows and stormwater inflow/infiltration.

Through the adoption and implementation of this strategy, Council can approach the future with confidence that it will provide sustainable sewer asset management while continuously improving its desired levels of services to its customers.

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1 PROJECT BACKGROUND

1.1 Introduction

The development of sewer infrastructure for the transport and disposal of human waste can be attributed to greatly improving human health by reducing illnesses such as cholera and typhus. During the mid 1850's it was clearly demonstrated that a relationship existed between disease outbreaks and contaminated water supplies from sewage disposal. Dr John Snow identified the link between sewage disposal and Cholera infection during the 1854 Cholera outbreak in London (Johnson 2006).

Some sections of Australian sewers are more than 100 years old and their condition is declining as networks age and effluents become more hostile, that is they contain materials the sewers were not designed to carry (Kirkham 2000). Most larger regional centres in Australia contain sewer assets installed as early as the 1920's. Smaller centres generally have sewer assets installed in the late 1940's and 1950's following the end of the Second World War.

In Australia during the past two decades the rehabilitation of existing civil infrastructure assets has become increasingly important. Along side the construction and development of new assets, the rehabilitation of infrastructure is one of the major challenges for engineers moving into the future. The rehabilitation of existing sewer assets has become prevalent since the 1990's as the age of existing infrastructure has reached its useful life.

1.2 The Research Problem

A strong and sustainable local government system requires a robust planning process to ensure that assets are appropriately maintained and renewed in accordance with principles

of best practice management (Tamworth Regional Council 2010). The role of maintaining assets would be one of the most important roles for Local Government organizations. The ability of a Local Government organization to effectively manage its assets and provide local residents the quality of infrastructure that they expect and require is critical to the viability of any Council region.

Tamworth Regional Council currently owns and operates a sewer asset portfolio of approximately 187 million dollars. According to Tamworth Regional Council's Management Plan (2010), to ensure Council's continuing sustainability an overall Asset Management Strategy has been developed to establish the following financial objectives and aims to;

- Maintain service levels as best possible and fund other recurrent obligations such as loan repayments, plant replacement and employee leave entitlements;
- Pursue strategic management objectives identified in the Management Plan;
- Preserve the investment of the community in the many assets to which Council is custodian; and
- Protect itself against financial setbacks and where possible unknown contingencies.

In relation to sewer asset management, Council identifies the following objectives:

- Maintain the sewer reticulation including minimising infiltration and inflow through CCTV investigation, reconditioning and relining, addressing infiltration and inflow problems, and
- Maintain an asset register for sewer assets allowing financial plans to be developed based, in part, on asset management principles and provide input into the preparation of corporate wide asset management plans associated financial Modelling and acquisition of an asset management system

This study aims to conduct research and evaluation on the methods used for sewer asset management including asset condition assessment and rehabilitation. This research shall be used to develop a sewer asset management strategy for Tamworth Regional Council that establishes an ongoing works program and budget. The project shall consider all aspects of

sewer asset management to improve Tamworth Regional Council's sewer network performance for aspects such as blockages, overflows and storm water inflow/infiltration.

The ultimate objective of the study is to provide Tamworth Regional Council with an effective sewer asset management strategy that optimizes budget expenditure on asset management and improves Tamworth Regional Councils service delivery objective in relation to sewer services.

1.3 Project Methodology

The broad methodology used for completing the project is outlined as follows:

- Complete a literature and industry review of current sewer asset management including asset assessment and rehabilitation within Australian. This shall include research on models available for predicting the future condition of sewer assets and also research of current sewer rehabilitation techniques, including trenchless and non-trenchless applications
- Research, describe and define the existing sewer asset management practices currently in place for Tamworth Regional Council, including current methods of sewer assessment.
- Research current sewer network performance criteria for Tamworth Regional Council.
- Develop a sewer asset management strategy for Tamworth Regional Council that establishes an ongoing works program and budget.
- Conduct a gap analysis between Tamworth Regional Council sewer asset management practices and current best practice strategies for sewer asset management.
- Provide a sewer asset management plan for Tamworth Regional Council with budget allocation for assessment and rehabilitation strategies.
- Report findings via oral presentation and in the required written format.

The flow diagram depicted in Figure 1-1 provides a graphical representation of the processes involved with development and implementation of the proposed sewer asset management improvement process

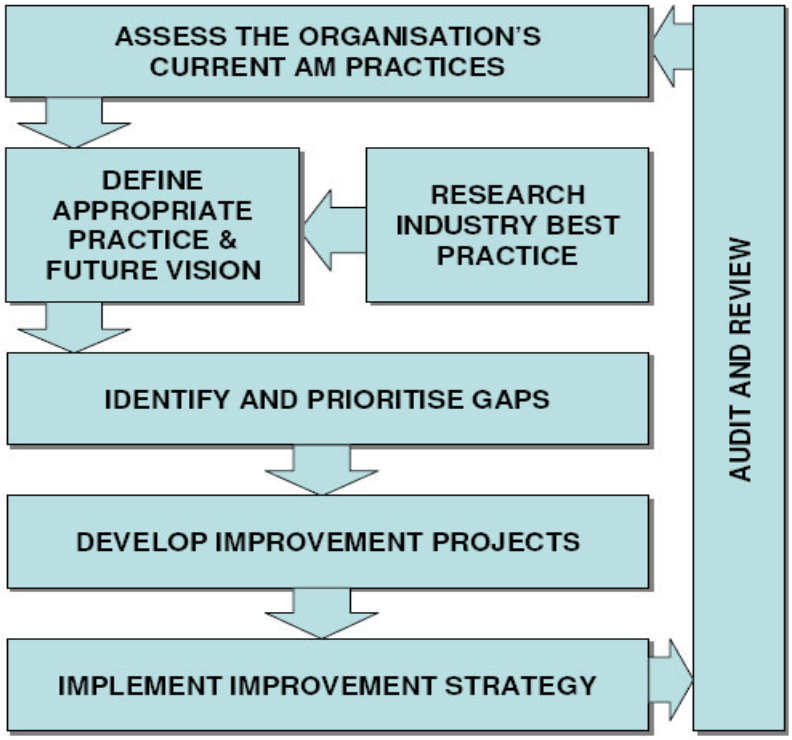


Figure 1-1 Graphical representation of the sewer asset management process

1.4 Background

Tamworth Regional Council (TRC) was established in March 2004, amalgamating the northern New South Wales (NSW) shires of Barraba, Manilla, Nundle, Parry and the City of Tamworth. It is one of the biggest councils in inland NSW, with a population of over 57,000 spread over an area of 9,653 square kilometres (TRC 2010). The Tamworth region has a strong agricultural sector, supported by several large food processing plants.

Tamworth Regional Council is located approximately halfway between Sydney and Brisbane as detailed in Figure 1-2 below.

Figure 1-2 Study location area

Tamworth Regional Council owns and operates four sewer network systems in Tamworth City, Kootingal, Manilla and Barraba. This study will focus primarily on the Tamworth sewer network in detail. However, the other three sewer networks shall be discussed and included in the overall sewer asset management plan developed.

The boundaries and geographical layout of Tamworth Regional Council, including location details of all population areas is provided in Figure1-3.

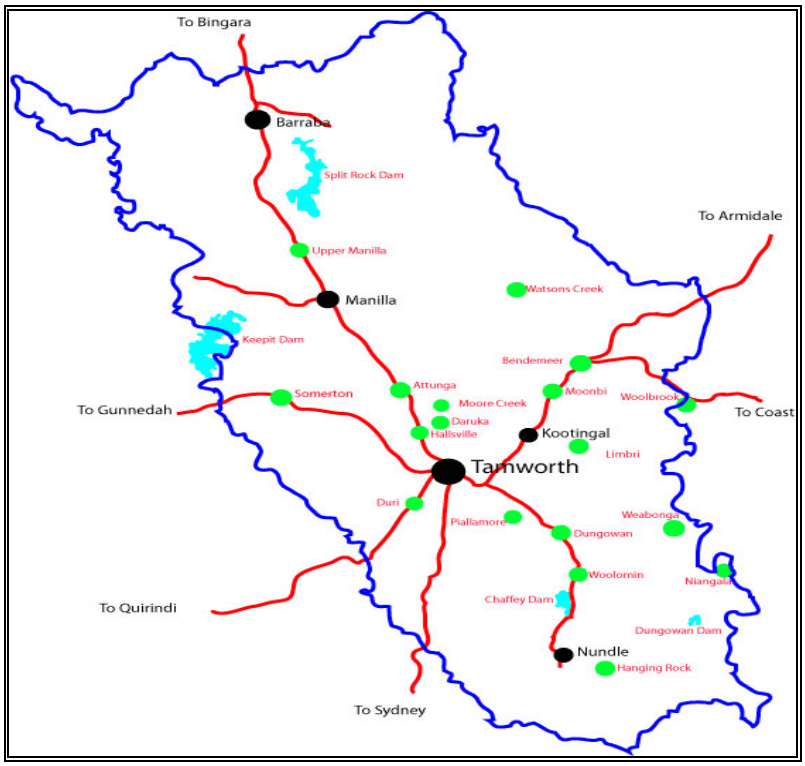


Figure 1-3 Boundary of Tamworth Regional Council (DLG 2010)

1.5 Tamworth Regional Council Sewer Networks

1.5.1 Tamworth Sewer Network

Tamworth is located approximately halfway between Sydney and Brisbane on the New England Highway. The city supports a population of approximately 40,000 people, which can swell dramatically during January each year when the city hosts the annual Country Music Festival. This huge influx of people can put a great deal of pressure on the city's infrastructure. The city has several large industries that discharge to sewer, including chicken, beef and lamb abattoirs.

Tamworth is currently serviced by two separate wastewater treatment works (WWTW), namely Swan Street WWTW and Westdale WWTW. The two separate networks are divided by the Peel River which splits the city. Swan Street WWTW services the northern and eastern areas of the city. It should be noted that strategies and much of the infrastructure are already or being constructed to decommission Swan Street WWTW and transfer flows via a new pumping station to an upgraded Westdale WWTW. Westdale WWTW currently services all development south of the Peel River and all industrial wastewater sources.

The wastewater transportation system consists of a series of gravity sewer mains, wastewater pumping stations and rising mains. The sewer network consists primarily of vitrified clay, asbestos cement, concrete and polyvinyl chloride pipe materials. The two systems are each discussed in turn. Figure 1-4 details the sewer layout for the city.

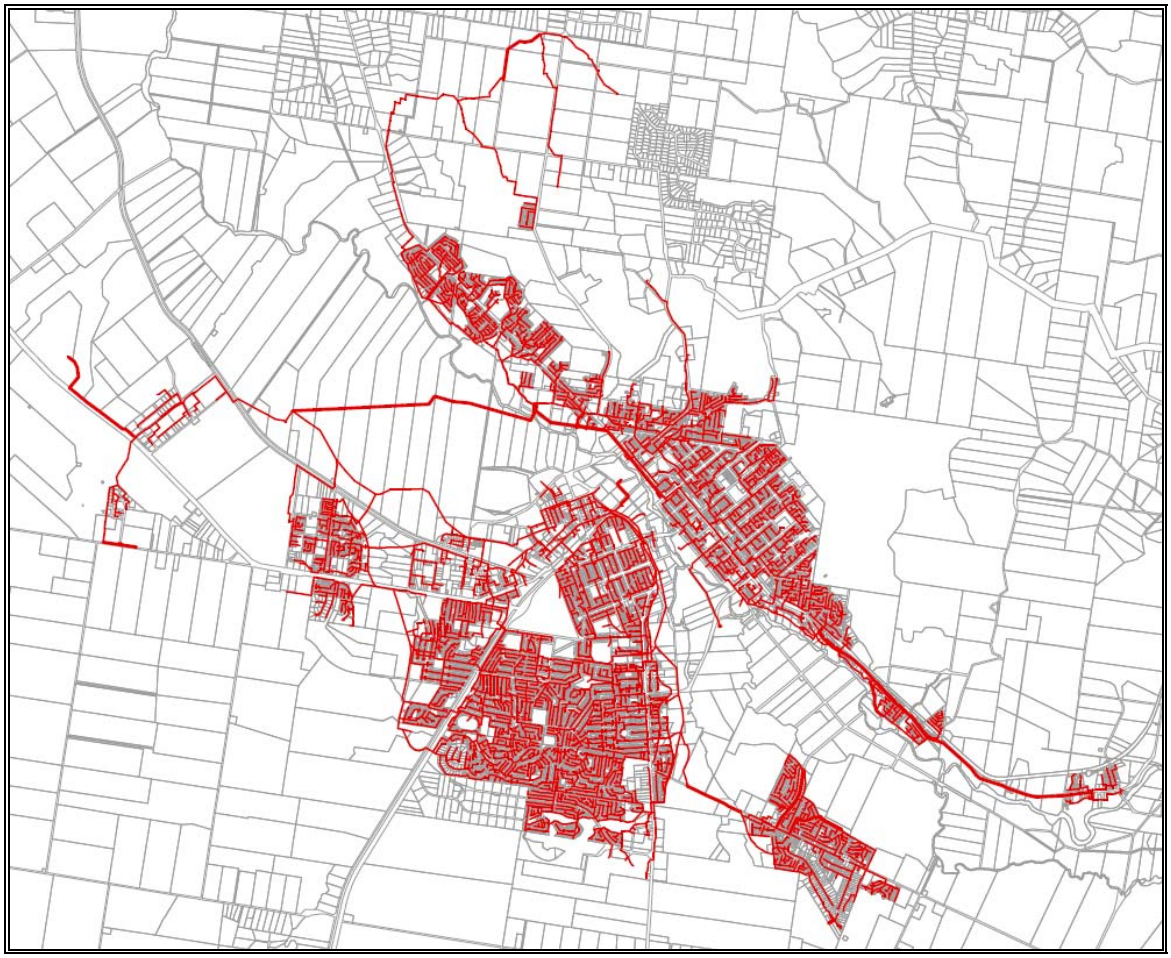


Figure 1-4 Sewer Layout of Tamworth City

The Swan Street WWTW catchment consists of 6 sewage pumping stations (SPS) which transport flows from their individual gravity catchments, as well as any pumped inflows from upstream pumping station catchments to the WWTW, which also has its own gravity catchment. A schematic of the Swan Street WWTW wastewater transportation system is shown in Figure 1-5.

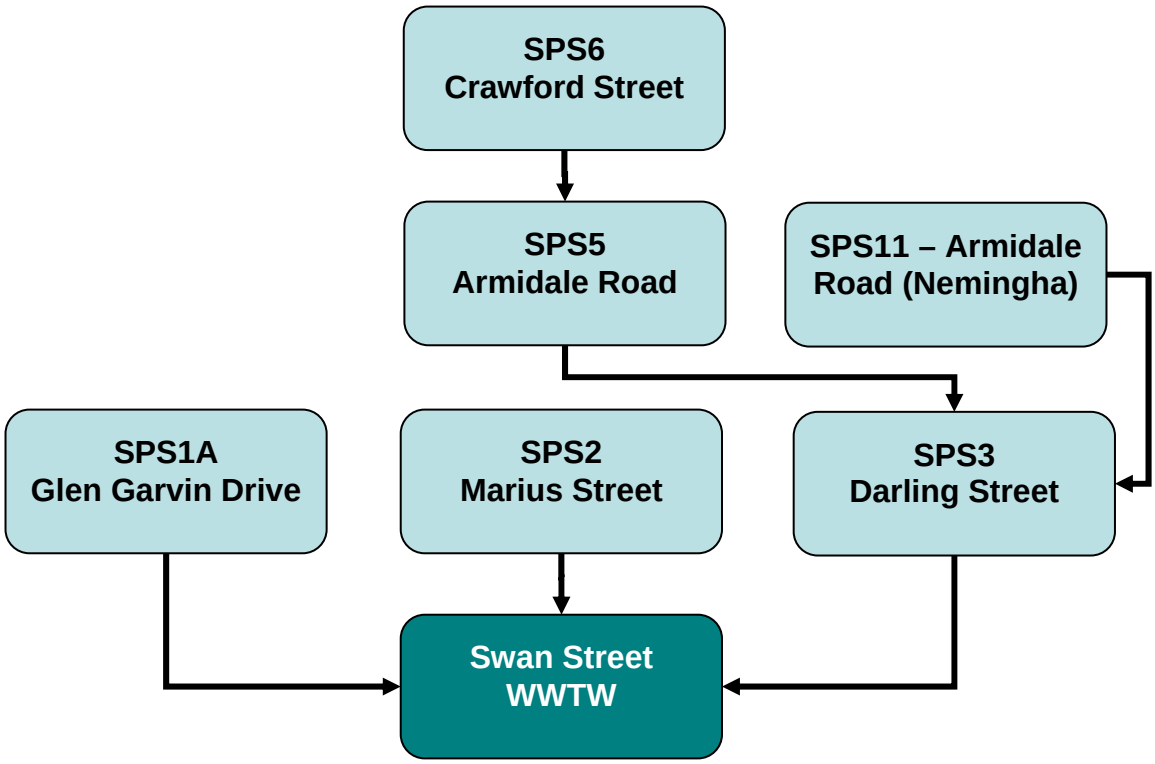


Figure 1-5 – Swan Street WWTW Transportation System

The Westdale WWTW catchment consists of 7 sewage pumping station catchments which transport flows to the WWTW. The Westdale catchment receives all large industrial wastewater dischargers. A schematic representation of the Westdale wastewater transportation system is shown in Figure 1-6.

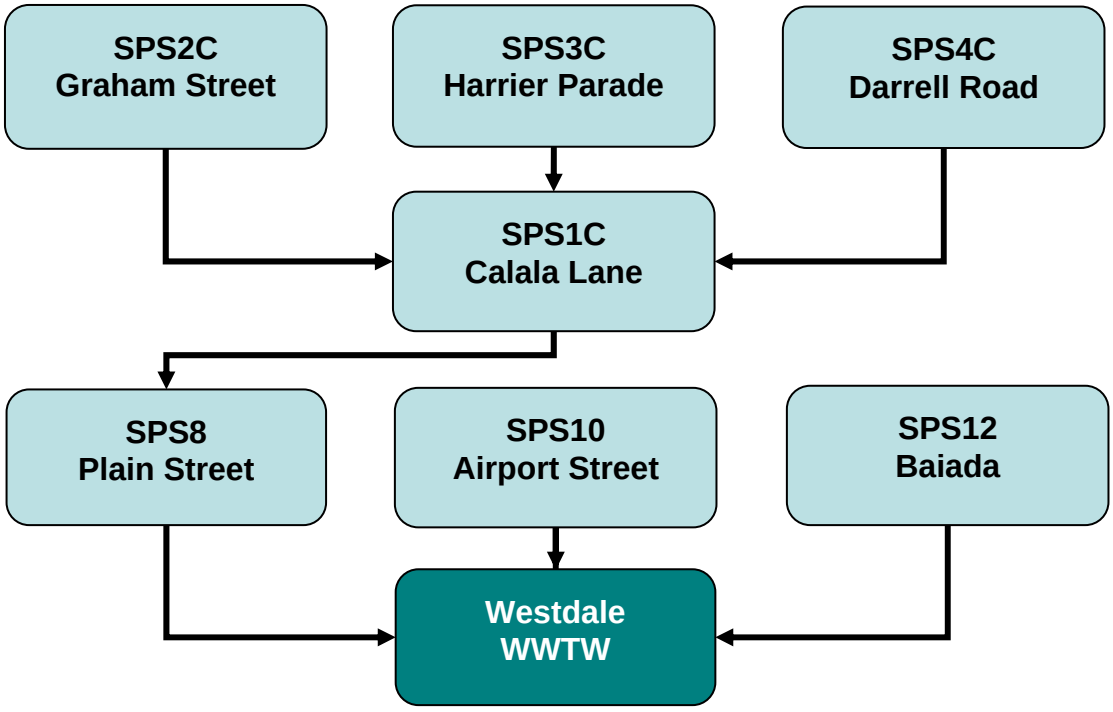


Figure 1-6 – Westdale WWTW Transportation System

1.5.2 Manilla Sewer Network

The original sewer network for Manilla was completed in 1948. A major augmentation was undertaken north of the Manilla River and completed in 2000. The system services approximately 2,000 people and consists primarily of a gravity sewer network with a deep carrier main, approximately six metres deep. This carrier main connects to the main pump station which delivers wastewater to the treatment facility. The sewer network consists primarily of vitrified clay and concrete pipes in older areas and polyvinyl chloride (PVC) in the newer augmented areas. A schematic layout of the Manilla sewer network is provided as Figure 1-7.

Figure 1-7 Sewer Layout of Manilla

1.5.3 Barraba Sewer Network

The original sewer network for Barraba was completed in 1952. The system currently services approximately 1,500 people and consists primarily of a gravity sewer network with a deep carrier main, approximately eight metres deep. This carrier main connects to the main pump station which pumps wastewater to a gravity main that delivers wastewater to the treatment facility. The sewer network consists primarily of vitrified clay and concrete pipes. A schematic layout of the Barraba sewer network is provided as Figure 1-8.

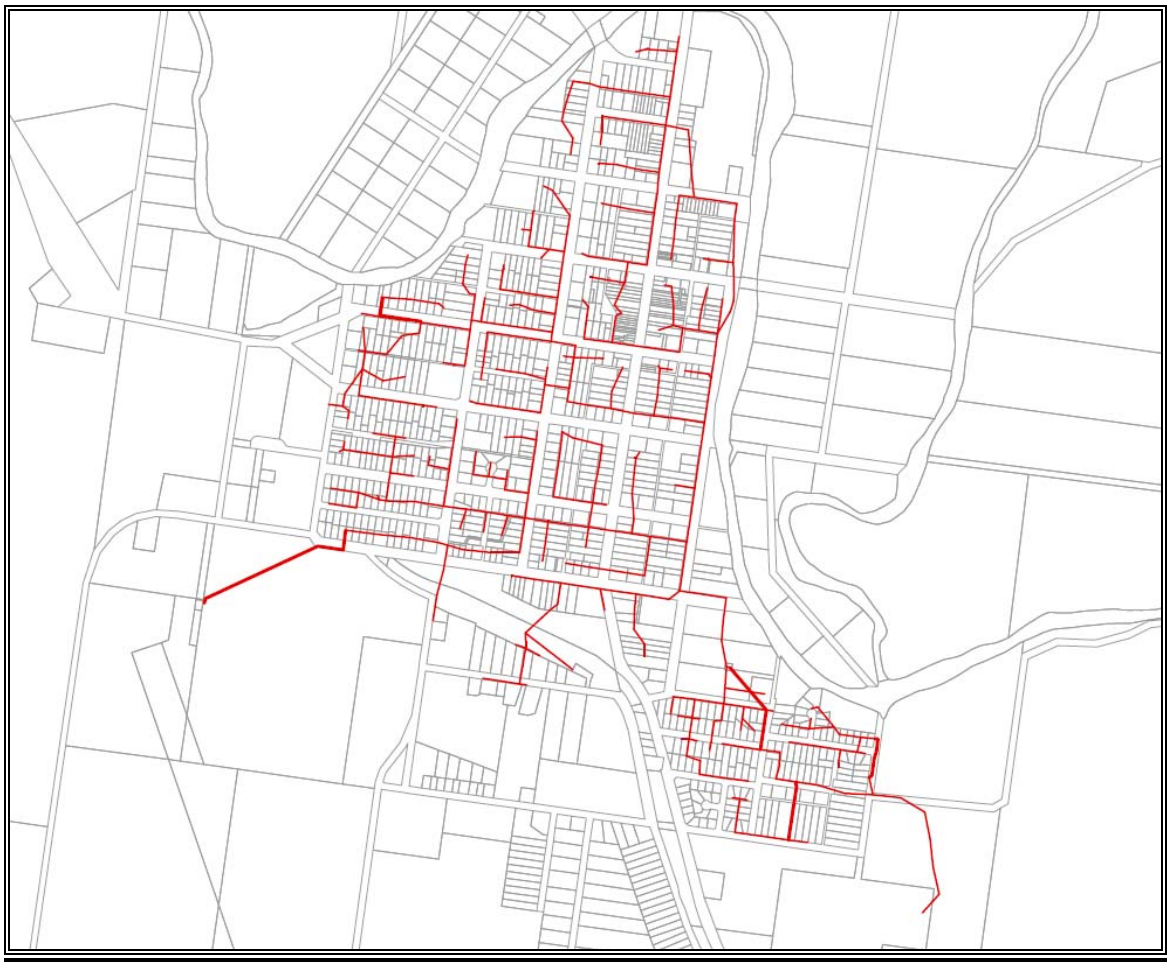


Figure 1-8 Sewer Layout of Barraba

1.5.4 Kootingal Sewer Network

Kootingal is a relatively new sewer network with construction being completed in 1990. The system services a population of approximately 1,500 people and is entirely constructed of polyvinyl chloride pipes. A schematic layout of the Kootingal sewer network is provided as Figure 1-9.

Figure 1-9 Sewer Layout of Kootingal

2 LITERATURE REVIEW

2.1 Introduction

This chapter will review literature to establish the need for asset management with a particular emphasis on sewer infrastructure management. The review defines and examines the development of asset management and researches current best management practices in relation to sewer asset management, including asset condition assessment and renewal technologies. The later section of the chapter details recent innovations and possible future directions of sewer asset management.

2.2 What is Asset Management?

Assets in general are classified according to their purpose and can be either physical or financial in nature. Physical assets may have a physical or tangible form such as roads, buildings or underground services, or they may also be intangible in the form of intellectual property. Financial assets generally refer to cash or other investments of financial nature. In order to determine the value of an asset, most accounting practices calculate value based on the useful life an asset retains.

Local Government often controls many physical assets including:

- Road network including bridges,
- Storm water networks,
- Water and sewer reticulation networks,
- Water and wastewater treatment facilities,
- Parks and recreation assets including sporting fields, swimming pools, and
- Property assets such as civic buildings, libraries and halls.

For the purposes of this study sewer networks shall be the primary focus for asset management. These assets may include sewer mains, pressure mains, maintenance holes, sewer lateral (property) connections and other associated infrastructure such as vents, valves etc. Mechanical and electrical aspects of the sewer network such as pump and electrical works associated with pump stations shall not be included in this study. Wastewater treatment facilities shall also be outside the scope of this study and not be considered.

2.3 Asset Life Cycle Management Strategies

A principle of asset ownership is the effective management of assets throughout the asset lifecycle. According to the Queensland Government Enterprise Architecture (QGEA) (2009), good business practice requires that assets be appropriately secured and maintained, used for the purposes intended, periodically accounted for, assessed to ensure their continued value to the organisation and properly disposed of.

The management of an asset throughout its lifecycle includes planning and support for the investment decision, acquisition, access and ongoing maintenance, through to replacement or retirement planning. The objective of asset lifecycle management is to optimise asset acquisition, maximise the use of the asset and reduce associated service and operational costs resulting in increased asset performance and a lower total cost of ownership.

The asset lifecycle phases detailed in Figure 2-1 demonstrate the typical phases and management objectives in the asset lifecycle, from planning the investment decision through to retirement or replacement of the asset.

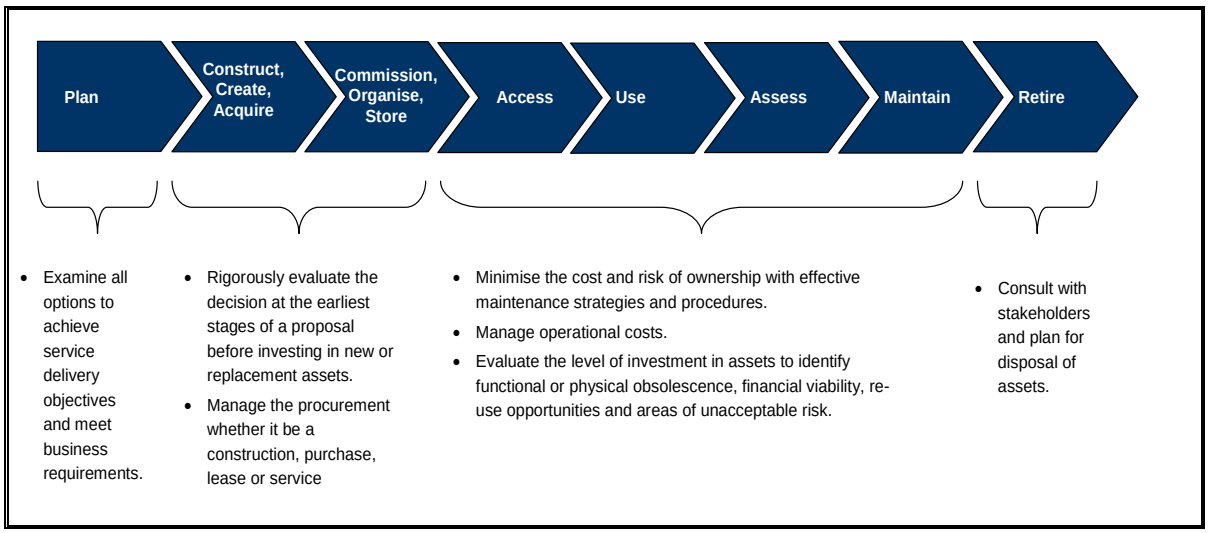


Figure 2-1 Asset lifecycle phases (QGEA 2009)

An independent inquiry into the financial sustainability of Local Government was completed in 2006 (Roorda 2006). This report examined the present condition and management of infrastructure in NSW Local Government. The report concluded the following;

- NSW Local Government is custodian of $50 billion of community assets of which $8 billion are water and sewer assets.
- The service potential of these assets is being consumed at an estimated rate of $0.9 billion per year approximately double the rate at which assets are currently being replaced.
- It is estimated $6.3 billion or about 13 percent of total asset value is required to bring existing assets to a satisfactory standard. This is almost eight times the current level of expenditure.

Further to this, the inquiry identified a significant shortfall in NSW Council's managing risk by implementing asset management plans. The following figure shows the status of Council's in NSW managing risk through asset management plans. In particular relevance to this study of the 50 Councils identified with sewer assets almost 50 percent do not have any asset management plan in place, with only 20 percent having a current asset management plan.

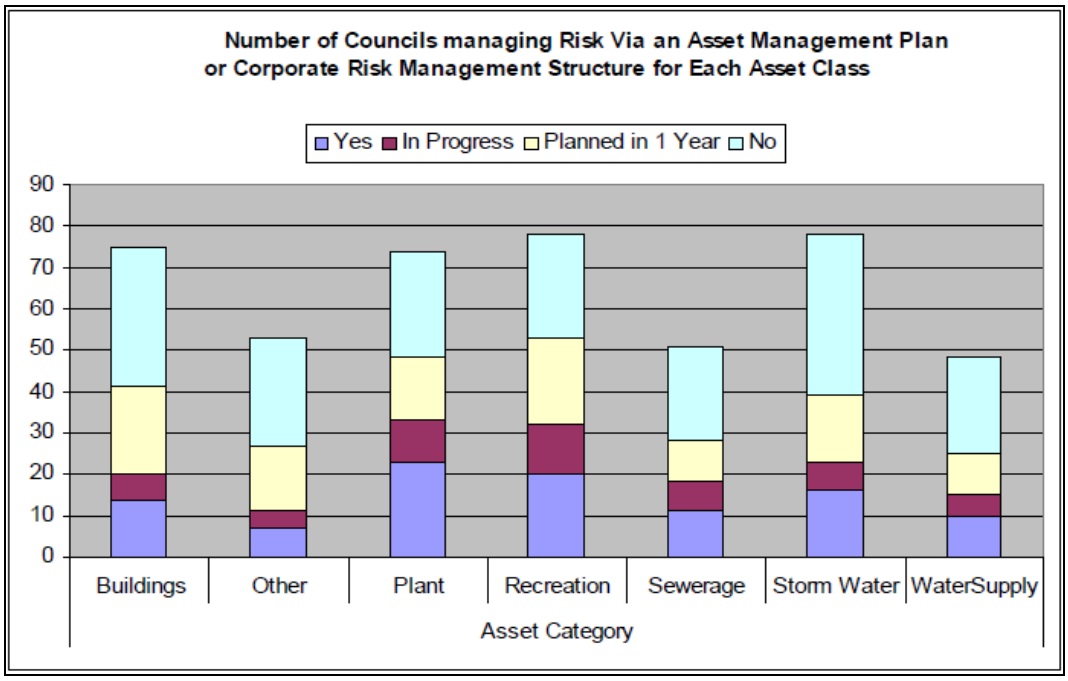


Figure 2-2 Status of asset management plans for NSW Council's (Roorda 2006)

2.4 Overall Description of Sewer Systems

The sewers of today evolved from open drains which flowed between houses transporting all wastes, including storm water and faecal matter, by gravity to nearby rivers or streams (NSW Public Works, 1987). This form of wastewater transport and disposal caused offensive odour, pollution of water ways and ultimately health problems.

Sewer systems developed from this, into stand alone systems designed not to have storm water inclusion. However, inevitably through ground water infiltration or rainfall infiltration, storm water enters into the system (NSW Public Works, 1987). Sewer network systems are generally a gravity pipe, system however to prevent deep excavation pump stations and rising mains are incorporated at low elevation points to pump wastewater to higher elevations to once again allow gravity flow.

Domestic sewage normally contains more than 99.9% water with less than 0.1% impurities (NSW Public Works, 1987). Commonly, sewer systems also receive non-domestic wastewater often termed 'trade' or 'industrial' wastewater. This wastewater can be of

varying nature and can contain high strength wastewater. This water comes from industrial processes such as manufacturing, food processing, pharmaceutical processing etc. The nature of the wastewater discharged is dependent upon the industry type and wastewater treatment present at the site. Most water authorities, including Local Government, have policies in place to control the quality and quantity of industrial wastewater discharged to sewer.

2.5 Current Sewer Asset Management Strategies

The underground pipeline infrastructure is one of the most capital intensive infrastructure systems. Many of the pipeline systems in use today, especially sewer systems, are very old and reaching their design lifetimes (Guo et al, 2008). The typical design life for sewer assets is in the order of 50 to 80 years depending on the material and standard being used for construction. Often however, the life cycle of sewer infrastructure can be dramatically shortened due to the nature of material being transported through the system. For example, industrial wastewater high in pollutants can lead to severe corrosion of infrastructure. Poor design of infrastructure leading to long retention times of wastewater can lead to an increase in hydrogen sulphide level in sewers and subsequently increasing corrosion of sewer.

Municipalities are facing increasing challenges due to the aging and deterioration of infrastructure assets, inadequate renewal budgets, climbing renewal deficits, increasing demand levels, and new requirements to comply with stricter environmental and accounting regulations (Danylo and Lemer 1998; Grigg 1999; Halfawy 2004). NSW Local Government Water Utilities are required to report their water and sewer performance to state government authorities such as the NSW Office of Water (NOW) and the Department of Environment, Climate Change and Water (DECCW). NOW is the NSW State Government branch primarily focused on the service obligations of utilities and responsible for allocating state government funding. The DECCW is responsible for monitoring sewer system environmental licenses which in recent time have extended to include the reticulated sewer system. In 2006, the NSW Department of Local Government (DLG) established

requirements for Local Government to undertake the valuation of sewer assets at fair value. To achieve this, Council must assess the value of assets based on condition reporting rather than previously used depreciation methods of 'straight line depreciation' which calculated asset value based on age and expected life. For sewer assets this is a much more realistic method of asset valuation. As stated previously sewer assets can deteriorate much more rapidly than expected when subjected to harsh environments. This form of asset valuation however, does require Council to heavily invest in asset management systems and condition assessment and reporting programs.

2.6 Sewer Asset Management

Typical sewer asset management involves the following processes:

- Condition Assessment – This involves the inspection and data acquisition of asset condition.
- Monitoring – Ongoing inspection is undertaken to determine changes in asset condition. The performance of the asset is monitored. This may be undertaken by failure data etc
- Deterioration Modelling – The ongoing monitoring process is used to determine the deterioration of assets.
- Performance Modelling – The ongoing performance of assets is recorded and Modelled to determine problem assets or areas of assets.
- Asset Prioritisation – Based on Modelling results, asset priorities are established to determine work programs and budget allocations.
- Rehabilitation Methods – Investigation is undertaken in regards to the most cost effective rehabilitation options to renew assets.
- Renewal Planning – Involves how and when the asset will be renewed.

Due to the increasing age of infrastructure and the lack of previous asset management, in reality often the Modelling steps detailed above are often required to be overlooked by necessity as the assets are past the stage of being able to be monitored and require immediate rehabilitation (Hass 1994).

The cost impacts and importance of planning, design, construction and maintenance of assets vary depending on the age of the asset. The bar-chart presented in Figure 2-3 presents a simplified form of the length of time each component acts over the life of an asset.

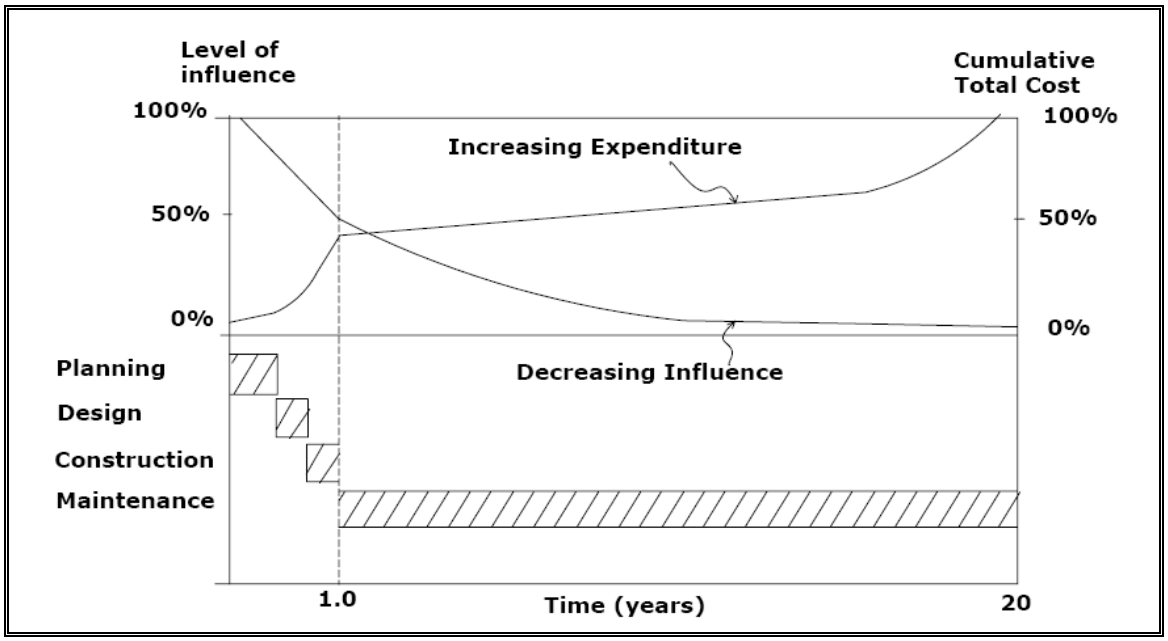


Figure 2-3 Influence levels of sub systems on the total costs. (Haas 1994, pg 17)

As detailed above, the initial phase of an asset primarily involves decision making and commitment on whether to build or acquire an asset. Once the asset has been constructed the cost of maintenance increases with the life of the asset.

Current asset management work practices have resulted in significant process and data fragmentation, which have subsequently created much inefficiency that impedes the implementation of effective management strategies (Halfawy, 2008). The segregation of assets with Local Government does not enable effective management strategies. In larger Council organisational structures, water, sewer, storm water and road assets are often the responsibility of separate divisions. In many instances this does not enable the effective planning and co-ordination of asset management. For example a Council undertaking a road renewal may be able to incorporate other asset management options into this program

hence saving future costs and public disruptions. In order to solve this interdepartmental organisational problems. Halfawy (2008) recommends the following multidisciplinary approach;

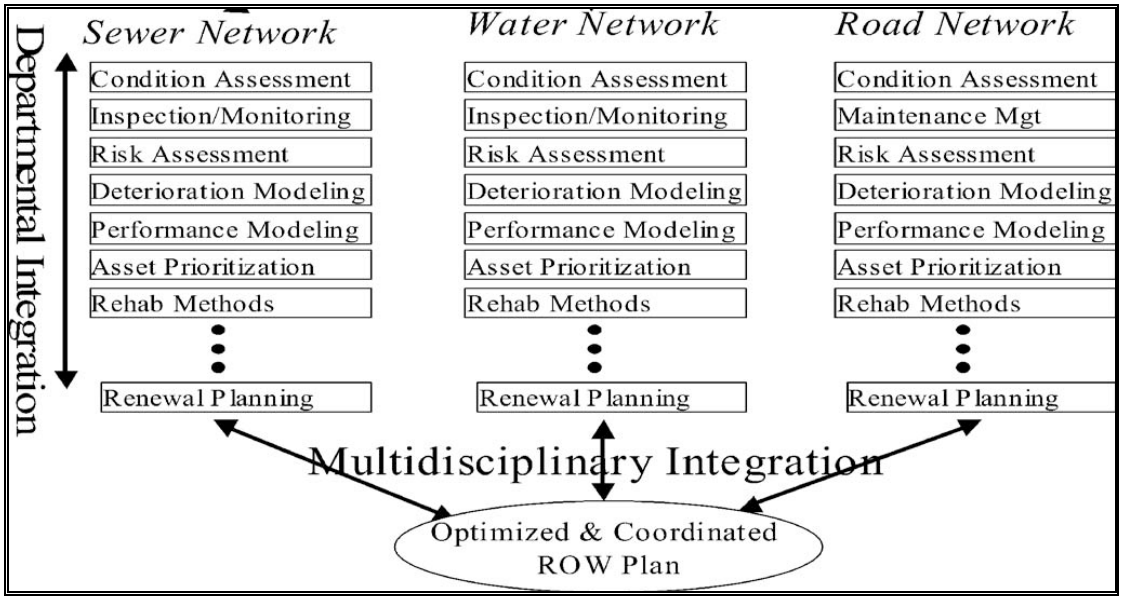


Figure 2-4 Multidisciplinary approach to asset management (Halfawy 2008)

Optimally, renewal plans for infrastructure assets at a particular site should be coordinated to span multiple co-located assets as possible, thus reducing or eliminating unnecessary rework, and minimizing the disruption, costs, and risks associated with maintenance operations (Halfawy 2008). The process detailed in Figure 2-4 shows how different organization departments of Council can integrate their asset management approaches. This is particularly important in larger organizations where asset segregation of items such as roads, storm water, water and sewer are more likely to occur. The integration of asset management for various assets can reduce asset costs, for example packaging of condition assessment programs into a single contract could reduce overall costs. The rehabilitation of one asset could be coordinated with other assets to minimise the overall costs to the organization. An example of this could be the rehabilitation of water or sewer assets with the renewal of an adjacent road asset. This not only reduces the overall costs to Council but also reduces disruptions to consumers.

2.7 Sewer System Condition Assessment

Sewers are currently inspected by video or photographs and assessment is undertaken to identify defects and select assets for rehabilitation. Inspections are generally carried out on known problem areas or where complaints regarding sewer chokes and overflows have been received. Alternatively a more proactive approach involves the inspection of large areas of sewer. This approach can be costly depending on the length of inspection and the diameter of sewer mains being assessed.

With regard to the current sewer pipe inspection technology, all commercial robots are completely tele-operated, usually via a tether cable and human operator (Amir et al 2006). Current pipe camera equipment provides high quality visual data to allow condition assessment. Despite this, sewer inspection robots have poor mobility function to pass any kind of pipe-bends such as curves and junctions so that those robots are only capable to move into the straight pipes (Amir et al 2006). A typical tractor type camera used for sewer inspection is detailed in Figure 2-5.

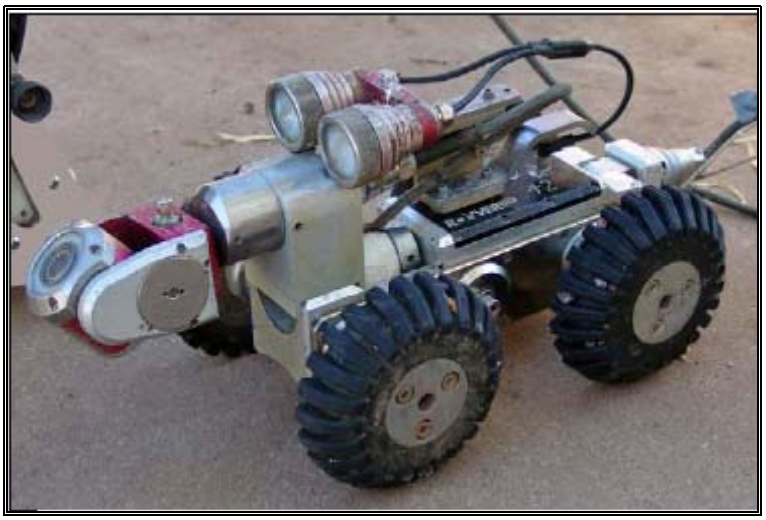


Figure 2-5 Sewer inspection tractor

Assessment of pipe condition can be undertaken to a number of standards. Typical assessment involves both serviceability and the structural integrity of pipes and applies a scoring system based on asset condition. A scoring system is used to identify and prioritise

rehabilitation work schedules. This approach allows the most critical assets to be rehabilitated within any allocated budget. The current conduit inspection reporting code currently being used by the Australian Water Industry is the *Water Services Association of Australia Conduit Inspection and Reporting Code WSA 05 -2008* (WSAA). This code has been developed by the Water Services Association of Australia which is a combined water industry group that involves representatives from the largest water utilities in Australia.

2.8 Sewer System Deterioration

Failures of sewer assets are heavily linked to the site conditions, pipe materials and quality of construction. Typical sewer asset failures may be attributed to corrosion, stress failure such as cracking or more extreme cases pipe collapse, obstructions and blockages and issues related to poor construction.

Corrosion generally occurs to assets constructed of concrete, asbestos cement or iron products. Corrosion can occur where low pH water is received to sewer from an industrial source but more readily occurs due to the formation of hydrogen sulfide gas within the network. The corrosion is caused by a combination of complex chemical and biological processes ultimately leading to the formation of sulphuric acid. The cost of remediation or replacement of corroded sewer systems is very high for large systems, in the order of several hundreds to several thousands of dollars per metre depending on pipe diameter and depth (University of Queensland 2010)

Maintenance holes are a major component of sewer network systems and are generally constructed from concrete, although some plastic products are now available. Corrosion of maintenance holes is common when subjected to high concentrations of hydrogen sulfide, particularly when poorly constructed with incorrect cement type.

Pipe cracking and collapse is often caused by materials not being able to support the loadings applied. Cracking is particular evident in non-flexible pipe materials such as vitrified clay and concrete. Cracking may also be caused by the entry of foreign objects

such as tree roots. Sewer blockages caused by tree roots is a common problem and can have a major impact on service standards and escalate public health risks. According to the ESC 75% of Yarra Valley Water's sewer blockages were caused by tree root infiltration (McCoy 2009). According to Sydney Water, the chokes in the Sydney region can be attributed to intrusions by tree roots (81%), debris (9%), soft choke (4%), other (3%), grease (2%), silt (1%) and broken pipe being the lowest contributor (less than 1%) (Samsung et al 2009). This is shown graphically in Figure 2-6.

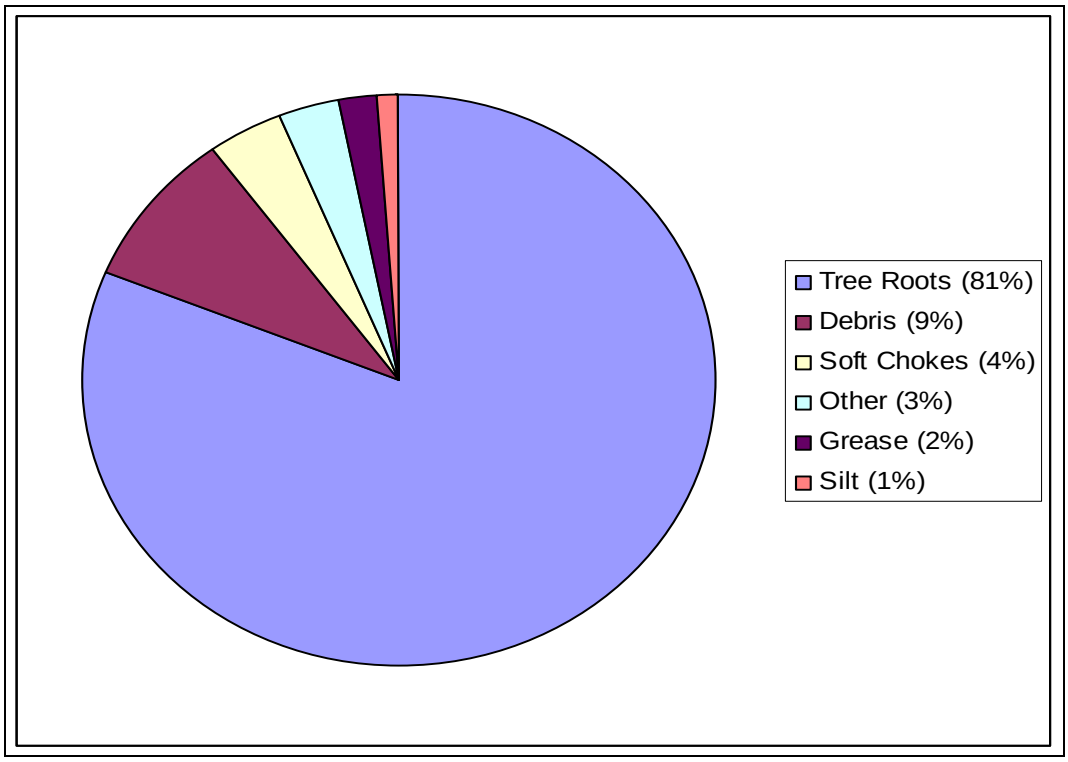


Figure 2-6 Causes of sewer choke in Sydney Water areas (Samsung et al 2009)

Poor design and construction can lead to sewer asset problems. Examples include poorly connected laterals to the sewer main which inevitable causes blockages (WSAA 2006). Poor designs can also lead to sewer network failures through not allowing enough grade for self cleansing velocity to be reached and material is deposited within mains (NSW Public Works 1987).

The following figures illustrate examples of typical sewer asset deterioration experienced with sewer networks.

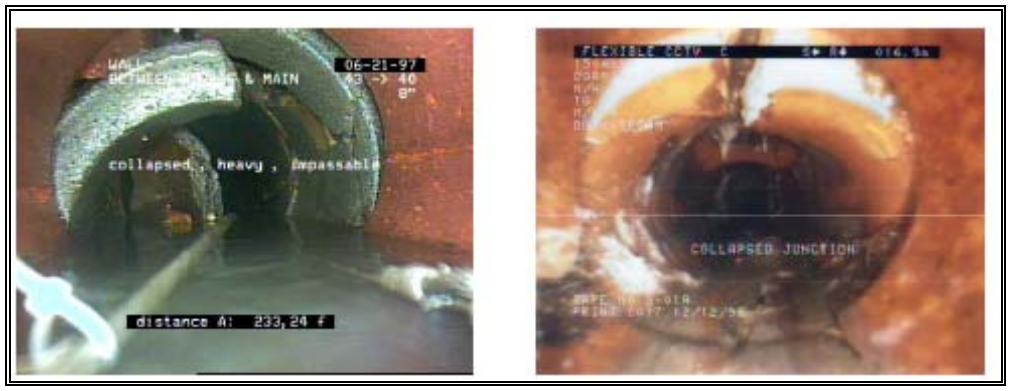


Figure 2-7 Example of sewer pipe collapse in a clay main (WSAA 2005)

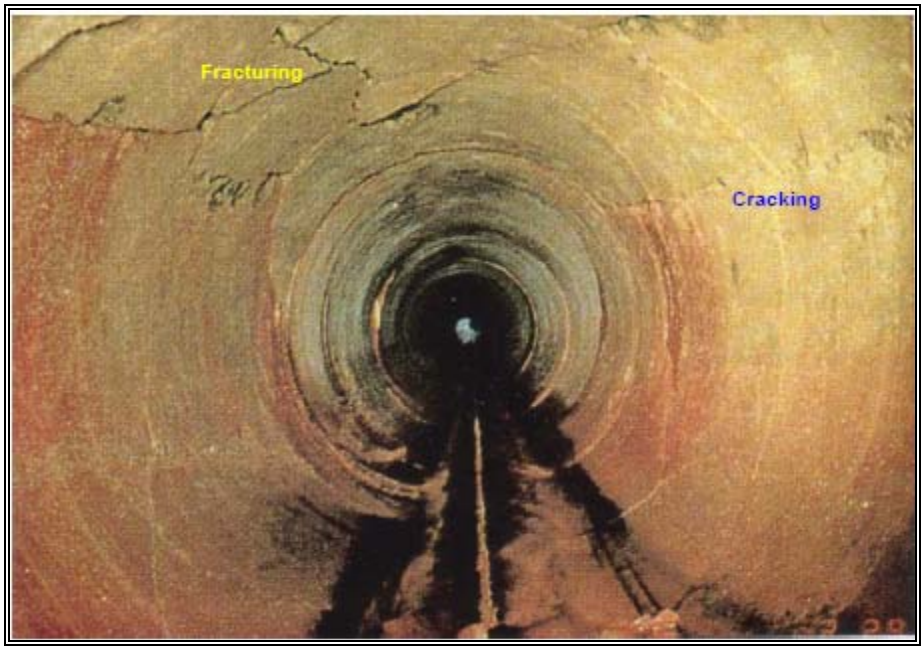


Figure 2-8 Example of sewer pipe cracking in a concrete main (WSAA 2005)

Figure 2-9 Example of poorly constructed lateral connection (WSAA 2005)

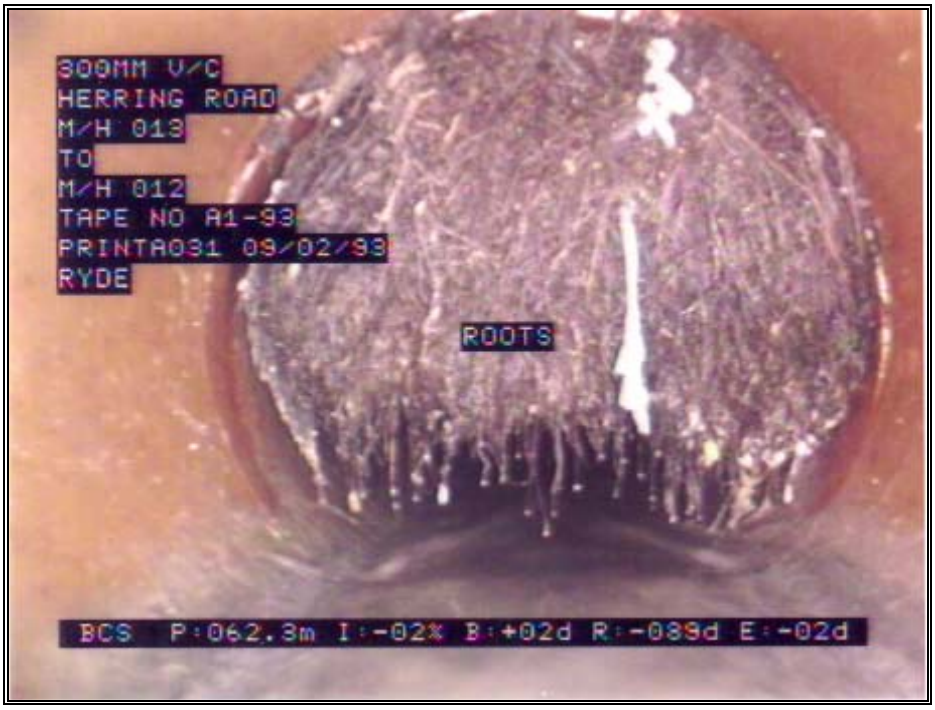


Figure 2-10 Example of root infiltration in a sewer main (WSAA 2005)

Figure 2-11 Example of concrete corrosion in a sewer main (WSAA 2005)

Figure 2-12 Example of concrete corrosion in a sewer maintenance hole

2.9 Sewer Rehabilitation

The objective of the rehabilitation of sewer pipe systems is to improve their function while reducing inflow/infiltration and insufficient carrying capacity pipes (Lee et al 2008). The rehabilitation technique used depends on several factors including:

- Site conditions
- Nature of problem to be rectified
- Budget allocation

Sewer asset rehabilitation techniques are often categorised into 'trenchless' and 'non-trenchless' techniques. Non trenchless techniques generally refer to work where excavations are required. Often it is preferred to avoid these instances as sewer assets are generally in close proximity to private property or other underground services, and these options tend to be the most expensive. Despite this, reconstruction of assets is often required due to the asset being too greatly deteriorated to allow for trenchless rehabilitation methods to be used. Further to this, realignment of assets may be preferable than renewing assets by trenchless means in the existing location. Despite building codes not allowing buildings and structure to be constructed over sewer mains this is often the case. If an option exists to realign an asset from under a structure, this may be more beneficial than the risk of renewal insitu.

The use of sewer rehabilitation has increased significantly since trenchless techniques were first introduced in the 1970's, with sewer rehabilitation being less disruptive and often cheaper than convention methods of sewer repair (McFarlane 2008). Trenchless sewer asset technology has improved greatly over the past two decades. Most water utilities now use a combination of trenchless sewer rehabilitation methods to renew sewer mains. Trenchless processes for sewer main renewal include pipe bursting, slip lining and relining. These processes are briefly outlined.

2.9.1 Pipe Bursting

Pipe bursting uses a bursting tool which is inserted into the pipe to be replaced and pulled through the pipe, shattering or splitting it. An expander behind the head displaces fragments or pieces of pipe as new pipe is pulled in behind it (Griffin 2009). Pipe bursting can be either pneumatic, hydraulic expansion or static pull. Figure 2-13 shows a typical pipe bursting operation detailing the location of both insertion and reception pits in relation to the existing and replacement pipe.

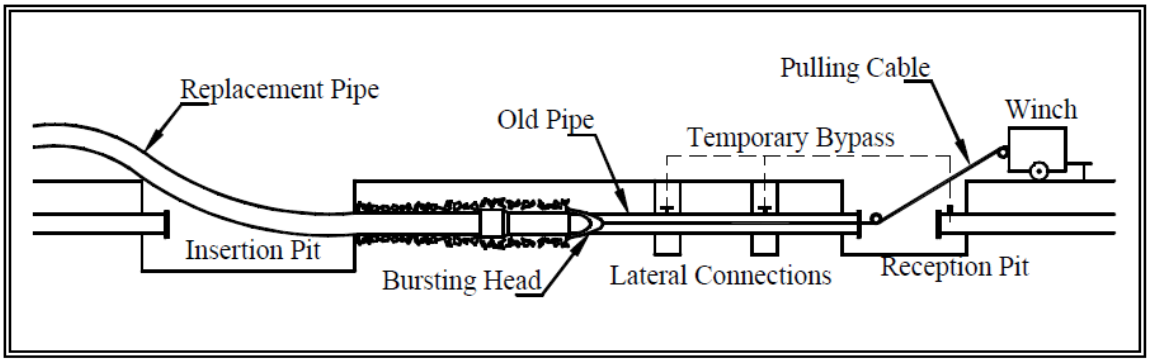


Figure 2-13 Typical pipe bursting operation layout (Simicevic & Sterling 2001)

The most favourable ground conditions for pipe bursting are soils that can be moderately compacted (reducing the lateral extent of outward ground movements), in which the expanded hole behind the bursting head does not cave in before the replacement pipe is installed (Simicevic & Sterling 2001).

Pipe bursting is suitable for pipes made of brittle materials, such as vitrified clay, cast iron, plain concrete, asbestos, and some plastics. Reinforced concrete pipe can also be successfully replaced, if it is not heavily reinforced, or if it is substantially deteriorated. Ductile iron and steel pipes are not suitable for pipe bursting (Simicevic & Sterling 2001). Pipe bursting can be limited when pipes have been encased in concrete as often the case when located under structures. The most common pipes used as replacement pipes in pipe bursting are high density polyethylene.

The advantages of the pipe bursting method are it completely renews the existing main and can be used to increase main diameter. The major disadvantages are the lateral connection to the sewer main must be reinstated by reconstruction as these are broken during bursting. Launch and reception pits are generally required to be excavated to allow installation equipment to operate. Pipe bursting can also disrupt the ground condition in the vicinity of the work and has the potential to damage any near by structure including other underground utilities when bursting is undertaken at either inadequate separation distances or depth (Simicevic & Sterling 2001). Figure 2-14 details the typical effects that pipe bursting can have on localised ground conditions.

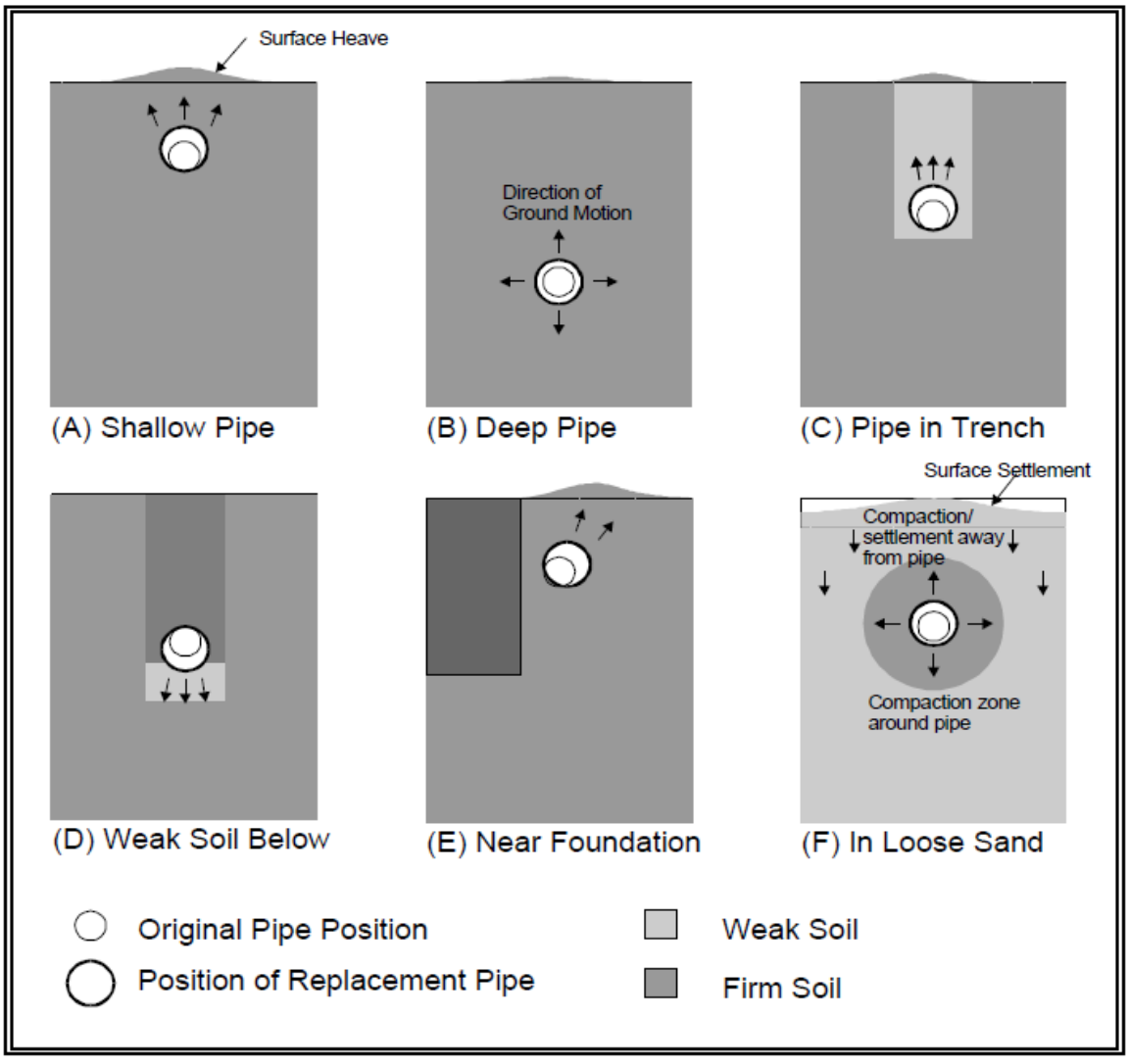


Figure 2-14 Expected effects on ground conditions due to pipe bursting (Simicevic & Sterling 2001)

2.9.2 Slip Lining

Slip lining is completed by installing a smaller 'carrier pipe' into a larger 'host pipe', grouting the annular space between the two pipes, and sealing the ends (Mohammed and Sanjov 2004). The major disadvantage of slip lining is it can dramatically reduce the pipe diameter and it is heavily dependent upon the condition of the host pipe.

2.9.3 Relining

There are several methods of sewer main relining but all methods can be installed without any excavations. The general processes vary but the ultimate product installs a liner inside the host pipe. The lateral connections are cut using a robotic cutter and camera to reinstate the connection. Two of the most common methods in use in Australia and internationally are cured in place lining and Ribloc (spiral) lining.

Cured in place lining involves the installation of a resin impregnated felt tube within the existing sewer pipe. In this process the tube is generally impregnated with resin prior to delivery to the work site. Care is required to keep the liner out of the sunlight and in a cool environment (refrigerated) until installed, as heating will cause the resin to harden due to a chemical reaction that cannot be reversed once started. This process involves three stages

- The liner is winched through the manhole in smaller diameter sewer mains or inverted through the main.
- The liner is inflated either with air or water.
- Heat is applied to harden the resin and enable the liner to remain in its final form.
- The ends of the liner are cut and made smooth and to restore services

A pre-rehabilitated and post rehabilitated photograph of a cured in placed relined sewer main is provided as Figure 2-15.

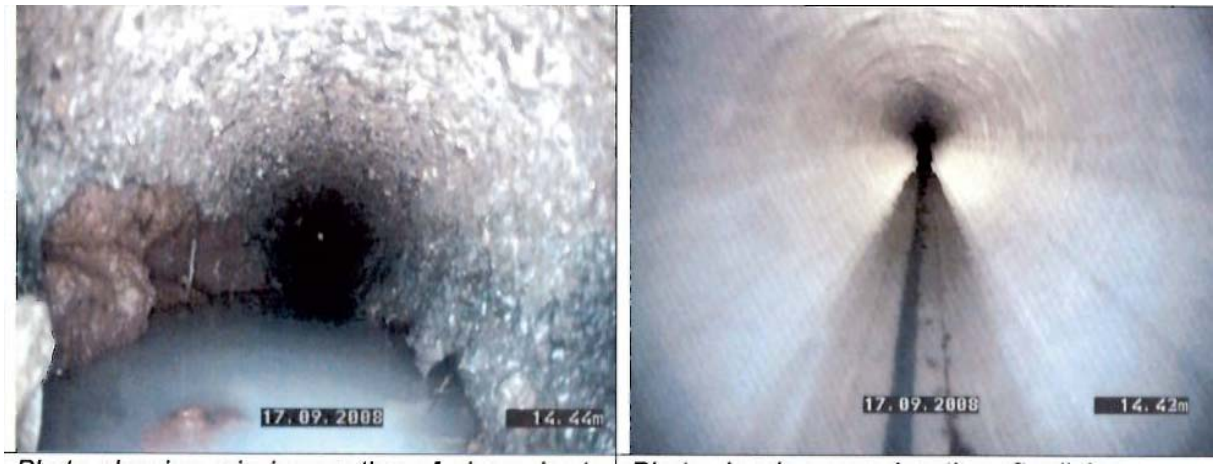


Figure 2-15 Example of sewer main pre and post cured in place relining (Insituform Pacific 2008)

Ribloc lining involves the installation of a PVC main inside the existing sewer main. To achieve this, a strip of PVC is spirally wound into the existing pipe an the expanded to form a tight fit between the new pipe and the existing pipe. Figure 2-16 details a renewed main using Ribloc technology.

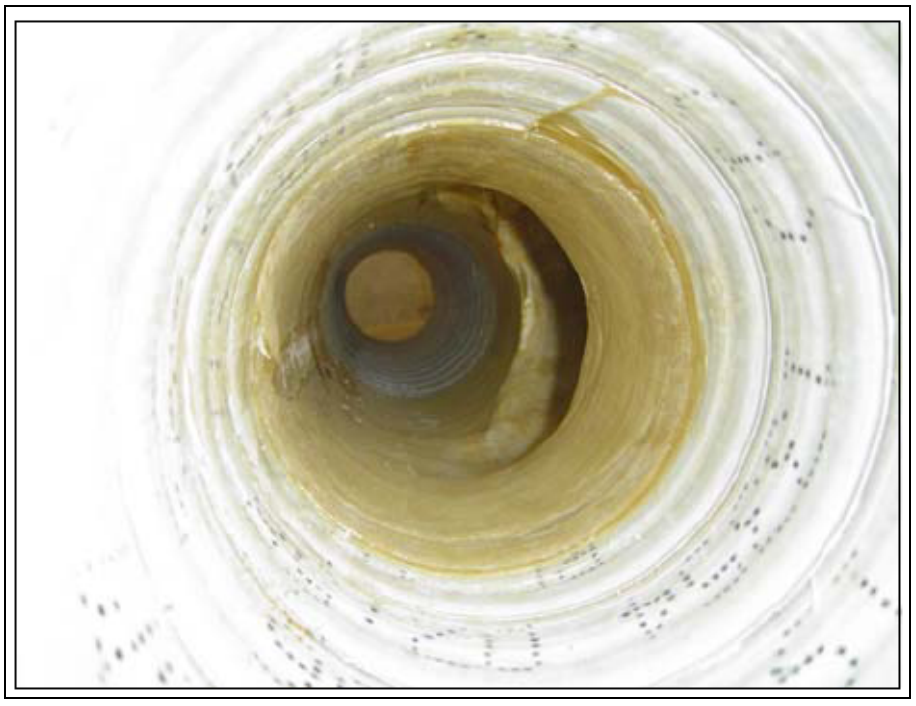


Figure 2-16 Example of renewed sewer main using Ribloc technology (WSSA 2005)

Relining can be used in conjunction with lateral sealing. In this process a seal is installed from inside the previously lined pipe into a lateral connection. This seal can prevent the ingress of groundwater as the system becomes entirely sealed. An example of lateral sealing is provided in Figure 2-17.

Figure 2-17 Example of sewer lateral connection lining (WSAA 2005)

As previously outlined, sewer roots are one of the largest problems encountered to maintain an effective sewer network. Non construction methods of cleaning and sewer mains with high pressure water, can often be sufficient maintenance. In instance were roots are identified as causing the problem, herbicide products are available to be used within sewer mains to prevent future root growth.

2.9.4 Access Structures

There are numerous products currently available for insitu rehabilitation of maintenance holes. Simicevic (2010) details that the following rehabilitation techniques are available

- Epoxy coating
- Polyurethane/Polyurea coating

- Calcium Aluminate cement mortar coating
- Cured in-situ lining
- Concrete protective lining
- High Density Polyethylene or Polyvinyl Chloride lining

2.10 Future Sewer Asset Management Strategies

Sewer pipeline inspection and condition assessment technologies are improving. Companies, such as RedZone Robotics Inc., are developing a new generation of equipment that improves data acquisition techniques and deploys multiple sensing techniques for acquiring more comprehensive inspection data (Guo et al 2008).

Automated pipeline defect classification has been a subject of intense study in recent years, though the existing research has been limited by data acquisition techniques, image analysis and pattern recognition approaches. It is worth noting that to enable automated knowledge discovery for sewer pipeline inspection and condition assessment, not only classifying the types of various defects is necessary, but also discovering regions of interest and recognizing them as defective or not (so called detection) (Guo et al, 2008). Moselhi and Shehab (1999) developed an early framework for automated detection of surface defects in sewer pipes. They also developed an automated recognition process for infiltration defects in sewer pipes using neural networks. Figure 2-18 compares the automoted defect process to the manual approach.

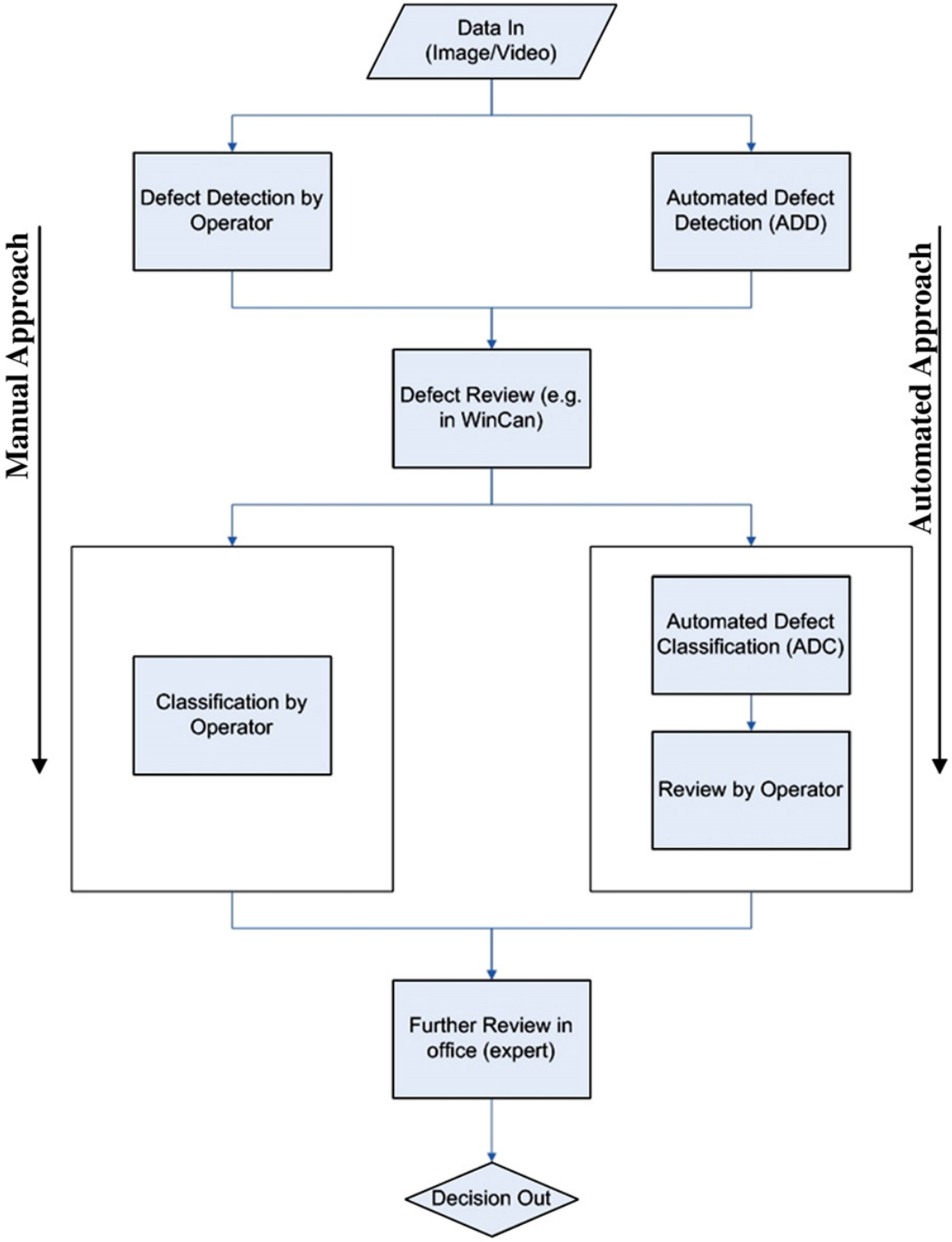


Figure 2-18 Automated versus manual sewer inspection process (Moselhi & Shehab 1999)

Geographical information systems are becoming increasingly used in the water and sewer asset industry. Some trial work is being used to model predicted sewer deterioration using geographical information systems. One example of these trial is geographical information systems are currently being used to assist Sydney Water, a state owned water utility, in their decision-making process to reduce the number of chokes occurring within their jurisdiction (Samsung et al 2009). This system models likely sewer root problems based on asset depth, vegetation and complaint records.

To prevent root growth in pipes some new techniques have been developed. One such techniques combines CCTV and herbicide spray to accurately spray roots within sewer mains. According to McCoy (2009) the spot spray process combines the use of the CCTV tractor with a spray arm fitted to the underside of the tractor for the purpose of spraying any tree root intrusions. A separate spray line delivers the herbicide to the spray arm that feeds out from the back of the CCTV van. This greatly reduces the amount of spray used in compared to traditional root foaming processes as outlined in table 2-1 below.

Table 2-1 Comparison of spot spray versus root foam chemical usage (McCoy 2009)

	Root Foaming	Spot Spray
Concentrated Chemical/m (mls)	9	0.185
Distance treated (m)	50,000	50,000
Volume of Chemical used for 50Km (L)	**450**	**9.25**

3 SEWER ASSET MANAGEMENT IMPROVEMENT

3.1 Introduction

The proceeding chapters identify the importance of asset management in relation to sewer assets due to the increasing age and poor condition of the assets on a national scale within Australia. This chapter outlines the reason why a review of the current sewer asset management processes undertaken by Tamworth Regional Council should be completed. The chapter also provides the methodology that was used to identify and compare current industry practices to Council's sewer asset management strategies by the use of a gap analysis process.

3.2 Need for a Review of the Current Council Sewer Asset Practices

As previously discussed underground pipeline infrastructure is one of the most capital intensive infrastructure systems and many of the pipeline systems in use today, especially sewer systems, are very old and reaching their design lifetimes. As briefly discussed in chapter one Council operates an increasingly aging system with a substantial quantity of sewer asset aged in excess of 60 years. Council's sewer assets also receive high strength wastewater from large industrial dischargers that have the potential to significantly increase the rate of asset deterioration and subsequent failure.

The amalgamation of the smaller Councils with Tamworth City in 2004 has also posed problems in relation to the reliability of asset data for these areas. Particular issues with the quality of asset information have been identified for the previous Councils of Manilla and Barraba, most likely due to the restricted resources of these Councils. The inconsistency and possible poor quality data in these areas are further justification for the need to review current sewer asset management strategies and practices.

Tamworth Regional Council despite undertaking a significant amount of condition assessment data and asset renewal programs does not appear to have a clearly defined process for sewer asset management. The sewer asset portfolio for the Council is valued in the order of $187 million and represents a significant economic investment by the Council. As such a review of the current processes undertaken in relation to sewer asset management may improve the economic efficiency of the management of assets by the following;

- Identify assets that have been overlooked in previous condition assessment programs,
- Identify new technologies for asset condition assessment and renewal that can provide potential budget savings, and
- Provide clear directives in relation to sewer asset management procedures.

Further to the points above, Council is currently undertaking a corporate asset management review for all assets including sewer assets. The purpose of this corporate review is to ensure Council is meeting all legislative requirements and to improve current asset management practices. It is aimed that the findings of this study can be utilized by inclusion in the corporate asset review.

3.3 Objective of the Review

The ultimate aim of this study is to provide Tamworth Regional Council with an effective sewer asset management strategy that optimizes budget expenditure on asset management and improves Tamworth Regional Council's service delivery objectives in relation to sewer services. This review will enable council to improve its service to customers and ensure Council fulfills all legislative requirements in relation to sewer assets. The project shall consider all aspects of sewer asset management to improve Tamworth Regional Council's sewer network performance for aspects such as blockages, overflows and storm water inflow/infiltration. To achieve these goals, the study shall identify shortfalls in Council's current sewer asset management strategy and produce projects aimed to give clear direction in relation to future sewer asset management. A short to medium term

work program in the order of three years shall be developed for sewer asset management to enable future work and budgeting to be forecast.

3.4 Scope of Study

The scope of this study is the asset management of current sewer assets under the control of Tamworth Regional Council. The study shall examine assets associated with Council's wastewater transportation systems. These assets include;

- Sewer gravity mains,
- Sewer pressure mains,
- Maintenance holes,
- Property lateral connections, and
- Other associated civil infrastructure including vents, valves.

The study will consider civil assets only and will not consider electrical and mechanical components primarily due to the relative short life span of these assets in comparison to civil assets. The study shall not include any wastewater treatment or disposal facilities.

3.5 Methodology

To achieve the stated objectives of this study a review of the current sewer asset management techniques utilized by Tamworth Regional Council shall be undertaken. Further to this a review of best industry sewer asset management shall be undertaken, thus enabling a gap analysis between best practice and current management practices to be completed. The identified gaps between best industry practice sewer asset management and current Council practice shall provide the direction of the proposed improvement strategies or projects.

To achieve these outcomes the following approach shall be implemented within the study;

1. Council staff that have involvement with sewer asset management shall be identified and invited to form a sewer asset management group. This group shall be utilized for knowledge and input at various stages of the study. To develop an asset management group, a project commencement meeting with the Director of Council's water section shall be undertaken to identify all key Council staff.

2. Meetings will be held with staff members identified as contributing in the role of sewer asset management and comprising the sewer asset management group. The aim of these meetings is to provide details of the proposed study with relevant Council staff and complete a desktop analysis to identify the current asset management procedures used for sewer assets. It is aimed these meetings shall provide the background information in relation to any relevant policies, studies, databases or procedures currently in use for sewer asset management by Council.

3. On completion of the initial meetings and desktop survey, an audit in relation to the current status of sewer asset management including asset condition assessment and rehabilitation shall be completed. This audit will compile current sewer asset information from relevant databases and reports and include asset information such as age, quantity, condition. It is also aimed that information in relation to asset management practices such as condition assessment, asset revaluation and asset renewal can be detailed.

4. The information obtained during the audit procedure shall be compiled in the study to enable assessment of the sewer asset management practices being undertaken by Council.

5. The previously completed literature review of best industry practice for sewer asset management shall be used to benchmark current sewer asset management techniques used within Australia and internationally. This review will examine industry asset management practices, including asset condition assessment and renewal. The

completion of benchmarking will enable a gap analysis to be completed between Council and best industry practice.

6. A gap analysis between Council's sewer asset management and best industry practice shall be completed based on the input of the sewer asset management group. To enable a gap analysis process to be undertaken a gap analysis tool incorporating three key areas of asset management namely, stewardship, asset management planning and financial planning shall be developed using the NAMS.PLUS asset management software. NAMS.PLUS has been developed by the Institute of Public Works Engineering Australia (IPWEA) to assist councils in developing asset management plans and implement sustainable asset management practices. A suite of templates, guidelines and other tools has been developed based upon the IPWEA International Infrastructure Management Manual 2006. Figure 3-1 details all asset management tools available in NAMS.PLUS.

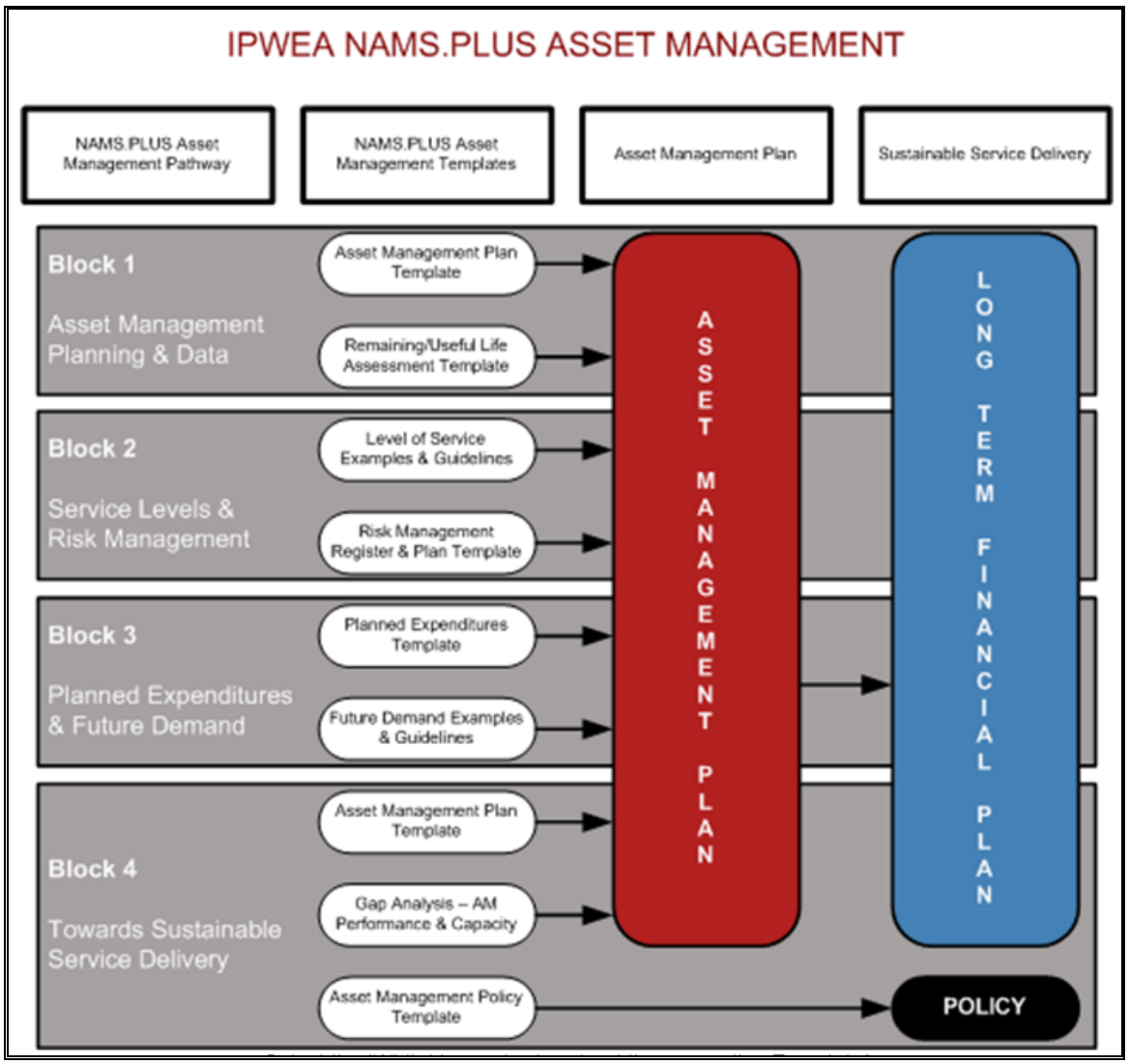


Figure 3-1 NAMS.PLUS asset management templates

The Gap analysis tool detailed in figure 3-1 shall be used in this study. This tool allows the user to answer a series of questions for asset management stewardship, asset management planning and financial planning. On answering each specific question the user is asked to select the desired capability, present capability and importance for the question asked. This process shall be further discussed and detailed in Chapter 6.

7. On completion of the gap analysis process a list of projects aimed to reduce and gaps between Council sewer asset management practices and its desired levels shall be compiled. Projects identified as sewer specific shall be completed as part of this study. Projects determined as being of a corporate project for example the

development of a corporate asset management policy shall be discussed and detailed for future work.

8. The final stage of the study will complete projects specific to sewer assets management that can improve Council's sewer asset management approach. These projects shall be documented in this study for further use by Council. Any projects deemed to be of corporate nature i.e. needing to be developed by Council as a whole shall be identified for future work.

3.6 Risk Assessment

In order to complete this study some field observations and inspection shall be required. This may involve lifting maintenance hole lids on roadways and private properties. As this work is being completed for Tamworth Regional Council, Council requires the risk assessment to be developed in accordance with their safety management system procedures. A risk assessment developed and approved with regard to these procedures is supplied as Appendix B.

4 COUNCIL'S CURRENT SEWER ASSET STATUS

4.1 Introduction

This chapter outlines the current status of sewer asset management being undertaken by Tamworth Regional Council and its formulated strategies to manage its sewer assets. A literature search shall be undertaken in relation to any studies or strategies developed by Tamworth Regional Council in regard to sewer assets. A review of how Council's sewer asset data is stored, maintained and used shall be completed. Further to this, the techniques and technologies used by Council for sewer asset condition assessment and asset renewal including budget expenditure shall be completed.

4.2 Review of Tamworth Regional Council Sewer Infrastructure Studies

Tamworth Regional Council has a substantial budget in relation to sewer asset management and sewer asset rehabilitation. During the past ten years Council has completed a number of studies in relation to sewer reticulated system. These studies include the following;

- Sewer overflow studies (Barraba, Manilla and Tamworth)
- Infiltration hydraulic studies (Tamworth)
- Sewer servicing strategies (Tamworth)
- Strategic Business Plan – For Sewer Services

Despite these studies it would appear that very little study has been undertaken in regard to the condition management of Council's sewer assets. The studies detailed above shall be covered in more detail in the following subsections.

4.2.1 Sewer Overflow Studies

Sewer overflow studies have been completed for the Barraba, Manilla and Tamworth sewer networks as a requirement of the NSW EPA. Hunter Water Australia (HWA) was engaged by Tamworth Regional Council to undertake the preparation of sewer overflow investigations reports for these centres in 2007. These reports were deemed a requirement of the NSW EPA due to the shift in requirements of wastewater licences to cover the entire sewage treatment systems and include overflows from the sewage pumping stations and reticulation systems. This licensing approach aims to minimise the potential harm to public health and the environment from the discharge of sewage into the environment. The EPA requires that the sewer overflow investigation reports be prepared to assess the risk of sewer overflows with respect to public health, economic and environmental impacts.

Investigation of the Tamworth wastewater transportation system revealed that in general, the system performs well. The following table details the level of risks associated with sewer overflows for the Tamworth sewer network during both dry and wet weather events (Hunter Water Australia 2007)

Table 4-1 Risk associated with sewer overflows from the Tamworth sewer network

SPS Catchment	Dry Weather Risk	Wet Weather Risk
SPS 1A	Low	Low
SPS 1C	Low	Low
SPS 2	Low	Low
SPS 2C	Low	Low
SPS 3	Moderate	Moderate
SPS 3C	Low	Low
SPS 4C	Low	Low
SPS 5	Low	Low
SPS 6	Low	Low
SPS 8	Moderate	Low
SPS 10	Low	Low
SPS 11	Low	Low
Swan Street STP	Low	Low
Westdale STP	Moderate	Low

Likelihood	Impacts				
	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Almost Certain (A)	Significant	Significant	High	High	High
Likely (B)	Moderate	Significant	Significant	High	High
Moderate (C)	Low	Moderate	Significant	High	High
Unlikely (D)	Low	Low	Moderate	Significant	High
Rare (E)	Low	Low	Moderate	Significant	Significant

Despite the risk associated with the network a number of sites were identified as having potentital risks. An example detailed in the report identifies sewer manholes Mh8186 and Mh1374, identified as being of concern to operators, are located in a residential driveway off Karwin Street in South Tamworth, as shown in Figure 4-1.

Figure 4-1 Manholes Mh8186 and Mh1374 Karwin Street, South Tamworth

During a site investigation residents confirmed recent overflows from these manholes. Multiple overflows were also reported by a resident from a house branch inspection opening in a property directly opposite. Public exposure to surcharges in Karwin Street from manholes Mh8186 and Mh1374 is possible and is associated with wet weather events to be discussed in subsection 4.2.2.

4.2.2 Infiltration Hydraulic Studies

A sewer infiltration and inflow study was completed on the Tamworth City sewer network by the NSW Department of Commerce in 2005. This study examined a number of sewer catchments believed to have expected storm water infiltration issues. Despite the report not making any conclusions or recommendation it did identify a number of sites

that experienced significant increase in flows due to storm water ingress. The flow profile for one particular site, asset Mh4238, has been provided below.

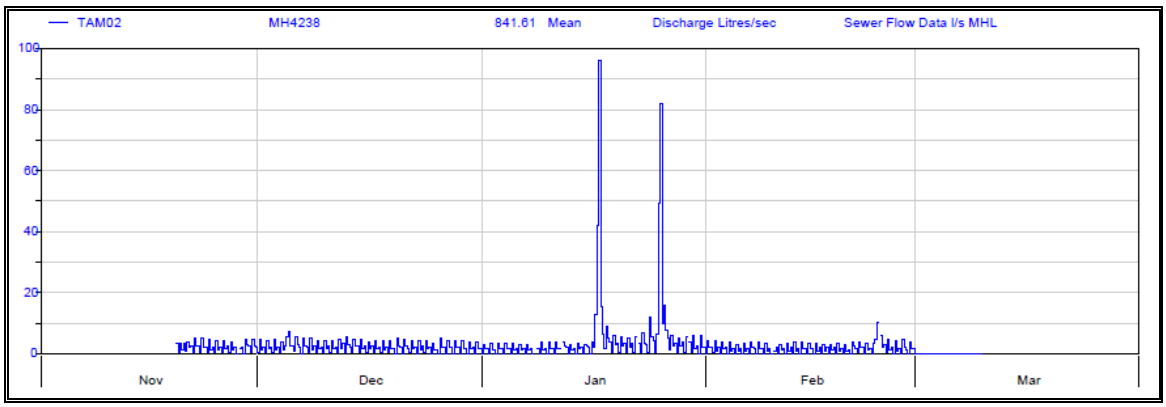


Figure 4-2 Sewer flow profile for site Mh4328

The sewer catchment for this asset is provided in Figure 4-3 and has the following asset characteristics;

- Pipe diameter 375mm
- 800 upstream properties
- 540 upstream pipe segments

This catchment is connected the Karwin Street catchment identified in Council's sewer overflow investigation reports.

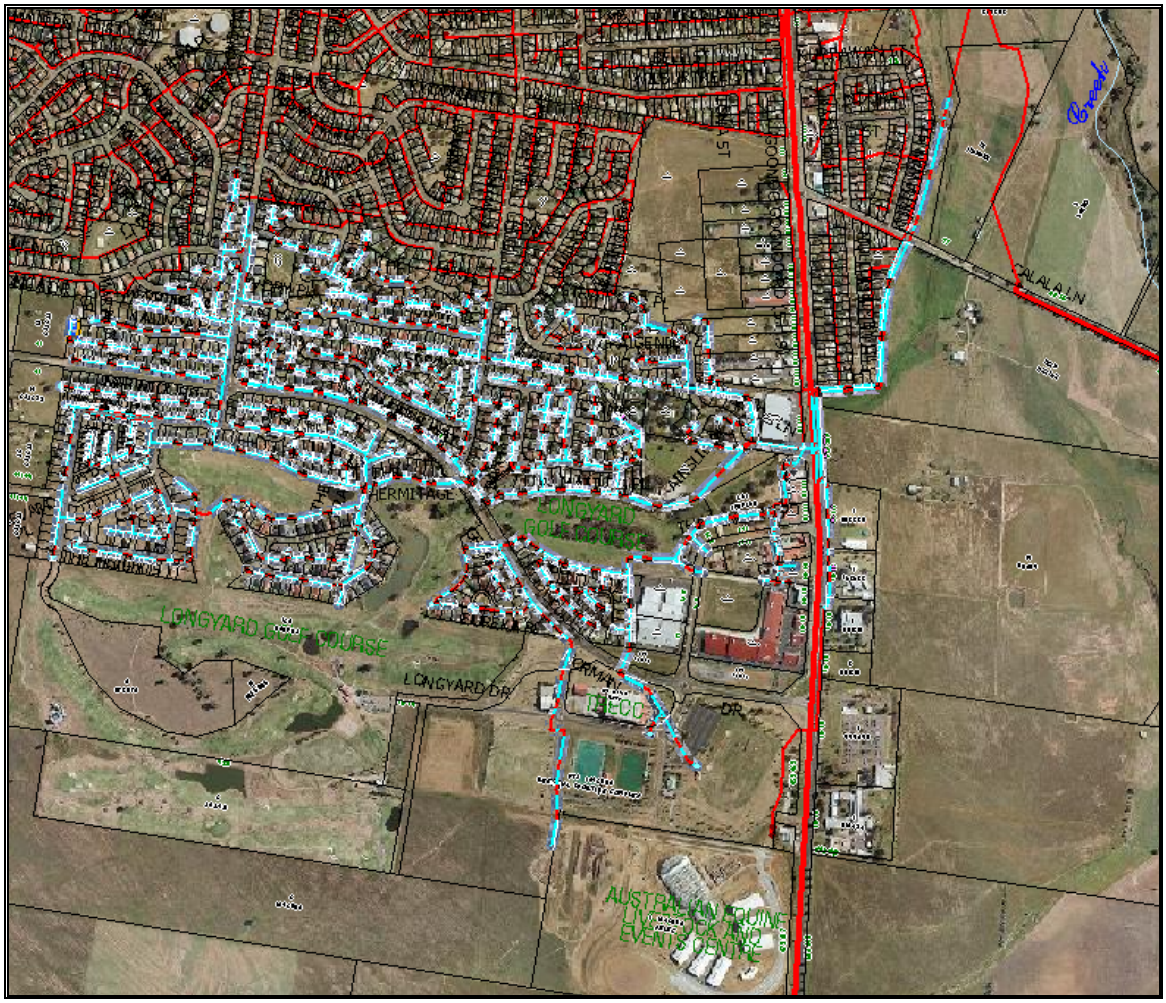


Figure 4-3 Sewer catchment for asset Mh4328

No further investigation has been completed in regards to this significant increase in flow during rainfall events to attempt to identify and resolve any issue contributing to the increased flow. However, it can be concluded that flow is increasing from 5 litres per second up to 100 litres per second adding significant volumes of water to the sewer system. This would have the effect of increasing downstream pumping costs and increasing the risk of sewer overflows. The sharp increase in the graph indicates that there is an almost immediate increase in flow during rain events suggesting that additional flow input is coming directly from a source i.e. storm water cross connection to sewer. This site should be further investigated by installing flow monitoring upstream to isolate the source of the increased flow.

4.2.3 Sewer Servicing Strategy

A sewer servicing strategy has been completed for Tamworth. This involved the hydraulic modeling of the system and identifies current hydraulic capacity of the sewer system and predicts shortfalls based on expected population growth. It should be noted that this report does not consider asset condition. The sewer servicing strategy report forms the basis of Council's twenty year capital works program for sewer. The capital works program is used to budget and plan major infrastructure works in relation to sewer infrastructure.

The studies completed to date examine the theoretical hydraulic capacity of the sewer system, however very little research has completed in regard to establishing an asset management system based on asset condition.

4.2.4 Strategic Business Plan

Strategic business plans are a valuable management tool for Councils. They communicate scheme information to stakeholders and demonstrate that the schemes are well managed. Further, the NSW Minister for Water has determined that a satisfactory strategic plan is a prerequisite for the provision of financial assistance for sewerage schemes.

The planning horizon for the strategic business plan is approximately five years, however, the aim is to efficiently manage the sewerage infrastructure for the long term and minimise whole-of-life asset costs. As the average life of Council's sewerage infrastructure is about 70 years, the approach to developing this plan has been to run financial models over 30 years in order for the effects of the strategies to be properly evaluated.

The strategic business plan is divided into nine sections, as detailed in the following:

- An Introduction that explains why the plan has been developed.

- An operating environment review that sets out the institutional arrangements, legislative framework and regulatory obligations under which Council provides sewerage services.

- A mission statement that provides the focus of management in setting operational and maintenance objectives.

- A listing of performance indicators against which Council's social, environmental and economic performance is measured is included.

- The Levels of Service that sets out the quality performance targets and measurement of the actual level of service achieved in delivering sewerage services.

- A detailed description of service delivery including in-house and external resources utilised.

- A human resources plan that sets out the human resources and skills necessary to ensure compliance with customer service levels.

- A customer service plan that includes reviewing levels of service provided in regard to area served, population growth, pricing of services and sustainable development in providing sewerage services.

- A financial plan that sets out the funding strategy necessary to meet the cost of achieving the strategic business plan.

Of particular importance in the strategic business plan is Council's identified level of customer service. The levels of customer service Council attempts to provide to its customers are detailed in Table 4-2.

Table 4-2 Council's Identified Level of Customer Service

Service Criteria	Service Target	Compliance Measure
1. Availability of Service	Provide point of connection for all allotments within defined service areas	100% Compliance
2. System Failures		
Planned		
Minimum Notice	7 days	100% Compliance
Maximum Duration	4 hours	95% Compliance
Unplanned		
Blockages		
Minor (<10 houses affected)	400 per year	95% Compliance
Major (>10 houses affected)	5 per year	95% Compliance
Equipment Failure	2 per year	95% Compliance
Response Times		
During working hours	60 minutes	95% Compliance
Outside working hours	90 minutes	95% Compliance
Duration		
During working hours		
Minor (<10 houses affected)	2 hours	95% Compliance
Major (>10 houses affected)	2 hours	95% Compliance
Outside working hours		
Minor (<10 houses affected)	3 hours	95% Compliance
Major (>10 houses affected)	3 hours	95% Compliance
3. Customer Complaints		
Frequency		
Odour	50 per year	99% Compliance
Noise	Nil	99% Compliance
Bills (including trade waste)	20 per year	99% Compliance
Response Times		
Phone or personal	30 minutes	99% Compliance
Written	7 days	99% Compliance
Bill Inquiry	7 days	99% Compliance
General Phone Inquiry	Immediately	99% Compliance

4.3 Tamworth Regional Council Current Sewer Asset Management Practices

In relation to sewer asset management, Council identifies the following objectives:

- Maintain the sewer reticulation including minimizing infiltration and inflow through CCTV investigation, reconditioning and relining, addressing infiltration and inflow problems, and

- Maintain an asset register for sewer assets allowing financial plans to be developed based, in part, on asset management principles and provide input into the preparation of corporate wide asset management plans associated financial Modeling and acquisition of an asset management system (Tamworth Regional Council 2010)

In order to achieve the objective stated above, Council currently operates a significant budget in the order of $1,500,000 per annum for its sewer asset management and rehabilitation (Tamworth Regional Council 2010). This budget allocation is used for various projects involving closed circuit television (CCTV) survey of assets followed by rehabilitation of assets identified as requiring renewal. To date Council has completed a significant amount of CCTV survey and numerous contract works for insitu rehabilitation works. Appendix C details a summary of the amount of CCTV survey and rehabilitation completed by Council on each sewer network. A summary of this information is provided below in Figure 4-4.

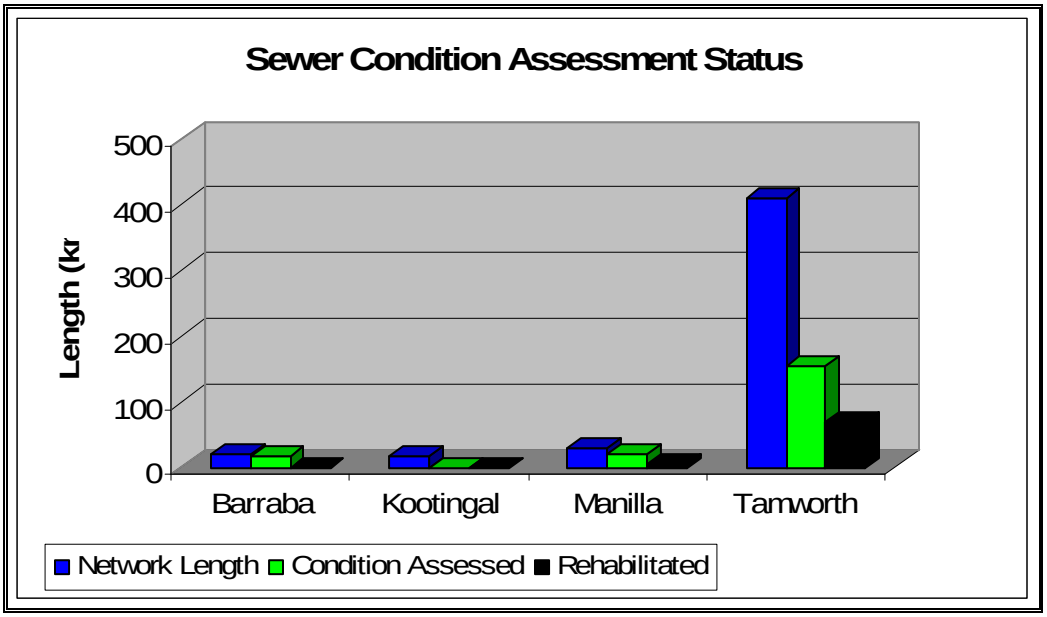


Figure 4-4 Status of CCTV Survey and Rehabilitation for Tamworth Regional Council

From the above figure it can be observed that almost all sewer assets have been surveyed in both Manilla and Barraba with almost a third of assets surveyed in Tamworth. From those assets surveyed within Tamworth almost 50 percent have been renewed or 20 percent of total assets have been renewed.

4.3.1 Asset Condition Assessment

Council owns and operates its own inspection equipment with an annual budget for labour and maintenance of $120,000. Pipe inspection equipment operated includes a closed circuit television camera. This camera has recording capabilities and is suitable for sewer mains up to 300mm in diameter. In sewer mains larger than this the camera tractor becomes submerged and does not provide suitable quality footage. Assessment of pipe work is undertaking to an internally developed standard which assess pipe structural integrity and serviceability. This scoring system is provided below;

Rating	**Description of Condition**
1	Excellent condition: Only planned maintenance required.
2	Very good: Minor maintenance required plus planned maintenance.
3	Good: Significant maintenance required.
4	Average: Significant renewal/upgrade required.
5	Poor: Unserviceable i.e. complete collapse of conduit.

The condition rating is linked to the remaining useful life of the asset as follows;

Condition Rating 1: Greater than 50% of useful life remaining

Condition Rating 2: Between 30 and 50% of useful life remaining

Condition Rating 3: Between 10 and 30% of useful life remaining

Condition Rating 4: Less than 10% of useful life remaining

Condition Rating 5: No useful life remaining

Council also undertakes sewer asset CCTV inspection and condition assessment by external contracting. This is undertaken where large scale work is required or larger diameter mains i.e. diameters greater than 300mm need to be inspected. Contract work is complete to the assessment criteria specified by the *WSAA-2006 Conduit Inspection Reporting Code*.

4.3.2 Asset Renewal Practices

Council undertakes a significant amount of proactive sewer asset renewal by various techniques. Council commenced asset rehabilitation programs in the late 1980's using primarily contracts to complete these works. Council has completed approximately 20 contracts for sewer relining and sewer pipe bursting renewing a total of 70 kilometres of sewer assets. Further to this Council has also completed numerous sewer main reconstruction (sewer main replaced in its given location) and sewer main realignment. Details of asset renewals are provided in Appendix C. The photographs provided below detail two different methods of sewer relining previously used by Tamworth Regional Council.

Figure 4-5 Sewer relining Ribloc (TRC 2010)

Figure 4-6 Sewer relining cured in place (TRC 2010)

4.3.3 Asset Data Storage and Maintenance

Sewer asset data is currently stored within Council's Geographical Information System (GIS). Data included with this system includes the following sewer asset information;

- Installation date,
- Material,
- Diameter,
- Depth,
- Length,
- Grade/slope, and
- Property connection details

Sewer asset assessment and renewal information is held in an Access database. This database stores the following sewer asset information;

- Date of all CCTV assessments,
- Comments regarding asset condition, and
- Asset condition rating.

In relation to asset renewal the database stores and can be used to provide the following information;

- Date of renewal,
- Method of renewal,
- Contractor/staff completing renewal, and
- Revised asset condition rating.

This database is held externally to the GIS database and requires manual data entry to update the GIS. This is a very labour intensive process and the largest disadvantage of the current system. Once this manual update is completed a map layer for completed sewer CCTV and rehabilitation data can be viewed. This layer provides the user with spatial information regarding the date of CCTV or rehabilitation and comments regarding the pipe condition during and after these works. A typical screen layout from Council's GIS is provided in Figure 4-7.

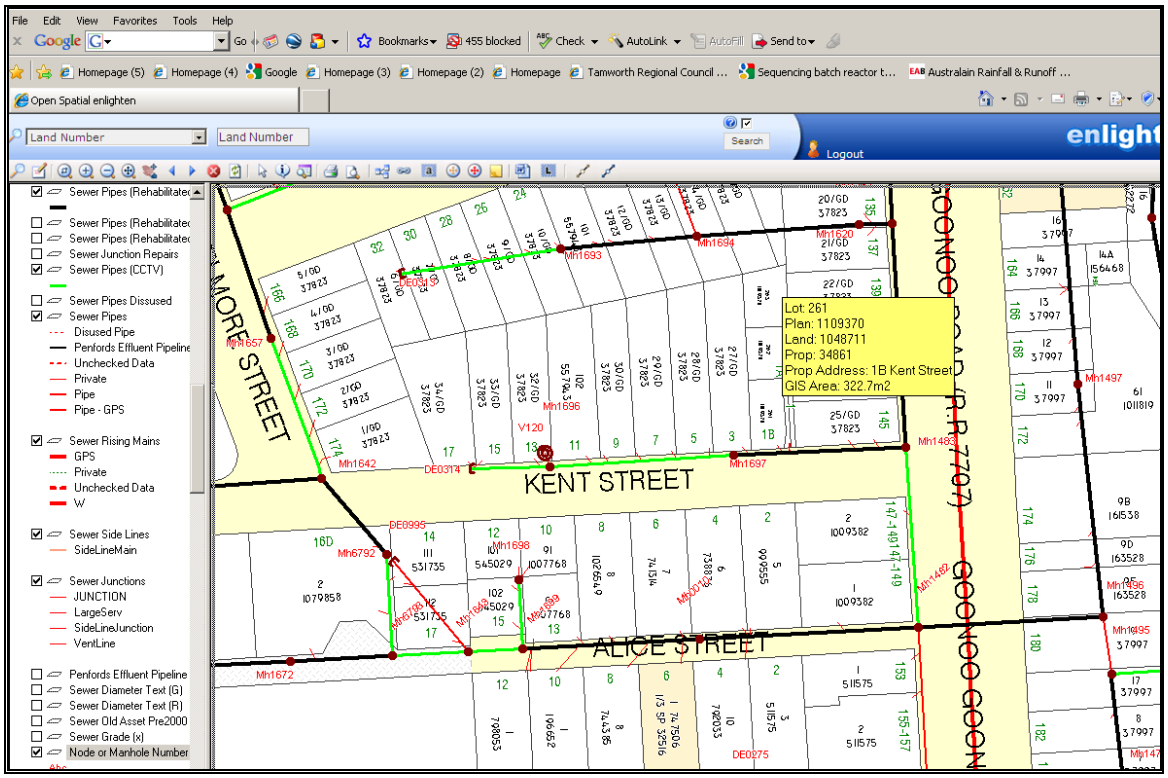


Figure 4-7 Typical Council sewer GIS layer

The figure above details sewer assets for an example location in Tamworth. Assets denoted in red have not been CCTV surveyed, assets denoted green have been surveyed and assessed, while those denoted black have been assessed and renewed by methods deemed appropriate.

Council owns a CCTV survey software called WinCan which is proprietary software of the WinCan company . This is an inspection and assessment program operated by many water authorities and CCTV inspection companies. The software can be used with a variety of conduit assessment coding systems included the *Water Services Association of Australia Conduit Inspection and Reporting Code WSA 05 -2008* utilised by Tamworth Regional Council. To date the system has not been incorporated in Council's internal CCTV inspection program and is only used for contract CCTV work. This system allows the direct coding of pipe condition by field operation staff. A typical screen display from WinCan is supplied in Figure 4-8 showing the completed asset surveys in the top right

corner, the current camera view in the top right corner and the current asset information is provided in the table at the bottom of the screen as inputted by the user.

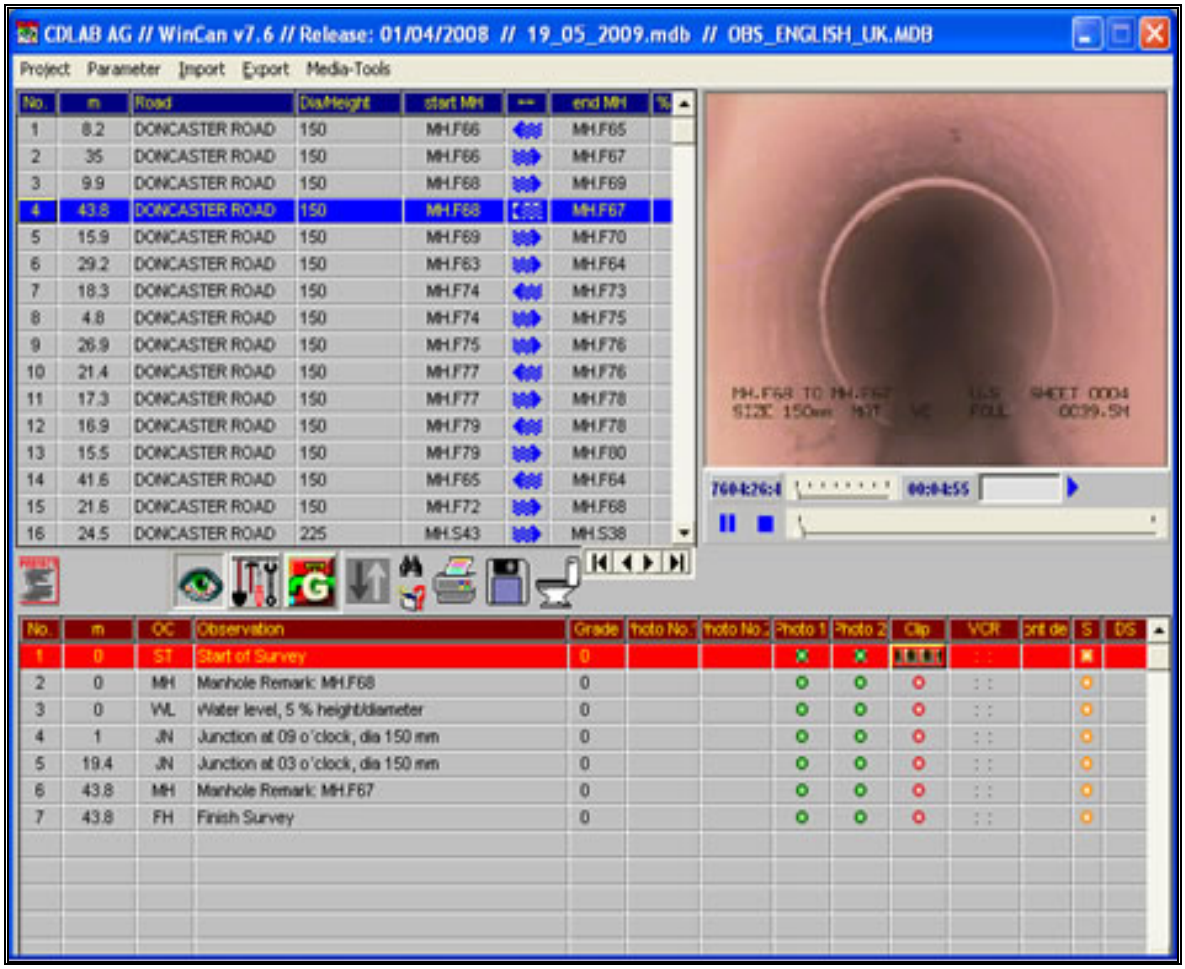
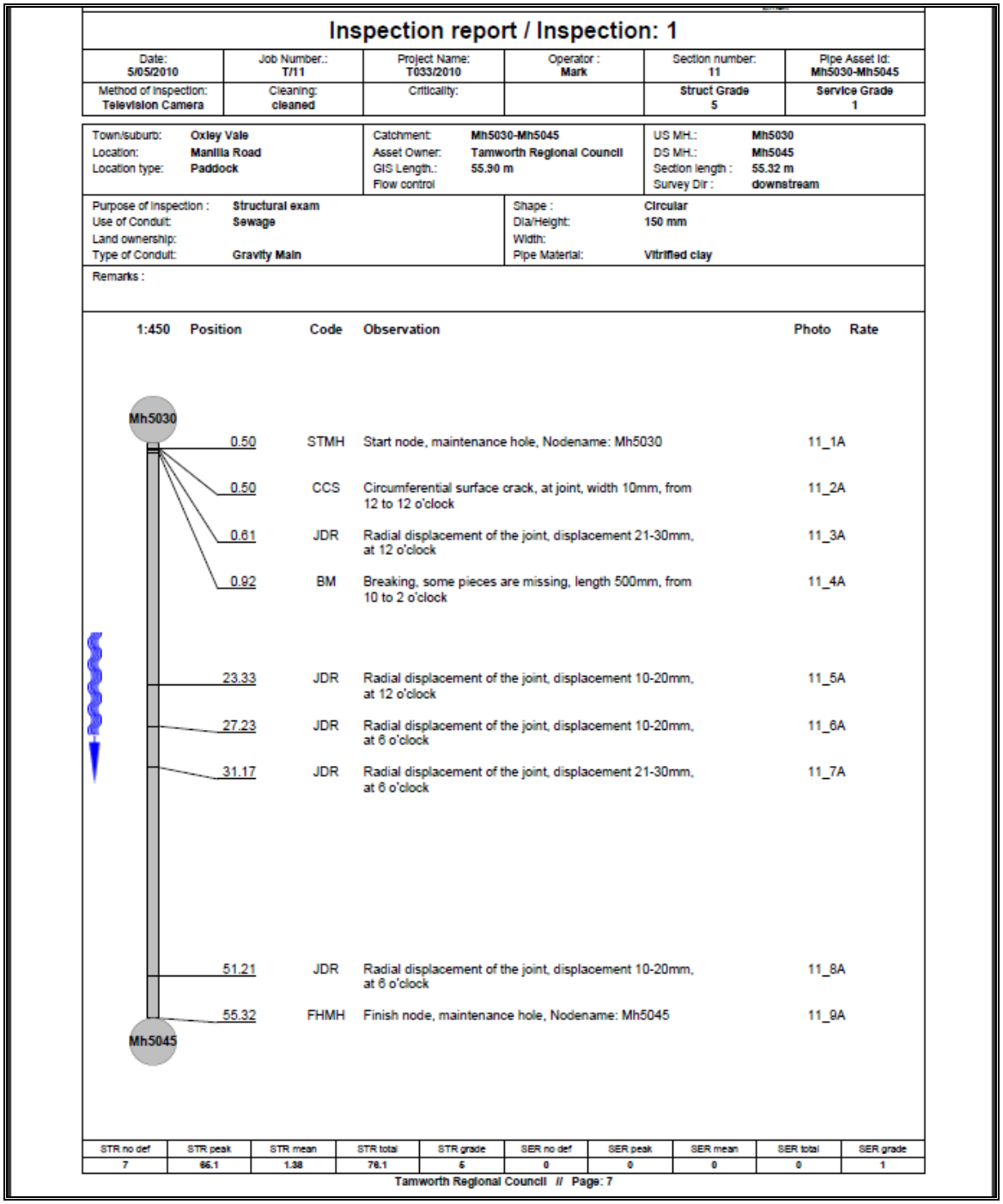


Figure 4-8 Screen layout of WinCan pipe condition assessment tool

On completion of asset assessment the following report provided in Figure 4-9 can be produced from the software detailing the asset lengths, critical aspects such as property connection and any noted defects. The software allows photographs of any recorded defects. The report also provides asset details such as length, location, diameter and material. Also included are the assets structural and serviceability grades based on the selected condition inspection code used.



Inspection report / Inspection: 1

Date:	Job Number.:	Project Name:	Operator :	Section number:	Pipe Asset Id:
5/05/2010	T/11	T033/2010	Mark	11	Mh5030-Mh5045
Method of Inspection:	**Cleaning:**	**Criticality:**		**Struct Grade**	**Service Grade**
Television Camera	cleaned			5	1

Town/suburb:	Oxley Vale	Catchment:	Mh5030-Mh5045	US MH.:	Mh5030
Location:	Manilla Road	Asset Owner:	Tamworth Regional Council	DS MH.:	Mh5045
Location type:	Paddock	GIS Length.:	55.90 m	Section length :	55.32 m
		Flow control		Survey Dir :	downstream

Purpose of Inspection :	Structural exam	Shape :	Circular
Use of Conduit:	Sewage	Dia/Height:	150 mm
Land ownership:		Width:	
Type of Conduit:	Gravity Main	Pipe Material:	Vitrified clay

Remarks :

1:450 Position	Code	Observation	Photo	Rate
Mh5030				
0.50	STMH	Start node, maintenance hole, Nodename: Mh5030	11_1A	
0.50	CCS	Circumferential surface crack, at joint, width 10mm, from 12 to 12 o'clock	11_2A	
0.61	JDR	Radial displacement of the joint, displacement 21-30mm, at 12 o'clock	11_3A	
0.92	BM	Breaking, some pieces are missing, length 500mm, from 10 to 2 o'clock	11_4A	
23.33	JDR	Radial displacement of the joint, displacement 10-20mm, at 12 o'clock	11_5A	
27.23	JDR	Radial displacement of the joint, displacement 10-20mm, at 6 o'clock	11_6A	
31.17	JDR	Radial displacement of the joint, displacement 21-30mm, at 6 o'clock	11_7A	
51.21	JDR	Radial displacement of the joint, displacement 10-20mm, at 6 o'clock	11_8A	
55.32	FHMH	Finish node, maintenance hole, Nodename: Mh5045	11_9A	
Mh5045				

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
7	66.1	1.38	78.1	5	0	0	0	0	1

Tamworth Regional Council // Page: 7

Figure 4-9 Sewer asset report produced from WinCan

4.4 Tamworth Regional Council Current Sewer Network Performance Reporting

The NSW Government continues to actively encourage the non-metropolitan NSW water utilities to achieve effective, sustainable, and safe water supply and sewerage businesses through the *Best-Practice Management of Water Supply and Sewerage Guidelines* (NOW 2009). Local Government Water Utilities are required to report key performance indicators for water and sewer annually to the state government. The NSW Office of Water collates this data to allow benchmarking between utilities. Within NSW there are 106 Local Government Water Utilities (excluding Hunter and Sydney Water) and in 2009 these utilities serviced a population of 1.7 million (95.2% coverage), with piped sewer services (NOW 2009).

In order for Tamworth Regional Council to complete this reporting, a complaint and response system for water and sewer has been established within Council's land and property database (Proclaim). The complaint receipt and resolution process is outlined in Figure 4-10.

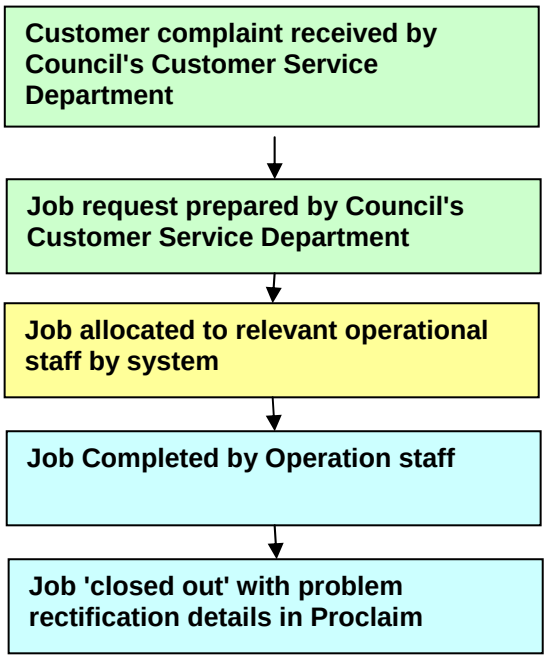


Figure 4-10 Representation of customer complaint resolution process

A typical complaint form developed from this process is provided in Figure 4-11 and provides information on the date and time of the complaint, the nature of the complaint, the affected property, staff allocation for problem rectification, problem resolution date and time and Council staff comments regarding the problem and methods used for resolution.

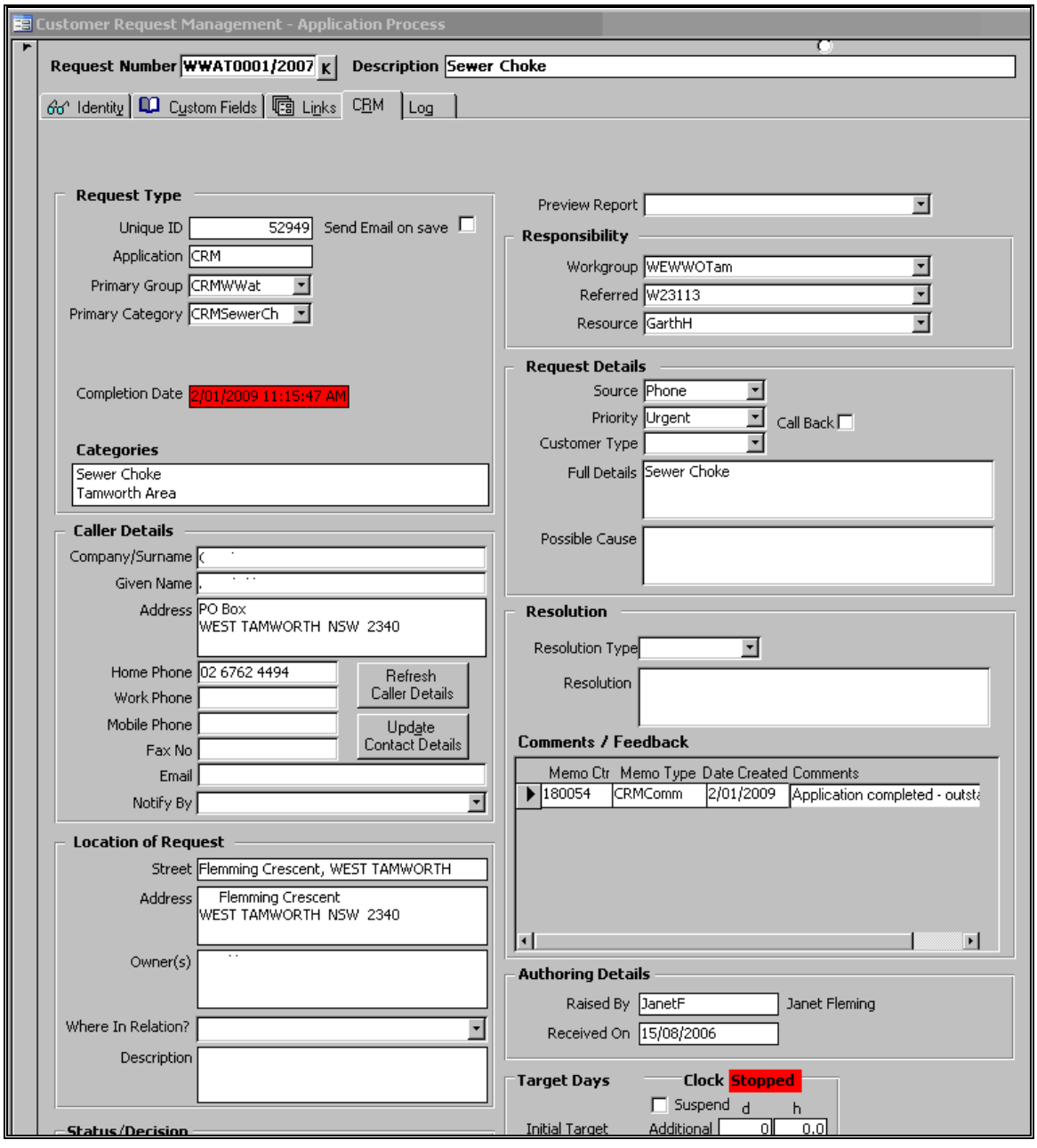


Figure 4-11 Example of sewer complaint form

Once in the Proclaim system the complaint information can be collated into reports based on dates or type of complaint i.e. overflow, odour etc for use in collating benchmark reports.

Results of benchmarking in relation to sewer reporting for 2009 Local Water Utility reporting are supplied in Appendix D. These results detail common statistics used for sewer network comparisons including odour complaints, sewer overflows and sewer operating costs. The aim of the study is to provide Tamworth Regional Council with an asset management program that shall improve these statistics.

4.5 Tamworth Regional Council Corporate Asset Management Practices

Due to the legislative requirements in relation to financial reporting for NSW Council's now in place, Tamworth Regional Council is in the processes of assessing its corporate asset management processes. Council has also identified that its current corporate asset management approach including the storage of asset maintenance data is not adequate for the size of the organization.

Roorda and Associates (2010) have been engaged by Council to undertake a corporate asset management performance study. This report aims to establish an asset management performance measurement and reporting framework for improvement to current asset management processes and subsequent long term financial planning in order to:

- Demonstrate asset management core competency against the national framework requirements and new NSW legislation,
- Demonstrate asset management and financial planning to maintain financial sustainability,
- Complete asset valuations in accordance with NSW Department of Local Government timetable, and

- Complete Asset Management Plans, Asset Management Strategy and Asset Management Policy.

To achieve this, the study undertakes an examination of the Council's long term stewardship, asset management and financial planning. Results of this study indicate that Council is not meeting its requirements for desired levels of service in relation to asset management. This further justifies reasons why a review of sewer asset management is require to identify any shortcomings. Results of the Roorda and Associates (2010), Tamworth Regional Council Asset Management Maturity and Performance Reporting is provided as Appendix E.

As part of this asset review process, Council has commenced compiling details in relation to all assets including sewer assets. Some of the work completed to date includes asset age profiles, and expected growth in the value of sewer assets based on new assets predicted to be installed. Figure 4-12 details the age profile of Council's sewer assets and provides and estimation of the costs of replacing assets constructed in different periods. This chart shows that a substantial proportion of Council's sewer assets were constructed prior to 1960 and the largest proportion of Council's sewer assets were constructed in the 1970's.

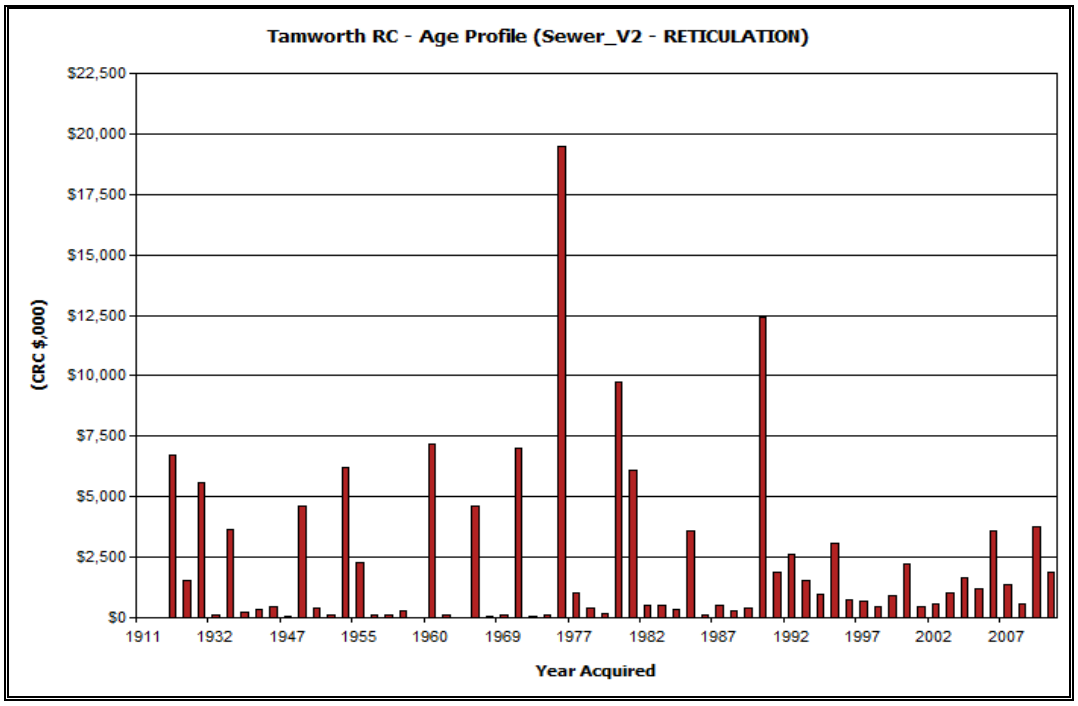


Figure 4-12 Sewer asset age profile and replacement value (Roorda 2010)

Figure 4-13 details Council's expected new sewer asset values for each year for the next twenty years. This chart has been developed based on current and expected future population increases and on Council's 20 year capital work program for the installation of new sewer assets to meet the predicted future growth.

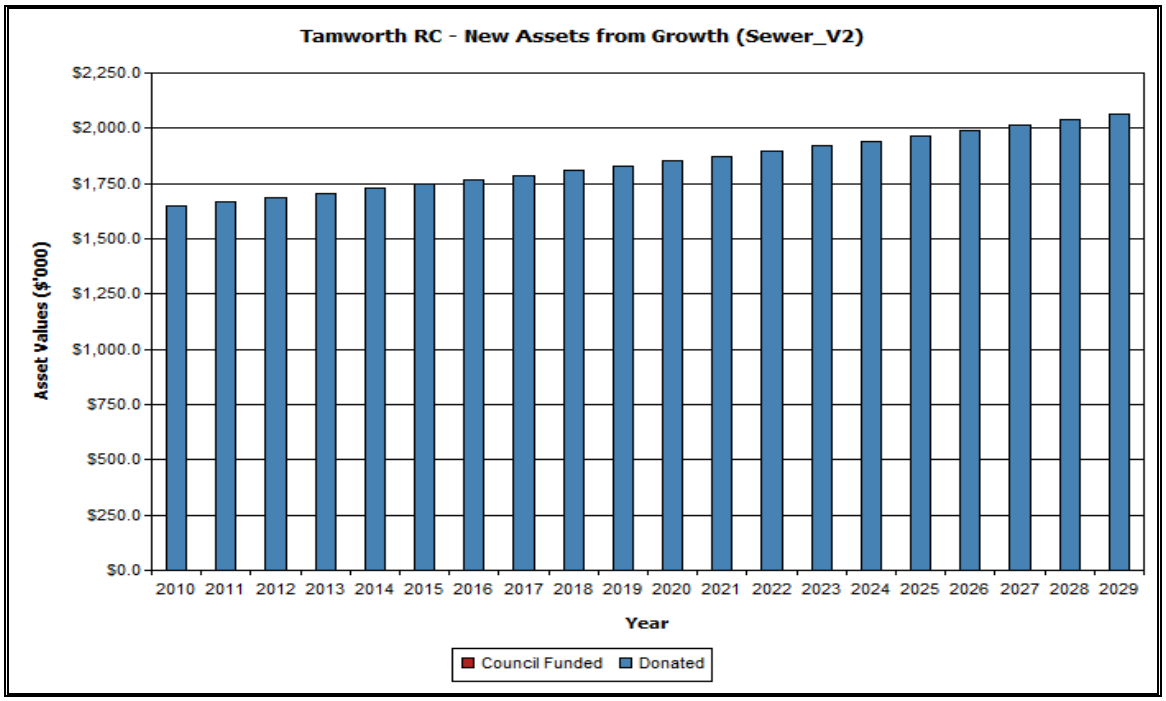


Figure 4-13 New sewer asset values 2010-2030 (Roorda 2010)

5 BEST INDUSTRY PRACTICE

5.1 Introduction

This chapter examines best industry practice in relation to sewer asset management to enable future benchmarking between Council's performance and best industry practice to be completed. To implement a successful sewer asset management strategy, a clear direction in relation to ultimate objectives and targets of the strategy must be established. These objectives must include the desired level of asset management practice and budget allocation Council is prepared to commit to achieve its service delivery obligations and legislative requirements in relation to sewer services. This chapter examines the relevant NSW legislative requirements for sewer assets and the current best industry practice for water authorities in relation to sewer management.

5.2 Legislative Requirements

Section 8 of the *Local Government Act 1993* (NSW) specifies that councils are to have regard to the long term and cumulative effects of their decisions, and are to bear in mind that the councils are the custodians and trustees of public assets and must effectively account for and manage the assets for which they are responsible. In relation to this obligation, Council have two specific legislative requirements in relation to sewer management namely environmental protection and financial reporting. Other general work legislation that Council's sewer assets can impact includes;

- Water Management Act, 2000
- Occupational Health and Safety Act, 2000
- Independent Pricing and Regulatory Tribunal Act, 1992
- Public Health Act, 1991

- Public Works Act, 1912
- Roads Act, 1993
- Environmental Planning and Assessment Act, 1979
- Waste Minimisation and Management Act, 1995
- Soil Conservation Act, 1938
- Water Act, 1912
- Noxious Weeds Act, 1993
- Catchment Management Authorities Act, 2003
- Environmentally Hazardous Chemicals Act, 1985
- National Parks and Wildlife Act, 1974
- Threatened Species Conservation Act, 1995
- Protection of the Environment Administration Act, 1991
- Protection of the Environment Operations Act, 1997

5.2.1 Environmental Requirements

Due to the nature of the material being transported within sewer assets the NSW Environmental Protection Agency establishes licence requirements for water utilities in relation to both the sewer network and treatment/disposal systems. These licences dictate the minimum performance requirements that must be establish for sewer network systems. As this study only applies to the transportation system the licence requirements typically include the following;

- Sewer overflows in dry weather,
- Sewer overflows in wet weather,
- Impacts on watercourses.

Along with compliance to individual licences water utilities in NSW are governed primarily by the *NSW Protection of the Operations Act 1997*.

5.2.2 Financial Requirements

The NSW Department of Local Government (2006) states that Councils must prepare their annual financial reports in accordance with the requirements of the:

- *Local Government Act 1993* (NSW) & *Local Government (General) Regulations 2005* (NSW).
- *Local Government Code of Accounting Practice & Financial Reporting* and the A*sset Accounting Manual*.

In particular, section 428 2(d) of the *Local Government Act 1993* (NSW) requires councils to report on the condition of the public works under the control of the council as at the end of that year, together with:

(i) An estimate (at current values) of the amount of money required to bring the works up to a satisfactory standard;

(ii) An estimate (at current values) of the annual expense of maintaining the works at that standard; and

(iii) The council's program of maintenance for that year in respect of the works.

5.3 Service Obligations

Service obligations relate to Councils customer charter and what is deemed to be a suitable service delivery to its customers. Tamworth Regional Council's customer service obligations have been previously detailed in table 4-2. These obligations are guidelines only for what Council deems suitable levels of service. In comparison, larger NSW water utilities such as Sydney and Hunter Water are required by the Independent Pricing and Regulatory Tribunal (IPART) to commit to an operating licence that includes target levels of inconvenience for customers. This licence establishes the maximum allowed failures for sewer systems controlled by these authorities and provides financial rebates to

customers when these minimum requirements are not achieved. For example Hunter Water's sewer customer service targets for 2010 are provided in table 5-1.

Table 5-1 Hunter Water Operating Licence Customer Service Targets

Sewer Overflows	Licence Target
Private Property experiencing a dry weather overflow	< 5000 p.a.
Private Property experiencing > 3 dry weather overflows	< 45

As previously discussed in section 4.4, NSW Council's are required to annually report on sewer network performance to the NSW Office of Water. Tamworth Regional Council undertakes this reporting annually and the results relating to sewer performance for the reporting year 2008-2009 have been provided as Appendix D These reports enable Council's to compare performance and benchmark against other Council's. The results provided must be carefully examine however due to the variation in the size of Council's and due to the reporting mechanisms Councils are using. On this basis Tamworth Regional Council should compare itself to similar sized Councils with similar structure and system complaint reporting mechanisms.

5.4 Best Industry Practice Approach

According to the Western Austalian Local Government Association (2009), an organisation that is delivering best practice asset management should be able to make the following claims:

1. We know what we own or have responsibility or legal liability for.

2. We have recorded these assets in a register down to an identifiable level.

3. We monitor the condition, performance, utilisation and costs of assets down to the managed component level and aggregate this data up to give outputs of cost and performance at the following levels:

- Asset;
- Facility;
- Sub system; or
- Full system / program.

4. We thoroughly understand and have recorded the current levels of service in terms of quantity and quality of service.

5. We understand the likely future levels of service required based on population growth, demographic changes and community expectations.

6. We understand the long term (20 years) infrastructure funding (renewal, upgrade and new) needs of our municipality to meet these customer expectations in both capital and recurrent expenditure.

7. We monitor and report on the condition, performance and functionality of our assets against prescribed service levels and regulatory requirements.

8. We have uniform processes across our whole organisation for the evaluation of any investment in:

- Capital works (Renewal, Upgrade and New)
- Maintenance
- Operations

The process involves an assessment of the relative risks and benefit costs of these investments.

9. We only make decisions on individual projects when all service programs have completed these outputs and the funding needs of the whole organization are known together with the knowledge of their impact on rates and charges.

10. We always approve the necessary renewal programs to sustain the existing levels of service before other works, providing they are justified through our processes.

11. We only approve capital for new works and services with the commitment of the necessary recurrent expenditure (*consider "whole of life cost" impacts).*

12. We assess the indirect or ancillary cost impacts of inadequate asset condition or performance on the community in terms of the economic consequences of failing to meet our agreed standards or service levels.

13. We link our corporate goals to our investments and ultimate action plans.

14. Our financial plan and the outcomes of our Asset Management Plans are intrinsically linked.

The above statements define the level of practice and capability considered to be industry best standard within Australia. From the research and benchmarking undertaken in this report, it is obvious most Councils would struggle to meet all objectives of best industry practice for asset management. As such a more suitable and practical approach is for Councils to determine an appropriate level of service. This desired level of service allows Council to meet all its stated goals and objective in relation to customer service requirements and should ensure all legislative requirements are met.

6 GAP ANALYSIS

6.1 Introduction

This chapter examines the gap analysis process used determine the differences (gap) between Tamworth Regional Council's sewer asset management and best industry practice. Previous sections of this report have identified the background to Tamworth Regional Council's sewer assets and defined some of the management strategies currently used by Council to prioritized and renew these assets. The current level of asset management deemed suitable as defined in Council's annual management plan has been identified along with Council's Customer service obligations. To further investigate Council's current sewer asset management strategies a comparison of it current performance against best industry practice shall be completed. Through the use of the gap analysis technique, a formal measure shall be obtained enabling shortfalls to be identified and recommendations formulated in the form of improvement projects to address these shortfalls.

6.2 Gap Analysis Background

A gap analysis allows an organization to understand 'where it is relative to where it wants to be in relation to asset management practice for a specified period of time (GHD 2007). The gap can be defined as the distance between the organisations current performance in comparison to the desired future performance.

The gap analysis serves three fundamental functions;

1. To assess asset management processes, practices and systems against best industry practice.
2. To identify areas where the organization has already achieved best industry practice, and
3. To identify areas where the organization requires improvement, guiding future action toward and measuring against best practice.

6.3 Gap Analysis Process

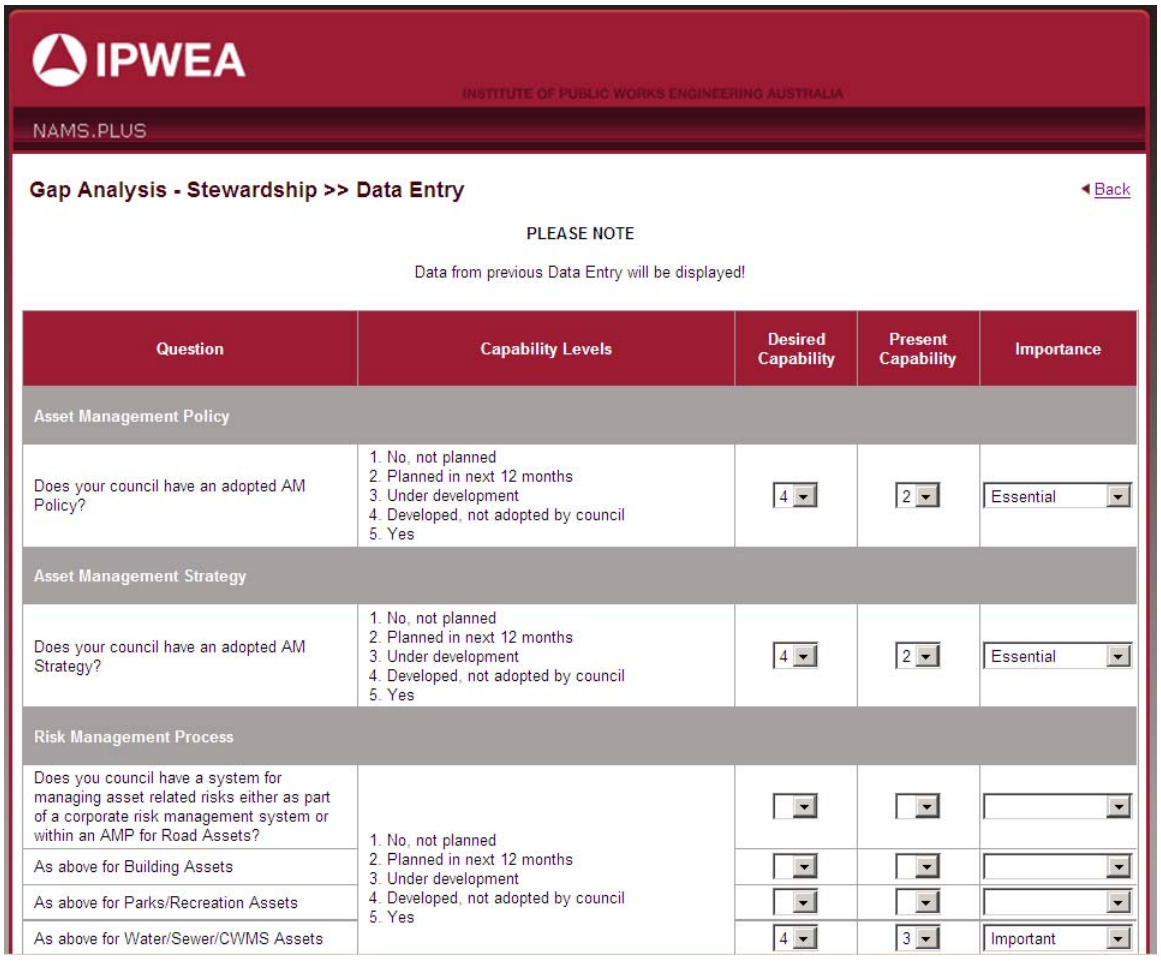
The object of the gap analysis is to develop a structured and repeatable assessment process designed to measure the "gap" between existing sewer asset management and the level of service at which Council considers suitable for it sewer assets. The gap analysis shall be divided into two processes. Process one will compare current sewer network performance and technologies used in relation to sewer management. The second process will examine the asset management processes used by Tamworth Regional Council for sewer assets utilizing NAMS.PLUS.

6.3.1 Sewer Asset Management Performance

As detailed in section 4.4, NSW Council's are required to annually report on sewer network performance to the NSW Office of Water. Tamworth Regional Council undertakes this reporting annually and the results relating to sewer performance for the reporting year 2008-2009 have been provided as Appendix D. An analysis of these results found that Tamworth Regional Council is performing well in regards of sewer odour complaints and has far fewer complaints than many similar sized Council's i.e. greater than 10000 properties. In relation to sewer overflows the Council also appears to perform relatively well against similar size Councils with approximately 13 overflows per 100 kilometres of sewer main. The results for sewer odour complaints and chokes are made even more positive given the low operating, management and administrative costs on a per property basis.

6.3.2 Sewer Asset Management Processes

To enable input from the relevant staff involved with sewer asset management at Tamworth Regional Council the sewer asset management group formed was used to answer a series of questions in relation to sewer asset management. The areas of asset management to be addressed were stewardship, asset management planning and financial planning. The group of six elected that the desired capability be set at '4', the level defined as competent for all three components. To utilize this gap analysis tool in NAMS.PLUS each member of the sewer asset management group was asked to complete scorecards provided within the NAM.PLUS gap analysis tool. The scorecard templates have been provided in appendix F. with a sample of the template provided in Figure 6-1.


IPWEA

INSTITUTE OF PUBLIC WORKS ENGINEERING AUSTRALIA

NAMS.PLUS

Gap Analysis - Stewardship >> Data Entry ◂ Back

PLEASE NOTE

Data from previous Data Entry will be displayed!

Question	Capability Levels	Desired Capability	Present Capability	Importance
Asset Management Policy				
Does your council have an adopted AM Policy?	1. No, not planned 2. Planned in next 12 months 3. Under development 4. Developed, not adopted by council 5. Yes	4	2	Essential
Asset Management Strategy				
Does your council have an adopted AM Strategy?	1. No, not planned 2. Planned in next 12 months 3. Under development 4. Developed, not adopted by council 5. Yes	4	2	Essential
Risk Management Process				
Does you council have a system for managing asset related risks either as part of a corporate risk management system or within an AMP for Road Assets?	1. No, not planned 2. Planned in next 12 months 3. Under development 4. Developed, not adopted by council 5. Yes			
As above for Building Assets				
As above for Parks/Recreation Assets				
As above for Water/Sewer/CWMS Assets		4	3	Important

Figure 6-1 Scorecard template sample from NAMS.PLUS

As can be observed in Figure 6-1 NAMS.PLUS incorporates other Council assets such as roads, Parks and recreational areas etc. For the purposes of this study these assets were ignored with scores allocated for sewer assets only.

To establish a level of priority in relation to addressing the identified gaps, a weighting factor was assigned to each component. This weighting system was selected by each member of the sewer asset management group based on their opinion of the importance of certain aspects of the asset management system. This weighting can be observed as the 'importance' in Figure 6-1. The derived weighting factor numerically describes the relative importance of the specific quality elements in relation to the Council's sewer asset management practice. This product of the gap score and the applied weighting factor (4th row) gives the weighted gap score (5th row) which has been used to determine the relative priority for improvement (6th row).

On completion of each entry by a member of the sewer asset management group NAMS.PLUS stores the entry and averages the entered data to give overall results for each question. Once each member of the sewer asset management group had completed the score card the results were compiled in NAMS.PLUS to give an overall depiction of Council's current sewer asset management strategy.

6.4 Gap Analysis Results

On collation of the gap analysis results the following output was developed from NAMS.PLUS. To prioritise improvement projects, the product of the developed gap score and the applied weighting factor (4th row) gives the weighted gap score (5th row) which has been used to determine the relative priority for improvement (6th row).

Table 6-1 Results of NAMS.PLUS gap analysis

		Governance						Asset Management Planning							Financial Planning			
	Assessment Score	Asset Management Policy	Asset Management Strategy	Risk Management Process	AM Accountability and Responsibility	Sustainability Reporting	Asset Identification and Recording	Asset Data Maintenance	Asset Condition Data	Risk Management	Service Levels and Delivery Costs	Future Demand Impacts	Asset Management Plans	Life Cycle Costs in Investment Decision	Revaluation Process	Reporting Asset Consumption	Long Term Financial Plan
Excellence	5																
Competence	4																
Systematic Approach	3																
Awareness	2																
Needs Improvement	1																
			Current Capability								Desired Capability						
Present Capability		2.0	2.5	1.5	2.5	2.0	3.5	2.8	3.0	2.0	2.5	4.0	2.0	3.0	3.5	3.5	4.0
Desired Capability		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Gap		2.0	1.5	2.5	1.5	2.0	0.5	1.2	1.0	2.0	1.5	0.0	2.0	1.0	0.5	0.5	0.0
Importance Weighting		5.0	5.0	4.0	4.0	4.0	5.0	5.0	5.0	4.0	5.0	4.0	4.0	4.0	5.0	4.0	5.0
Weighted Gap		10	7.5	10	6.0	8.0	2.5	6.0	5.0	8.0	7.5	0.0	8.0	4.0	2.5	2.0	0.0
Priority for Improvement		**1**	**6**	**1**	**8**	**3**	**11**	**8**	**9**	**3**	**6**	**14**	**3**	**10**	**11**	**13**	**14**

6.4.1 Stewardship

Asset Management Policy

It was clear from the results that the Council did not have a defined corporate asset management policy. The only statements in relation to asset management are detailed in Council's annual management plan stated objectives.

Asset Management Strategy

The results indicated that are formal strategy was not in place however asset management had been occurring based on the recurring annual budget provided for sewer asset management.

Risk Management Approach

Council operates an integrated management system that states risk based approach to its activities based on the Australia Standard for Risk Management. At this stage this process has not been incorporated into sewer asset management.

Asset Management Accountability and Responsibility

Accountability is defined within staffing profiles however corporation accountability has not be addressed.

Sustainability Reporting

No specific sustainability reporting was undertaken however it was included in to financial reporting, long term capital works planning and strategic planning documents.

6.4.2 Asset Management Planning

Asset Data Maintenance

Results indicate that there are processes in place for asset data maintenance such as works as executed drawings etc. However, there appears to be some loss of data in this process that needs to be improved.

Asset Condition Data

Sewer asset condition data is available and a large proportion of the sewer assets have been assessed. The availability of data from a central database appears to be lacking and needs to be addressed.

Risk Management

Currently no risk management process is formally developed for managing sewer assets. It is believe that informal assessments are undertaken based on structural condition of the asset.

Service Levels and Delivery Costs

No specific service levels have been established for sewer asset management. These need to be defined to enable a delivery costs analysis to be undertaken.

Future Demand Impacts

Future demand impacts associated with the growth of the Council have recently been modeled. The results of this study have been incorporated into the long term capital works program and financial modeling.

Asset Management Plan

No sewer asset management stating work to be completed in the short to medium term has been completed. Work has occurred from a recurring annual budget.

6.4.3 Financial Planning

Life Cycle Costs in Investment Decisions

Life cycle cost analysis is undertaken on large projects in relation to sewer assets but on smaller scale projects this is not completed.

Revaluation Process

A revaluation process for sewer assets has been developed based on asset condition. This process is compliant with all legislative requirements.

Reporting Asset Consumption

This has been included in the revaluation process.

Long Term Financial Plan

Council has developed twenty year financial plans for sewer assets based on expected growth and current asset status.

6.5 Sewer Asset Management Project Development

The gap analysis process determined areas of sewer asset management that Council was both adequately and not adequately addressing. From this, assessment priorities can be established and projects developed to address shortcomings in relation to Council's current sewer asset management. This shall enable the organization to work toward meeting its sewer asset management targets and obligations.

The next stage in developing a suitable sewer asset management strategy involves the identification of individual improvement projects or actions targeting the specific priority areas defined in the gap analysis assessment. While the performance of the sewer network appears to be satisfactory in comparison to other similar sized Councils, significant deficiencies were determined in relation to the processes involved with sewer asset management. Improvement of these processes should enable better sewer network performance for Tamworth Regional Council. A draft of suggested improvement actions was formulated on this basis for discussion and input by the sewer asset management group.

Following discussion of the potential projects a final listing of projects was developed aimed at enabling Council to meet its sewer asset management goals and objectives.

These projects were broken into two sections namely corporate projects and sewer specific projects. Corporate projects will be raised in this study for future action but will not be covered in detail as this will require a corporate approach to be undertaken by Tamworth Regional Council. For example the introduction of an asset management policy is required for sewer asset management however this policy needs to incorporate other assets within Council asset portfolio. Sewer specific projects shall be identified and discussed in detail.

Table 6-2 Identified sewer asset management improvement projects

Sewer Asset Management – Improvement Projects		
Stewardship		
Project 1	Develop and commit to an asset management policy	Corporate
Project 2	Develop and implement a corporate asset management strategy	Corporate
Project 3	Incorporate risk management into the corporate asset management strategy	Corporate
Project 4	Develop corporate accountability and responsibility in relation to asset management	Corporate
Asset Management Planning		
Project 5	Provide document control for works as executed procedure	Corporate
Project 6	Develop sewer asset condition and rehabilitation database	Sewer
Project 7	Adopt WSAA standards for sewer condition assessment	Sewer
Project 8	Develop a risk based approach to sewer asset management	Sewer
Project 9	Develop and implement a sewer inflow/infiltration strategy.	Sewer
Project 10	Develop short-medium sewer asset management plans, work programs and budget.	Sewer

7 PROJECT IMPLEMENTATION

7.1 Introduction

This chapter completes the projects required for Council to improve its sewer asset management practices and achieve its desired standard. Having established and prioritized the projects required to improve Council's sewer asset management using the gap analysis assessment process, the implementation of these projects is now required. The following section outlines the approach taken to complete all of the identified improvement projects.

7.2 Sewer Asset Condition and Rehabilitation Database

A sewer asset condition and rehabilitation database is required that enables Council to link its sewer asset condition assessment information obtained from CCTV survey with its current corporate asset system (GIS).

To achieve this objective, a database was developed within Council GIS. The database allows direct input of asset condition assessment data for the following sewer transportation assets;

- All pipe assets
- Access chambers
- Property connections (junctions)
- Vent structures

The asset condition assessment structure of the database was completed based on asset survey forms completed by Council staff members. These forms have been provided in Appendix G.

The database also enables any renewals works to be recorded against the asset. The following details regarding asset renewals where included in the database;

- Date of renewal,
- Contract details,
- Renewal method,
- Renewal material, and
- Any comments related to renewal.

The construction of the database was completed and a typical output for the database is detailed in Figure 7-1.

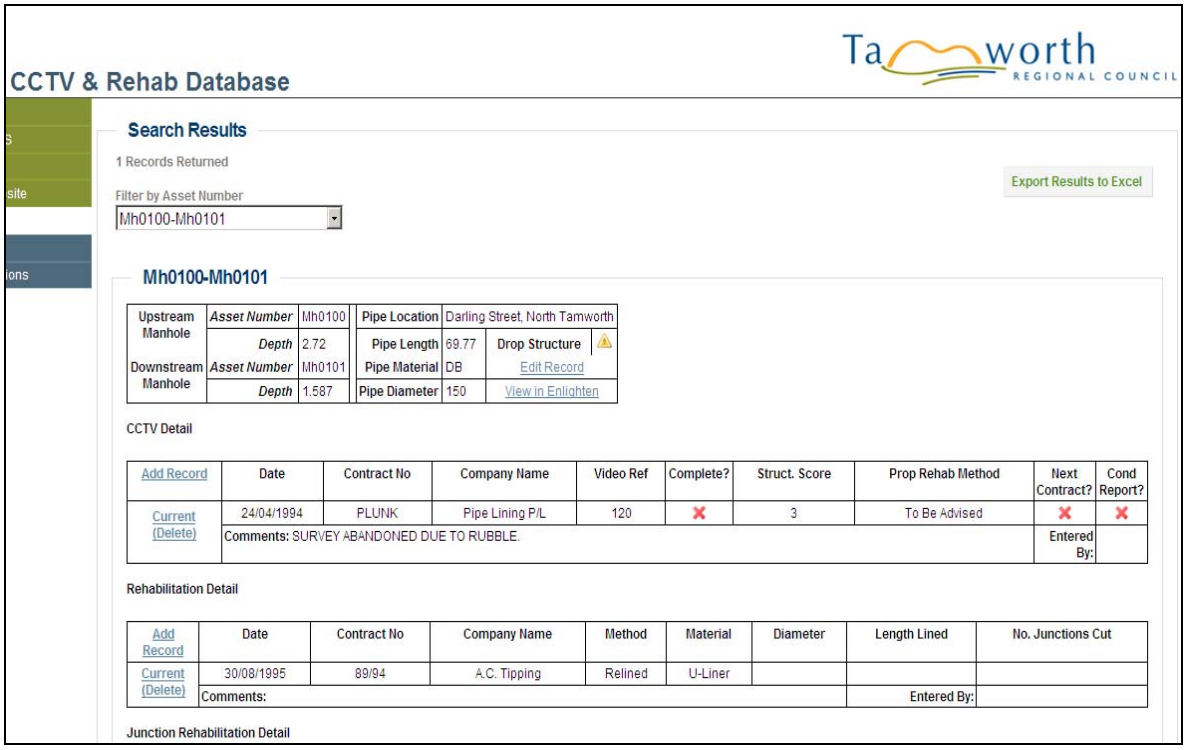


Figure 7-1 Developed sewer assessment and rehabilitation database

The database automatically updates the GIS layers previously identified in Figure 4-6 removing the need for manual data entry. The database has search function enabling search to be undertaken either by the asset identifier or by alternate search methods such as condition assessment scores. These results can be exported directly to excel for further

use i.e. allocation to work programs by using the export results to Excel function of the database.

7.3 Adoption of WSAA Standards for Sewer Condition Assessment

To enable Council a standardised assessment procedure the survey of sewer pipe assessment council should adopt the Water Services Association of Australia Conduit Inspection Reporting Code (WSA 05). To enable this standard to be adopted Council staff would require training in the operation of the standard. Training would be required for CCTV equipment operators and sewer asset managers.

If adopted the Council would need to amend its current assessment criteria to the codes detailed in the standard. The most practical way of achieving this would be to fully utilize the functionality of the WinCan program that Council has available. This program has the standard already incorporated and would allow direct assessment by field staff.

The adoption of this standard shall enable Council to have a standard approach to asset condition assessment i.e. it would allow direct comparison between contractual and internal assessments completed.

7.4 Risk Based Approach to Sewer Asset Management

To enable Council to have a systematic approach to sewer asset condition assessment and maintenance an approach that considers the risk of each asset is required. A risk based approach would consider the consequences of the asset failing and the likelihood of the failure occurring. To complete this project, two risk assessment templates were completed. The first risk assessment focused on all sewer network assets and the types of

failures, the cause of failures and the likelihood or risk of these failures occurring. The second risk assessment matrix places particular focus on gravity sewer assets and aims to provide a ranking system for the urgency of repair based on site conditions such as depth, neighbouring structures and pipe diameter.

The following risk matrix was developed to assess each identified asset risk for all sewer assets included in this study.

Table 7-1 Sewer asset network risk assessment criteria

Likelihood	Occurrence	Impact	Financial Costs	Consequences
Rare	May Occur only in exceptional circumstances - More than 20 years	No injuries	<$10000	Insignificant
Unlikely	Could Occur at some time - Within 10-20 years	First Aid treatment, on-site release immediately contained	$10-$50k	Minor
Possible	Might Occur at some time - Within 3-5 years	Medical treatment required, on-site release contained with outside assistance	$50-$200k	Moderate
Likely	Will probably occur in most circumstances - Within 2 year	Extensive injuries, loss of production capacity, off-site release with no detrimental effects	$200-$1000k	Major
Almost Certain	Expected to occur - Within 1 year	Deaths, toxic release off-site with detrimental effect	>$1000k	Catastrophic

Table 7-2 Sewer asset network risk assessment

Asset at Risk	What Can Happen	Cause	Risk Rating	Risk Treatment Plan
Collector Mains	Collapse of collector mains	ageing pipes, traffic overload, ground movement, corrosion	High	CCTV investigation, relining program
Gravity Sewer Mains	Blockage of Pipes	Foreign material entering the system	Medium	Reactive Maintenance
Gravity Sewer Mains	Blockage of Pipes	Roots entering the system	Medium	Reactive maintenance, crms, targeted area under investigation
Gravity Sewer Mains	Collapse of gravity mains	ageing pipes, traffic overload, ground movement, corrosion	High	CCTV investigation, relining program, capital replacement program
Gravity Sewer Mains	Damage from Earthquake	Earthquake	Low	Reactive maintenance
Gravity Sewer Mains	Deterioration of existing pipes	Ageing pipes	High	Capital replacement program
Gravity Sewer Mains	Discharge to environment from infiltration	System overload from infiltration	High	Smoke testing
Gravity Sewer Mains	Infrastructure damaged by excavation	Excavations on work sites	High	
Gravity Sewer Mains	Overflow from	Under capacity of pipe system	Medium	Monitoring, CRMS requests, sewer modeling strategy, confirmation of levels
Gravity Sewer Mains	Pipe blockage	Tree roots, infiltration of foreign objects, silt.	Medium	Reactive flushing, reactive maintenance
Manholes	Deterioration of existing receiving manholes	Gas attack, age, insufficient venting,	Medium	
Sewer Vents	Deterioration of existing sewer vents	Age, environment, lightning strike, trees and vegetation growth	High	Inspections, maintenance, replacement programs

As discussed in section 4.3, Council currently prioritises work based on structural condition of its sewer assets based on CCTV survey assessment. This approach is suitable when all assets identified as requiring renewal can renewed within the allocated budget. In reality however, this scenario rarely exists and additional factors must be considered when allocated asset renewal priority and associated budget. To enable a priority of asset renewals to be established, the following risk assessment template was developed to consider asset importance i.e. size and site condition factors associated with the asset planned for renewal.

Table 7-3 Asset specific risk assessment template for identify renewal priorities

Score	Pipe Diameter (mm)	Traffic (Vehicles per day)	Nearest Structure (m)	Depth (m)
1	150	Less than 50	20	Less than 1
2	225	50 to 250	10	1 to 1.5
3	300	250 to 1000	5	1.5 to 2.5
4	450	1000 to 5000	2	2.5 – 4.5
5	Greater than 450	Greater than 5000	0	Greater than 4.5

The score for each asset and site condition factor i.e. pipe diameter, traffic volume, nearest structure and depth are totaled together to give an overall score. Assets can then be prioritized for renewal based on highest to lowest score. This process shall allow justification of the asset renewal process in the likely event of a lack of budget.

7.5 Development of Sewer Inflow/Infiltration Program

As identified in subsection 4.2.1 of this study, sewer overflow reports have been produced identifying high risk sewer overflow areas. Further to this subsection 4.2.2 identified the potential for overflows from hydraulic modelling.

One particular example outlined by the study is the sewer overflow occurrences at manholes Mh8186 and Mh1374 located in Karwin Street, Tamworth. Prior to the

investment in a full scale inflow/infiltration program for all Council's sewer network it is intended to use the Karwin Street Catchment as a trial program. The Karwin Street Catchment encompasses 1100 properties, as shown in the figure below, and has been identified by both completed hydraulic investigations and sewer overflow studies as being high risk for the occurrence of sewer overflows.

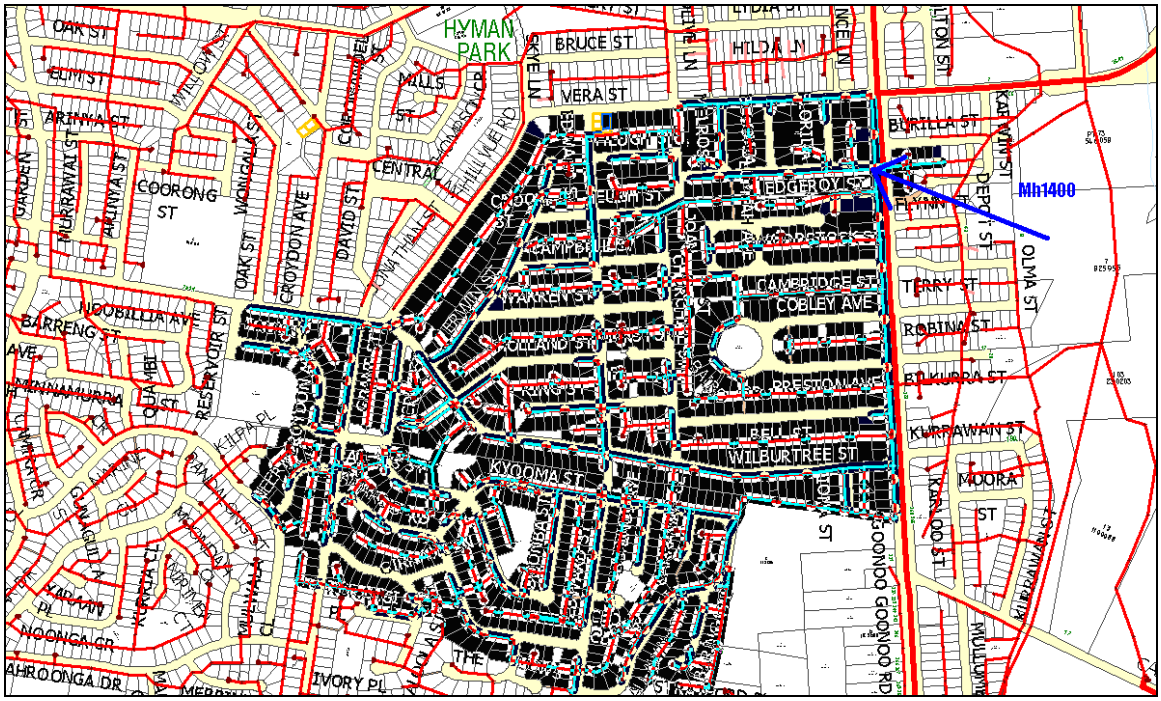


Figure 7-2 Karwin Street sewer catchment to be used as trial inflow program

The development of a sewer infiltration program will involve the following tasks;

- Installation of flow meters to determine flow rates during both dry weather and wet weather events. The catchment can be separated roughly into thirds at asset mh1400 (shown in the above figure). Three flow meters would firstly be installed at this asset to potentially narrow the problem to a distinct portion of the catchment. On the basis of results at this location, flow meters would be moved further upstream in an attempt to identify the problem area during wet weather.
- Conduct smoke testing on any potential storm water inflow areas to identify source of storm water to sewer.

- Report to Council regarding any identified storm water inflow problems with recommended rectification actions based on findings.

On completion of the trial the effectiveness of the methodology may be reviewed to allow for improvements and determine the scope of any future work.

7.6 Sewer Asset Management Plan

In order to deliver services in a cost effective manner, and to be able to demonstrate that this is being achieved, Council needs to take a strategic approach to the way it manages its assets. In addition, asset management practices must adopt a lifecycle approach. To achieve this, an asset management program has been developed to provide clear guidance in relation to sewer asset management for a three year period. As Council operates an annual budget based on financial years, the period covered by this plan is the 2010-2011, 2011-2012 and 2012-2013 financial years. The plan has been developed based on the information presented in this study and assessment of sewer asset status following the development of the sewer asset condition database in section 7.2. The budget allocation has been taken from Councils capital works program and management plans that allocate an annual recurring sewer rehabilitation budget of $1,500,000. All pricing is based on Council's unit pricing developed from previous works or indicative quotes obtained from service providers. This program is supplied as Appendix H with project timeframe summaries and costings supplied in table 7-3.

Table 7-4 Summary of three year sewer rehabilitation works program

Project Number	Description	Start Date	End Date	Total Cost ($)
2010-2011 Financial Year				
1	Clean & CCTV DN150, DN225 & DN 300 Sewer mains	June 2010	October 2010	$250,000
2	Manhole Rehabilitation	Early 2011	Mid 2011	$50,000
3	Sewer Main Pipe Bursting (Tamworth/Manilla)	November 2010	February 2011	$500,000
4	Sewer Main Relining (Tamworth)	March 2011	June 2011	$450,000
5	Sewer Main Relining (Barraba)	July 2010	October 2010	$800,000
			Total	**$2,050,000**
2011-2012 Financial Year				
6	Relining 300mm carrier main at Barraba			$200,000
7	Replacement of sewer vents (Tamworth, Manilla and Barraba)			$150,000
8	Condition assessment of large diameter sewer mains (Tamworth)			$300,000
			Total	**$650,000**
2012-2013 Financial Year				
9	Clean & CCTV DN150, DN225 & DN 300 Sewer mains	August 2012	October 2012	$250,000
10	Rehabilitate Large Diameter Sewer Mains	August 2012	October 2012	$1,250,000
			Total	**$1,500,000**
			3 Year Total	**$4,200,000**

As can be observed from the table above the first financial year exceeds the annual budget allocation of $1,500,000. The reason for this is that it is highly likely that not all work allocated for the 2010-2011 financial year would be completed and would carry

over to the following financial year. The three year total budget allows a contingency of $300,000 to be used as project over runs and for use in any additional projects as identified.

8 CONCLUSION

As identified in the introductory chapter of the study, a strong and sustainable local government system requires a robust planning process to ensure that assets are appropriately maintained and renewed in accordance with principles of best practice management. Despite this, recent inquiries in relation to Local Government asset management practices indicate Councils are not renewing assets to the desired standards of the community and the gap between budget allocation and asset renewal expenditure is continuing to increase. As such, the management of assets and delivery of services to consumers at their desired levels of service is becoming an increasingly large issue for Local Government.

This study has examined the current sewer asset management practices being undertaken by Tamworth Regional Council and completed a gap analysis by comparing these practices against current industry best practice. The results of this analysis developed a number of improvement projects that ultimately lead to an improved sewer asset management strategy for Tamworth Regional Council. The project considered all aspects of sewer asset management to improve Tamworth Regional Council's sewer network performance for aspects such as blockages, overflows and storm water inflow/infiltration.

The key objective of the developed strategy is to provide Council a clear strategy for future sewer asset management. In relation to sewer asset management, Council identifies the following objectives:

- Maintain the sewer reticulation including minimising infiltration and inflow through CCTV investigation, reconditioning and relining, addressing infiltration and inflow problems, and
- Maintain an asset register for sewer assets allowing financial plans to be developed based, in part, on asset management principles and provide input into the preparation of corporate wide asset management plans associated with financial Modelling and acquisition of an asset management system

With the ultimate implementation of the strategy it is anticipated that Council shall be able to meet the objectives stated above.

8.1 Further Work

The completion of this study provides a substantial step forward for Tamworth Regional Council's sewer asset management. The collation of previous studies completed by Council in relation to sewer asset management will enable further recommendations by relevant Council staff. The formation of the sewer asset management group provided an increase in the knowledge base of all staff involved with sewer asset management through the process of knowledge sharing and workshopping. This will provide Council with a well developed knowledge base and group information sharing mechanism for any future work.

All of the improvement projects developed by this study will require future work and staff allocation to enable completion. The most critical project is the ongoing work program developed for future asset renewal. To enable this to be satisfactorily completed adequate staff resource and budget allocation shall be required from Council.

As identified in the study, Council is currently completing a corporate asset management review for all of its assets. The results and recommendations of this research should be included in this review. The corporate projects identified by this study in table 6-1 should be implemented in association with the current corporate review being undertaken. It is hoped the corporate review will encourage Council to allocate budget for corporate asset management software that will enable integration of asset management between the relevant various departments of Council. This in turn should reduce capital expenditure on asset management allowing more asset renewals to be undertaken and reduce disruptions to customers.

All work completed within this study should be reviewed annually to determine both the success of implementation and the effectiveness of the projects. This will enable Council to modify the projects as required to improve the outcomes delivered.

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APPENDIX A – Project Specification

University of Southern Queensland

FACULTY OF ENGINEERING AND SURVEYING

ENG 4111/4112 Research Project
PROJECT SPECIFICATION

FOR:	Daniel Coe
TOPIC:	ASSET MANAGEMENT FOR TAMWORTH REGIONAL COUNCIL SEWER NETWORK
SUPERVISOR:	Dr David Thorpe
ENROLMENT:	2010
PROJECT AIM:	To conduct research and evaluation on the methods used for sewer asset management including asset assessment and rehabilitation. This research shall be used to develop a sewer asset management strategy for Tamworth Regional Council that establishes an ongoing works program and budget. The project shall consider all aspects of sewer asset management to improve Tamworth Regional Council's sewer network performance for aspects such as blockages, overflows and stormwater inflow/infiltration.
SPONSORSHIP:	-Tamworth Regional Council

PROGRAMME:

1. Research and evaluate current methods of sewer assessment data collection.
2. Research and evaluate any models available for predicting the future condition of sewer assets
3. Research current sewer rehabilitation techniques including both trenchless and non-trenchless applications
4. Research the current situation in relation to sewer management at Tamworth Regional Council including, current management strategies and current assets data.
5. Conduct a gap analysis between Tamworth Regional Council sewer asset management practices and current best practice strategies for sewer asset management.
6. Provide a sewer asset management plan for Tamworth Regional Council with budget allocation for assessment and rehabilitation strategies.
7. Report findings via oral presentation and in the required written format.

AGREED:

_____ (Student) _____ (Supervisor)

____/____/____ ____/____/____

Examiner/Co-examiner:_____

APPENDIX B– Risk Assessment

TAMWORTH REGIONAL COUNCIL **Standard Risk Assessment *SF321***

RISK ASSESSMENT SHEET

SRA-105 – Water & Sewer Assets Investigations

This is a general document in nature; site specific conditions must be assessed, discussed and documented through the Site Specific Induction form MSF- 010

TASK	HAZARD	CAUSE	RISK			CONTROL MEASURES
			Chance	Impact	Risk Rating	
General survey	Hit by vehicles	Traffic	L	H	M	- Refer to Standard Work Practice for Traffic Control (SWP-18002). - Refer to Standard Work Practice for Vests (SWP-18006). - Ensure flashing lights are available on vehicles and working correctly. - When work is being undertaken on roads, use a traffic observer / lookout person. - Ensure safe sight distances are maintained in accordance with Table 9.1 Section 9 of RTA Traffic Control at Works Sites Manual. - Where traffic is required to be stopped or where suitable gaps in traffic are infrequent, ensure ticketed traffic controllers are used.
	Electrocution	Working near overhead power lines / underground assets	L	H	M	- Ensure the location of overhead power lines are noted before commencing survey. - Note the location of underground services. - Refer to 'Take 5' Card to identify potential hazards.
Plant Operations	Electrocution	Contact overhead power lines	H	H	H	Complete site check list on SRA-200 "Work near Power lines" if working near power lines. Reassess each time (redo SRA-200) when job/task/ plant onsite significantly changes. Ensure two accredited, trained staff are onsite One observer and one operator for each working item of plant in accredited person zone. Note: One observer may be the supervisor
	Needle stick injury	Contact with needles / syringes	L	H	M	- Consider the use of PPE, such as needle resistant gloves. - Carry needle kits in vehicle. - Refer to Standard Work Practice for Syringes and Needles (SWP-18009).
	Manual handling	Carrying instruments / heavy objects Lifting Pit Lids	H	L	M	- Ensure correct manual handling techniques are followed. - Refer to Standard Work Practice for Manual Handling (SWP-18008). - Use mechanical lifting devices where appropriate.
	Bites	Bites from snakes, spiders etc.	L	H	M	- Ensure there is a first aid kit / snake bite kit available in vehicle or on person. - Ensure there are adequate communications with others available (e.g. mobile phone).
	Sprains and strains	Walking on uneven ground	M	M	M	- Ensure appropriate footwear is being worn by staff.

Risk Rating Priority:

High Risk *– It is* ***extremely important*** *to do something about this hazard* ***immediately***
Medium Risk *– It is* ***important*** *to do something about this hazard* ***as soon as possible***
Low Risk *– Do something when possible.*

Chance \ Impact	Low	Med	High
Low	L	L	M
Med	L	M	H
High	M	H	H

Control Measures:

- How can you reduce the ***frequency*** *of contact with the hazard?*
- How can you reduce the ***duration*** *of exposure to the hazard?*
-How can you reduce the ***severity*** *of the hazard?*

TAMWORTH REGIONAL COUNCIL **Standard Risk Assessment *SF321***

TASK	HAZARD	CAUSE	RISK			CONTROL MEASURES
			Chance	Impact	Risk Rating	
	Exposure	Exposure to weather conditions	H	M	H	- Ensure appropriate PPE is being worn - e.g. hat, sunscreen, long sleeves, sunglasses etc. - Refer to Standard Work Practice for Personal Protective Equipment (SWP-18051).
	Bites / injuries	Dogs	L	M	L	- Where possible, contact owner prior to commencing work. - Do not enter properties where dogs may be a threat.
Working in remote locations	Working in isolation	Injury while working alone	H	H	H	- Ensure there is a first aid kit available. - Ensure there are adequate communications with others available (e.g. mobile phone). - Refer to Standard Work Practice for Working Alone (SWP-18053).
Installation of flow meters in sewer	Asphyxiation	Fumes from sewer	M	H	H	- Ensure staff are trained and ticketed in working in confined spaces. - Ensure a Confined Space Entry Permit is completed prior to undertaking task. - Refer to Standard Work Practice for Confined Spaces (SWP-18001).
	Back injuries	Lifting lids Installing flow meters	L	M	L	- Ensure correct manual handling techniques are followed. - Refer to Standard Work Practice for Manual Handling (SWP-18008). - Use mechanical lifting devices where appropriate.
	Falls	Falling into manholes	L	M	L	- Safety harness equipment to be worn if working in manhole or around open manhole. - Ensure manhole is barricaded / fenced off if left unattended.
	Falling objects	Objects falling into manhole	L	H	M	- Ensure all objects are kept away from manhole entrance. - Ensure appropriate PPE is being worn when working below others - e.g. hardhat.
Collection of GPS co-ordinates & Inspection of water and sewer assets	Bites	Snakes	L	H	M	- Ensure there is a first aid kit / snake bite kit available in vehicle or on person. - Ensure there are adequate communications with others available (e.g. mobile phone).
	Bites/injuries	Dogs	L	M	L	- Where possible, contact owner prior to commencing work. - Do not enter properties where dogs may be a threat.
	Manual handling	Lifting pit lids	M	M	M	- Ensure correct manual handling techniques are followed. - Refer to Standard Work Practice for Manual Handling (SWP-18008). - Use mechanical lifting devices where possible.

Risk Rating Priority:

High Risk *– It is* ***extremely important*** *to do something about this hazard* ***immediately***
Medium Risk *– It is* ***important*** *to do something about this hazard* ***as soon as possible***
Low Risk *– Do something when possible.*

Chance \ Impact	Low	Med	High
Low	L	L	M
Med	L	M	H
High	M	H	H

Control Measures:

- How can you reduce the ***frequency*** *of contact with the hazard?*
- How can you reduce the ***duration*** *of exposure to the hazard?*
-How can you reduce the ***severity*** *of the hazard?*

TAMWORTH REGIONAL COUNCIL **Standard Risk Assessment *SF321***

TASK	HAZARD	CAUSE	RISK			CONTROL MEASURES
			Chance	Impact	Risk Rating	
	Physical / verbal abuse or threatening behaviour	Irate / abusive landholders	M	M	M	- Where possible, contact the landholder before entering premises. - Ensure staff are wearing / carrying Council identification. - Leave premises immediately if landholder becomes irate.
	Hit by vehicles	Traffic	L	H	M	- Refer to Standard Work Practice for Traffic Control (SWP-18002). - Refer to Standard Work Practice for Vests (SWP-18006). - Ensure flashing lights are available on vehicles and working correctly. - When work is being undertaken on roads, use a traffic observer / lookout person. - Ensure safe sight distances are maintained in accordance with Table 9.1 Section 9 of RTA Traffic Control at Works Sites Manual. - Where traffic is required to be stopped or where suitable gaps in traffic are infrequent, ensure ticketed traffic controllers are used.

APPENDIX C – Completed Sewer CCTV and Rehabilitation

Table A-1 Tamworth Regional Council Completed Sewer CCTV and Rehabilitation

Category	Network Location	Pipe Diameter	Pipe Count	Network Length (km)	Network Length (%)	CCTV Length (km)	CCTV (%)	Pipe burst (km)	Pipe burst (%)	Reline-CIPP (km)	Reline -CIPP (%)	Reline -Other (km)	Reline-Other(%)	Total Rehabilitated Length (km)	Total Rehabilitated Length (%)
Sewer - Gravity Mains	Barraba	150	374	17.95	3.8	16.554	92.2%	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
Sewer - Gravity Mains	Barraba	225	17	1.01	.2	0.341	33.8%	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
Sewer - Gravity Mains	Barraba	300	24	1.48	.3	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
Sewer - Gravity Mains	Barraba	450	6	.47	.1	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
	Total			**20.91**	**4.4**	**16.895**	**80.80%**	**0**	**0.00%**	**0**		**0**		**0**	
Sewer - Gravity Mains	Kootingal	150	240	13.46	2.8	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
Sewer - Gravity Mains	Kootingal	225	51	3.16	.7	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
Sewer - Gravity Mains	Kootingal	300	5	.24	.1	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
Sewer - Gravity Mains	Kootingal	375	1	.02	0	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
	Total			**16.88**	**3.6**	**0**									
Sewer - Gravity Mains	Manilla	150	508	27.22	5.7	20.000	73.5%	0.000	0.0%	4.312	15.8%	0.000	0.0%	4.312	15.8%

Table A-1 Tamworth Regional Council Completed Sewer CCTV and Rehabilitation

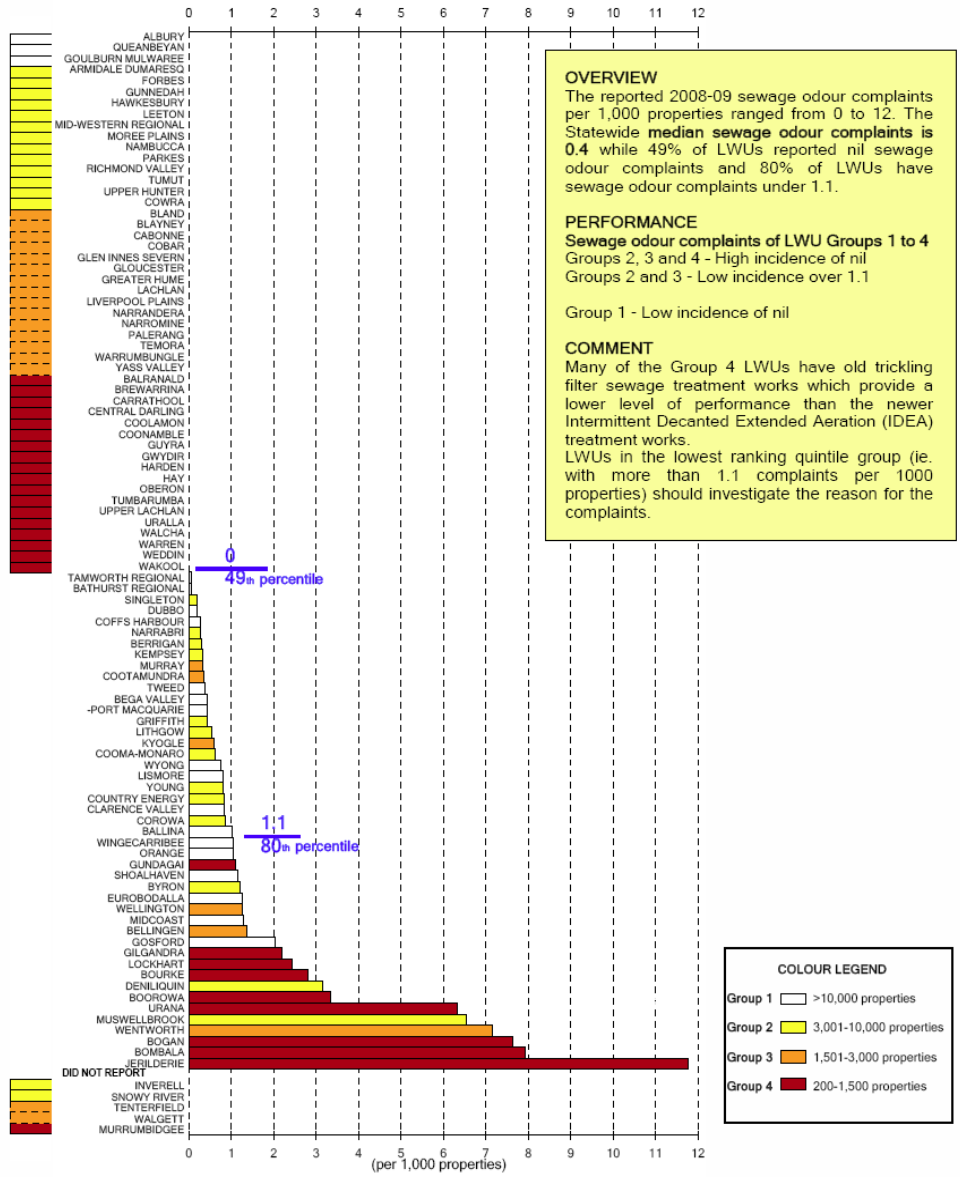
Category	Network Location	Pipe Diameter	Pipe Count	Network Length (km)	Network Length (%)	CCTV Length (km)	CCTV (%)	Pipe burst (km)	Pipe burst (%)	Reline-CIPP (km)	Reline -CIPP (%)	Reline -Other (km)	Reline-Other(%)	Total Rehabilitated Length (km)	Total Rehabilitated Length (%)
Sewer - Gravity Mains	Manilla	225	10	.57	.1	0.541	94.9%	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
Sewer - Gravity Mains	Manilla	300	23	1.33	.3	1.327	99.7%	0.000	0.0%	1.327	99.7%	0.000	0.0%	1.327	99.7%
Sewer - Gravity Mains	Manilla	375	3	.15	0	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
	Total			**29.27**	**6.1**	**21.868**				**5.639**	**19.3%**	**0.000**	**0.0%**	**5.638751**	**19.3%**
Sewer - Gravity Mains	Tamworth	1050	12	1.81	.4	0.000	0.0%	0.000	0.0%		0.0%	0.000	0.0%	0.000	0.0%
Sewer - Gravity Mains	Tamworth	150	7813	334.61	70.2	117.366	35.1%	3.318	1.0%	21.001	6.3%	29.128	8.7%	53.782	16.1%
Sewer - Gravity Mains	Tamworth	225	503	27.94	5.9	12.065	43.2%	0.415	1.5%	2.432	8.7%	2.818	10.1%	5.665	20.3%
Sewer - Gravity Mains	Tamworth	300	264	15.03	3.2	6.558	43.6%	0.231	1.5%	0.470	3.1%	2.160	14.4%	2.860	19.0%
Sewer - Gravity Mains	Tamworth	375	99	5.86	1.2	0.923	15.8%	0.000	0.0%	0.000	0.0%	0.867	14.8%	0.867	14.8%
Sewer - Gravity Mains	Tamworth	450	164	12.49	2.6	6.706	53.7%	0.000	0.0%	1.110	8.9%	2.483	19.9%	3.593	28.8%
Sewer - Gravity	Tamworth	525	74	6.75	1.4	5.430	80.4%	0.000	0.0%	0.000	0.0%	2.046	30.3%	2.046	30.3%

Table A-1 Tamworth Regional Council Completed Sewer CCTV and Rehabilitation

Category	Network Location	Pipe Diameter	Pipe Count	Network Length (km)	Network Length (%)	CCTV Length (km)	CCTV (%)	Pipe burst (km)	Pipe burst (%)	Reline-CIPP (km)	Reline -CIPP (%)	Reline -Other (km)	Reline-Other(%)	Total Rehabilitated Length (km)	Total Rehabilitated Length (%)
Mains															
Sewer - Gravity Mains	Tamworth	600	4	.64	.1	0.644	100.6%	0.000	0.0%	0.000	0.0%	0.135	21.1%	0.135	21.1%
Sewer - Gravity Mains	Tamworth	625	8	.75	.2	0.738	98.4%	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
Sewer - Gravity Mains	Tamworth	900	30	3.42	.7	3.231	94.5%	0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
	Total			**409.3**	**85.9**	**153.661**	**37.5%**	**3.963**	**1.0%**	**25.013**	**6.1%**	**39.637**	**9.7%**	**68.948**	**16.8%**

APPENDIX D – Results of Benchmarking in Relation to Sewer Reporting for 2009

Figure 7: Odour Complaints - Sewerage 2008-09

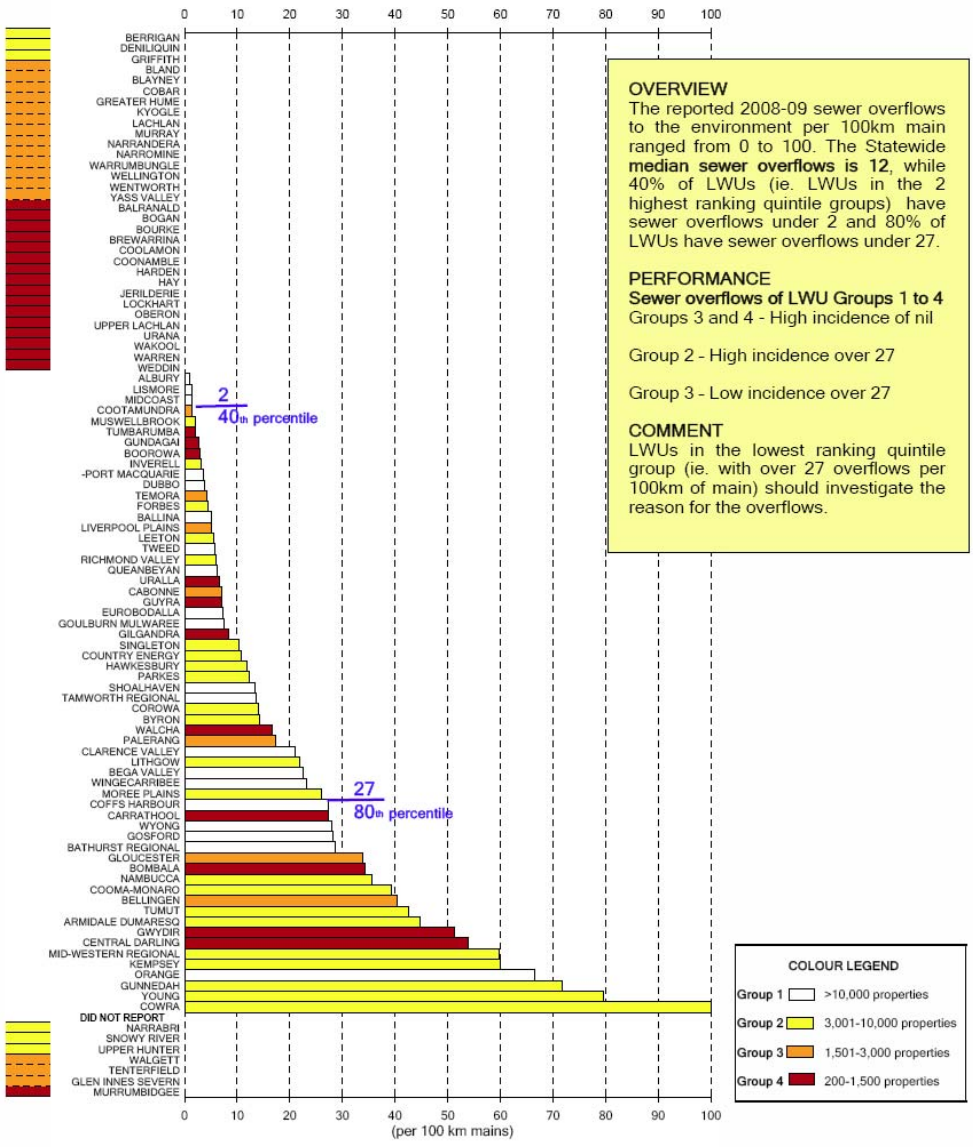


Parameter: $\frac{\text{Number of odour complaints from sewerage treatment works and pumping stations (ST39) x 1,000}}{\text{No. connected properties}}$

Notes:

1. This figure shows ranked values of the 2008-09 number of sewage odour complaints per 1000 connected properties for each Local Water Utility (LWU) in 4 groups, based on the number of connected properties served - over 10,000 (Group 1), 3,001 to 10,000 (Group 2), 1,501 to 3,000 (Group 3) and 200 to 1,500 (Group 4).
2. Refer also to page 7.
3. For general notes see page 23.

Figure 11: Sewer Overflows to the Environment - Sewerage 2008-09



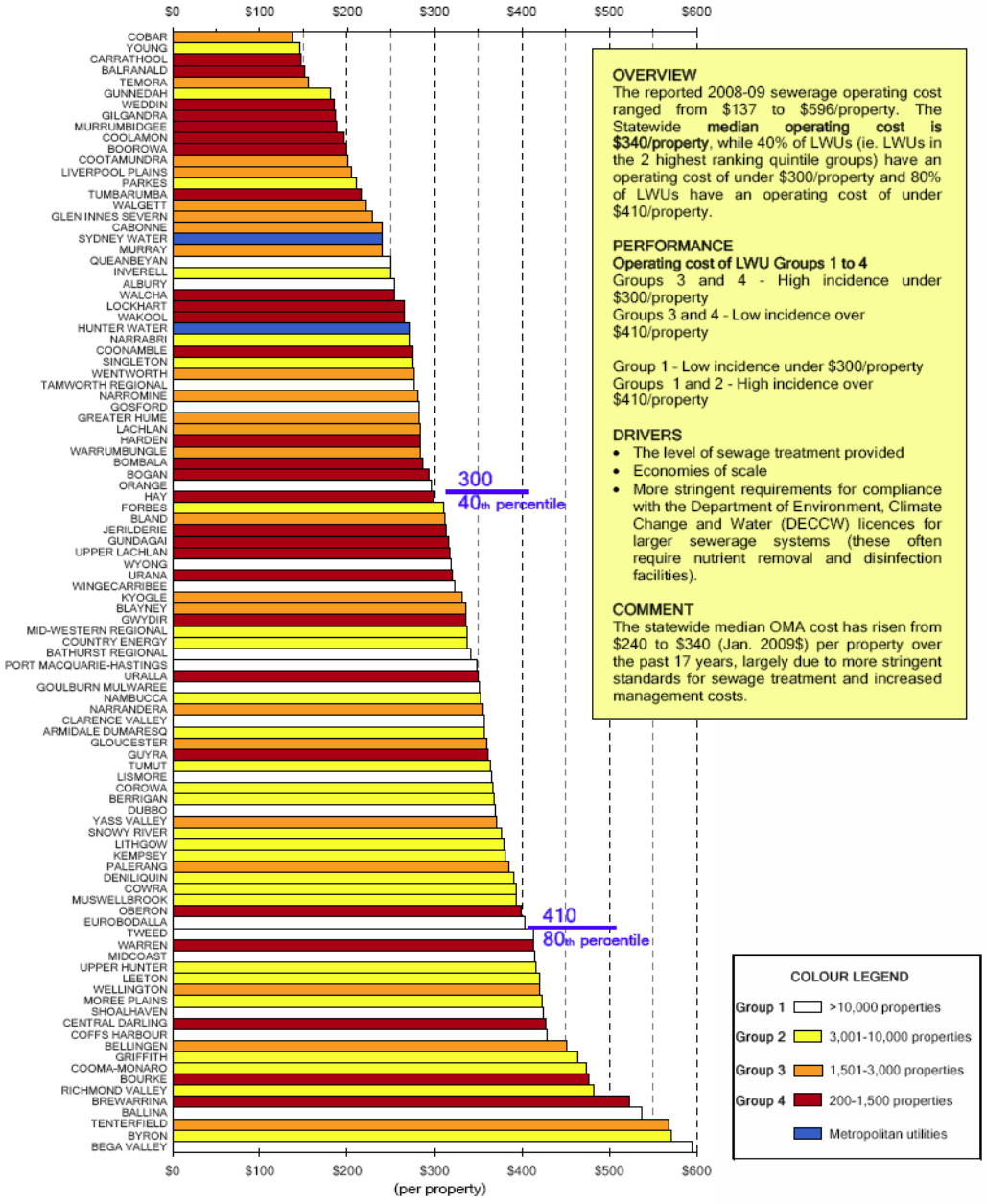
Parameter:

$$\frac{\text{Total number of sewer overflows (S53) x 100}}{\text{Length of reticulation/gravity mains (S7) + Length of rising/pressure mains (S8)}}$$

Notes:

1. This figure shows ranked values of the 2008-09 sewer overflows to the environment for each Local Water Utility (LWU) in 4 groups, based on the number of connected properties served - over 10,000 (Group 1), 3,001 to 10,000 (Group 2), 1,501 to 3,000 (Group 3) and 200 to 1,500 (Group 4).
2. For general notes see page 23.

Figure 16: Operating Cost (OMA) per property - Sewerage 2008-09

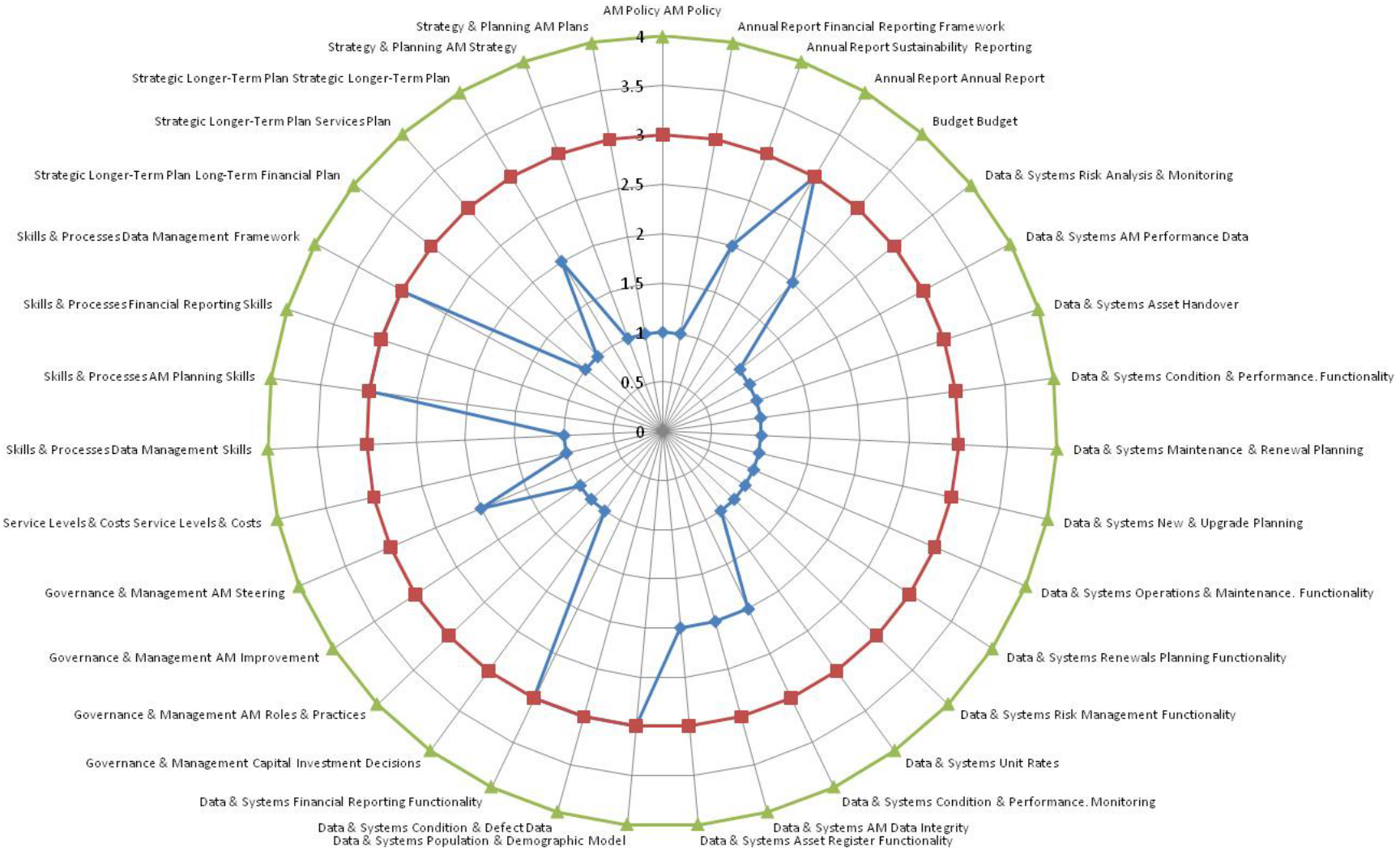


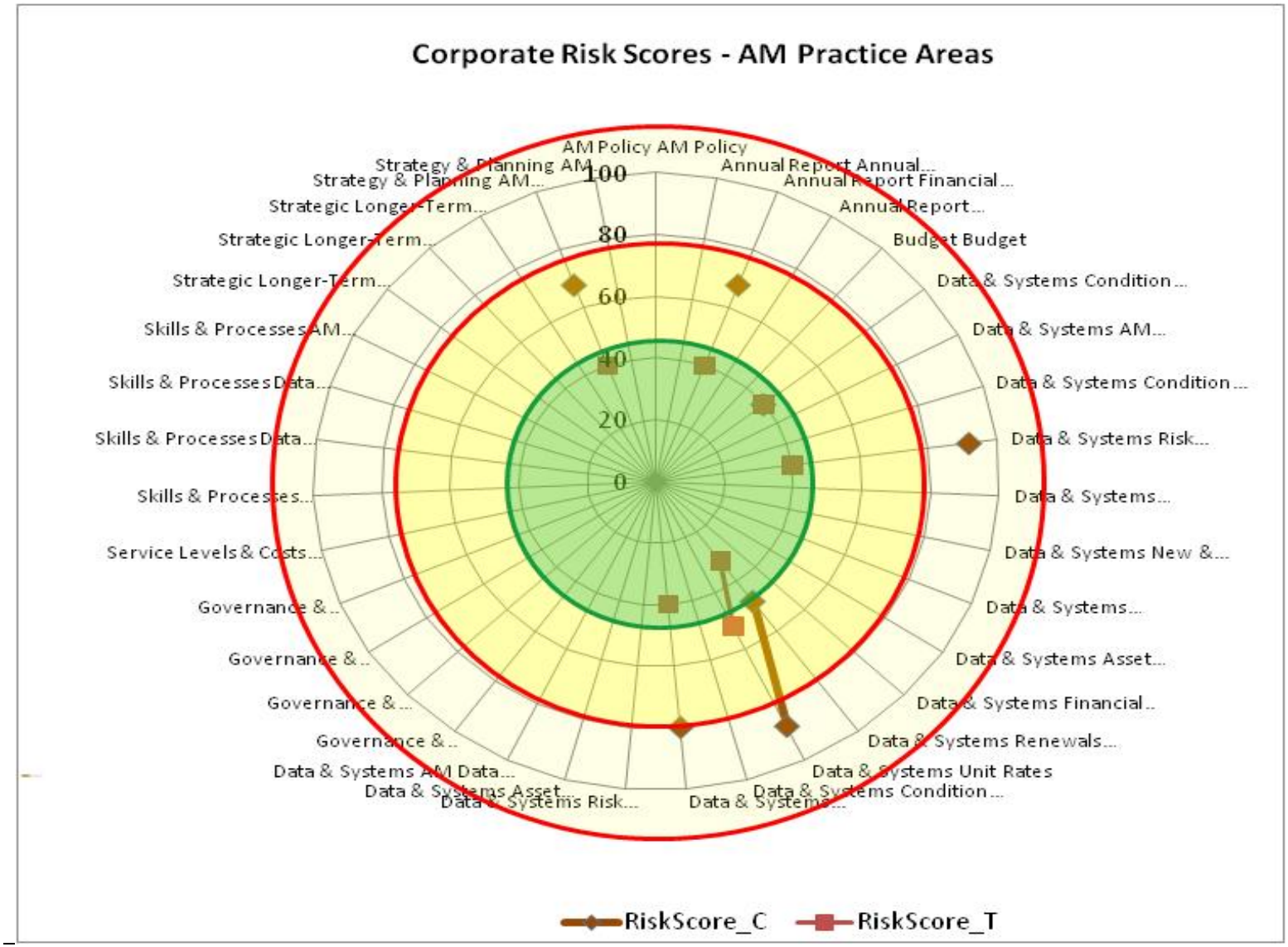
Parameter: $\frac{\text{Management expenses (S1) + Total operation expenses (S2) - Purchase of water + Bulk supplier's OMA}}{\text{No. connected properties}}$

Notes:

1. This figure shows ranked values of the 2008-09 sewerage operating cost (OMA - operation, maintenance and administration) per property for each Local Water Utility (LWU) in 4 groups, based on the number of connected properties served - over 10,000 (Group 1), 3,001 to 10,000 (Group 2), 1,501 to 3,000 (Group 3) and 200 to 1,500 (Group 4). The metropolitan water utilities (Sydney Water Corporation and Hunter Water Corporation) are shown in blue.
2. Refer also to pages 11 and 14.
3. For general notes see page 23.

APPENDIX E – Results of Corporate Management Review


AM Policy AM Policy
Annual Report Financial Reporting Framework
Annual Report Sustainability Reporting
Annual Report Annual Report
Budget Budget
Data & Systems Risk Analysis & Monitoring
Data & Systems AM Performance Data
Data & Systems Asset Handover
Data & Systems Condition & Performance. Functionality
Data & Systems Maintenance & Renewal Planning
Data & Systems New & Upgrade Planning
Data & Systems Operations & Maintenance. Functionality
Data & Systems Renewals Planning Functionality
Data & Systems Risk Management Functionality
Data & Systems Unit Rates
Data & Systems Condition & Performance. Monitoring
Data & Systems AM Data Integrity
Data & Systems Asset Register Functionality
Data & Systems Population & Demographic Model
Data & Systems Condition & Defect Data
Data & Systems Financial Reporting Functionality
Governance & Management Capital Investment Decisions
Governance & Management AM Roles & Practices
Governance & Management AM Improvement
Governance & Management AM Steering
Service Levels & Costs Service Levels & Costs
Skills & Processes Data Management Skills
Skills & Processes AM Planning Skills
Skills & Processes Financial Reporting Skills
Skills & Processes Data Management Framework
Strategic Longer-Term Plan Long-Term Financial Plan
Strategic Longer-Term Plan Services Plan
Strategic Longer-Term Plan Strategic Longer-Term Plan
Strategy & Planning AM Strategy
Strategy & Planning AM Plans
4
3.5
3
2.5
2
1.5
1
0.5
0


Corporate Risk Scores - AM Practice Areas
100
80
60
40
20
0
AM Policy AM Policy
Annual Report Annual...
Annual Report Financial...
Annual Report...
Budget Budget
Data & Systems Condition...
Data & Systems AM...
Data & Systems Condition...
Data & Systems Risk...
Data & Systems...
Data & Systems New &...
Data & Systems...
Data & Systems Asset...
Data & Systems Financial...
Data & Systems Renewals...
Data & Systems Unit Rates
Data & Systems Condition...
Data & Systems...
Data & Systems Risk...
Data & Systems Asset...
Data & Systems AM Data...
Governance &...
Governance &...
Governance &...
Governance &...
Governance &...
Service Levels & Costs...
Skills & Processes...
Skills & Processes Data...
Skills & Processes Data...
Skills & Processes AM...
Strategic Longer-Term...
Strategic Longer-Term...
Strategic Longer-Term...
Strategy & Planning AM...
Strategy & Planning AM...
RiskScore_C
RiskScore_T

APPENDIX F– NAMS.PLUS Gap Analysis Scorecard Template

F.1 Stewardship

F.2 Asset Management Planning

F.3 Financial Planning

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Question	Capability Levels	Desired Capability	Present Capability	Importance
Asset Management Policy				
Does your council have an adopted AM Policy?	1. No, not planned 2. Planned in next 12 months 3. Under development 4. Developed, not adopted by council 5. Yes			
Asset Management Strategy				
Does your council have an adopted AM Strategy?	1. No, not planned 2. Planned in next 12 months 3. Under development 4. Developed, not adopted by council 5. Yes			
Risk Management Process				
Does you council have a system for managing asset related risks either as part of a corporate risk management system or within an AMP for Road Assets?	1. No, not planned 2. Planned in next 12 months 3. Under development 4. Developed, not adopted by council 5. Yes			
As above for Building Assets				
As above for Parks/Recreation Assets				
As above for Water/Sewer/CWMS Assets				
As above for Drainage Assets				
Accountability and Responsibility for Asset Management				
Does your council have a cross-functional approach to asset management?	1. No, not planned 2. Planned in next 12 months 3. Under development 4. For some asset categories 5. Yes, for all asset categories			
Does your council's Executive Management Team consider AM issues at the corporate level?				
What is the primary role of your council's Asset Management Team?	1. No AM Team 2. Capital works prioritisation for some/all services 3. Capital program management for some/all services 4. Coordination of lifecycle AM activities for some services 5. Coordination of lifecycle AM activities for all services			
At what level are outcomes of the AMT accepted?	1. No AM Team 2. AM Team planned in 12 months 3. Specialist Officer 4. Department Head 5. Executive Management Team/CEO			
Does your council's Audit Committee consider AM issues?	1. No Audit Committee 2. Audit Committee planned in 12 months 3. Reporting as required 4. Regular meeting agenda item 5. Audit Committee considers sustainability indicators			
Are AM accountabilities and responsibilities defined in managers' position statements?	1. No 2. Planned in 12 months 3. Being developed 4. In Managers' position statements 5. CEO's pos. statements includes indicators for maintenance of appropriate assets to provide services			
Sustainability Reporting				
Does your council report on its financial sustainability?	1. No sustainability indicators developed 2. Sustainability indicators planned in 12 months 3. Sustainability indicators developed 4. Sustainability reported as required 5. Sustainability reported in Annual Reports			

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Question	Capability Levels	Desired Capability	Present Capability	Importance
Asset Identification and Reporting				
Does your council identify and record assets at the 'component' level for Road Assets for valuation and depreciation purposes? **Note:** Components for road assets are sealed surfacing, pavement (layers) K&G (x2), footpaths (x2), earthworks/formation (if required) within road segment ~200m urban, 0.5 - 5-10 km rural	1. No, assets recorded at network level (eg road network) 2. No, assets recorded at 'major' asset level (eg individual road/street) 3. No, assets recorded at 'segment' asset level (eg road ~200m - 5-10km length)? 4. Assets recording at component planned within 12 months 5. Yes, assets identified and recorded at component level.			
As above for Building Assets **Note:** Components for buildings assets are structure, mech/elect plant, fitout, etc where material	1. No, assets recorded at category level (eg all buildings) 2. No, assets recorded at sub-category asset level (eg all public halls) 3. No, assets recorded individual building level 4. Asset recording at component level planned within 12 months 5. Yes, assets identified and recorded at component level.			
As above for Parks/Recreation Assets **Note:** Components for parks/rec'n, assets are surface type, playground item, structure, etc, where above capital threshold	1. No, assets recorded at category level (eg all parks) 2. No, assets recorded at sub-category asset level (eg all passive parks) 3. No, assets recorded individual park level 4. Asset recording at component level planned within 12 months 5. Yes, assets identified and recorded at component level.			
As above for Water/Sewer/CWMS Assets **Note:** Components for Water/Sewer/CWMS assets are pipe reach (up to ~100m), pump station civil works, individual pumps, switchboards, etc, where above capital threshold	1. No, assets recorded at category level (eg all drainage schemes) 2. No, assets recorded at sub-category asset level (eg 100mm dia pipes, pump stations by size) 3. No, assets recorded at sub-category level for individual drainage schemes) 4. Asset recording at component level planned within 12 months 5. Yes, assets identified and recorded at component level.	4	4	Important
As above for Drainage Assets **Note:** Components for drainage assets are pipe reach between pits, pits structures, access points where above capital threshold	1. No, assets recorded at category level (eg all drainage assets) 2. No, assets recorded at sub-category asset level (eg 375mm dia pipes, pump station by size) 3. No, assets recorded at sub-category level for individual Water/Sewer/CWMS schemes) 4. Asset recording at component level planned within 12 months 5. Yes, assets identified and recorded at component level.			
Where is this asset data held?	1. No asset register 2. Hard copy 3. Technical asset register 4. Financial asset register supported by technical asset register(s) 5. One asset register serving financial & technical uses	4	3	Important
Asset Data Maintenance				
How current is your asset data?	1. Asset register > 5 years out of date 2. Asset register > 2 years out of date 3. Asset register > 1 year out of date 4. Asset register updated annually 5. Asset register updated monthly/continuously	4	4	
Does your council have a documented work procedure for asset register maintenance?		4	3	

Does your council have a documented work procedure for recognising and capitalising new and donated assets?	1. No 2. Planned in 12 months 3. Being developed 4. Yes 5. Yes and operates as scheduled	4	2	
Does your council have a documented process for reviewing useful lifes of assets?		4	2	
Has a council officer been allocated responsibility for maintaining Council's asset register?	1. No 2.Updating done by several staff members as required 3. Updating done by one staff member 4. Yes, included in a staff position statement 5. Yes, staff member is competent in role	4	4	
Does the responsible council officer have the time and resources to maintain the asset register?	1. No 2. Updates are always delayed 3. Updates are sometimes delayed 4. Updates are carried out to schedule 5. Currency of asset register is verified monthly	4	2	
Asset Condition Data				
Do you have condition data for Road Assets?	1. No, no condition data 2. Condition data for < 50% of assets 3. Condition data for > 50% of assets 4. Rolling program of condition assessment 5. Annual condition assessment			
As above for Building Assets				
As above for Parks/Recreation Assets				
As above for Water/Sewer/CWMS Assets		4	4	
As above for Drainage Assets				
Risk Management				
Does your council have a current listing of asset related risks and risk management treatments linked to capital and maintenance programs for Road Assets?	1. No 2. Planned in 12 months 3. Being developed 4. Risks assessed and risk treatments identified 5. Yes, linked to maintenance & capital works programs			
As above for Building Assets				
As above for Parks/Recreation Assets				
As above for Water/Sewer/CWMS Assets				
As above for Drainage Assets				
Relating Service Levels to Costs of Delivery				
Does your council know the life cycle costs of services provided using Road Assets?	1. No 2. Planned in 12 months 3. Being developed 4. Yes for some services 5. Yes, for all services			
As above for Building Assets				
As above for Parks/Recreation Assets				
As above for Water/Sewer/CWMS Assets				
As above for Drainage Assets				
Future Demand Impacts				
Has your council identified future demands and impacts on service delivery for Roads?	1. No 2. Planned in 12 months 3. Being developed 4. Yes for some services 5. Yes, for all services			
As above for Building Assets				
As above for Parks/Recreation Assets				
As above for Water/Sewer/CWMS Assets				
As above for Drainage Assets				
Asset Management Plans				
Has your council an adopted asset management plan for Roads?	1. No 2. Planned in 12 months 3. Being developed 4. Developed but not adopted by Council 5. Yes			
As above for Building Assets				
As above for Parks/Recreation Assets				
As above for Water/Sewer/CWMS Assets				
As above for Drainage Assets				

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Question	Capability Levels	Desired Capability	Present Capability	Importance
Consideration of Life Cycle Costs in Investment Decisions				
Does your council break up capital expenditures into capital renewal, capital upgrade and capital expansion?	1. No 2. Planned in 12 months 3. Being developed 4. Yes for some expenditure categories 5. Yes, for all expenditure categories	4	2	Important
Does your council receive and consider life cycle cost information in decisions relating to new/upgrade services and assets?	1. No 2. Planned in 12 months 3. Being developed 4. Yes for some services & assets 5. Yes, for all services & assets	4	2	Important
Revaluation Process				
How does your council do its asset revaluations for infrastructure assets (other than buildings)?	1. Values held at 'cost'. No revaluations 2. Revaluations done by external valuer 3. Revaluations done part by external valuer and part by council staff 4. Revaluations done by council staff 5. Revaluations done by council staff and verified by external source	4	4	Important
What is your council's revaluation frequency for assets?	1. Values held at 'cost'. No revaluations 2. 5 year revaluation cycle 3. 3 year revaluation cycle 4. 2 year revaluation cycle 5. Annual revaluation cycle	4	2	Important
Reporting Asset Consumption Against Service Delivery				
Does your council report asset consumption as an operating expense against the relevant service activity?	1. No, reported as corporate overhead expense 2. Planned within 12 months 3. Being developed 4. Yes for some service activities 5. Yes for all service activities	4	2	Important
Long Term Financial Plans				
What is the length of your council's long term financial plan?	1. 1 year 2. 2 - 3 years 3. 5 years 4. 10 years 5. 10+ years	4	4	Important
Long Term Financial Plans Include Projected Asset Renewals (Not Depreciation)				
Does your council's LTFP include asset renewals?	1. No 2. Planned in 12 months 3. Being developed 4. Includes renewals for some service activities 5. Includes renewals for all service activities	4	3	Important
Long Term Financial Plans Include Growth and Upgrade of Services				
Does your council's LTFP include provision for network growth and upgrade of services?	1. No 2. Planned in 12 months 3. Being developed 4. Includes growth and upgrade for some service activities 5. Includes growth and upgrade for all service activities	4	3	Important
Long Term Financial Plans Include Life Cycle Costs for New Assets and Services				
Does your council's LTFP include provision for future operating expenses associated with new assets and services?	1. No 2. Planned in 12 months 3. Being developed 4. Includes operating expenses for some new assets and services	4	3	Important

APPENDIX G–Asset Condition Assessment Forms

G.1 Sewer Manhole Inspection Sheet

G.2 Sewer Vent Inspection Sheet

G.3 Sewer Pipe CCTV Inspection Sheet

Sewer Manhole Inspection Sheet				
Manhole No	MH		Date Inspected	
Address			Inspected By	
Location	☐ Backyard	☐ Road	☐ Foot path	☐ Other
Site Access to Manhole	☐ Easy	☐ Fair	☐ Difficult	☐ None
Access Comments:				
Shape	☐ Circle		☐ Square	
Manhole Cover				
Material	☐ Concrete	☐ Cast Iron	☐ Other	
Lift Type	☐ Twin Lift	☐ Centre Lift	☐ Gattic	
Size	(mm)			
Condition	☐ Good	☐ Fair	☐ Poor	
Lid Surface Level	☐ Level	☐ Above (mm)	☐ Below (mm)	
Manhole Construction				
Material	☐ Insitu Concrete ☐ Precast Concrete Components ☐ Brick		☐ Fibreglass ☐ Polyethylene (PE) ☐ Other	
Access Equipment				
Access Type	☐ Steel Step	☐ PVC Step	☐ Ladder	☐ None
Condition	☐ Good	☐ Fair	☐ Poor	
Comments:				

Manhole Internal Condition Assessment			
Cracked	Fractured	Surface Damage	Displaced
Obstruction	Debris	Roots %	Corrosion %
Other:			
Comments:			

Sketch if Different to Plans			
Pipe	Diameter	Size	Vert Dist
Outlet			
Inlet1			
Inlet2			
Inlet3			
Inlet4			

Sewer Vent Inspection Sheet				
Vent No:	Date Inspected:			
Address:	Inspected By:			
Location	☐ Rear Yard	☐ Front Yard	☐ Road Reserve	☐ Other
Access to Vent:	☐ Easy	☐ Fair	☐ Difficult	☐ None
Access Issues:	☐ Power Lines	☐ Vegetation	☐ Infrastructure	☐ Other
Access Comments:				
Vent Details				
Material	☐ Concrete	☐ Cast Iron	☐ Galvanised	
	☐ Asbsetos Cement	☐ Stainless/Painted	☐ Other	
Base Diameter	**(mm)**	**Top Diameter**	**(mm)**	
Condition Rating 5 = Urgent – Add to current rehabilitation program, ***Condition Rating 4 = High Priority- Include in next program or alternative to current program*** ***Condition Rating 3 = Medium Priority -Reinspect in 3-5 years*** ***Condition Rating 2 = Low Priority – Reinspect in 5-10 years*** ***Condition Rating 1 = New Condition – No further action required***				
Structural Score ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5				
Damage Type: ☐ Cracking ☐ Corrosion ☐ Vegetation ☐ Unlevel				
Comments:				
Base Details				
Structural Score ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	**Comment**:			

Sewer Pipe CCTV Inspection Sheet				
Asset No:	Requested By:			
Address:	Date Inspected:			
	Inspected By:			
Reason for Inspection	☐ Customer Complaint	☐ Overflow	☐ Quality Control	☐ Development Application
	☐ Other	Comments:		
Date Inspected:		Inspected By		
Cleaning Details	☐ None	☐ Cleaned (Jet)	☐ Root Cut	☐ Other
Cleaning Comments:				
Pipe Details				
Material	☐ Concrete	☐ Cast Iron	☐ Vitrified Clay	
	☐ Asbestos Cement	☐ PVC	☐ Other:	
Diameter	**(mm)**	**Drop Structure** ☐ Yes		
Condition Rating 5 = Urgent Rehab Required - Example collapsed main, holes in pipe, sections missing. ***Condition Rating 4 = High Priority- Include in next rehab program - Example severe cracking, major aggregate exposure.*** ***Condition Rating 3 = Medium Priority -Rehab in 3-5 years – Example minor cracking or root infiltration, minor aggregate exposure.*** ***Condition Rating 2 =Low Priority – Reinspect in 5-10 years*** ***Condition Rating 1 = New Condition – No further action required***				
Structural Score ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5				
Damage Type: ☐ Cracking ☐ Corrosion ☐ Roots ☐ Collapse ☐ Poor Workmanship ☐ Dropped Pipe ☐ Other				
Comments: **CCTV File Name (As saved on harddrive) =**				
Proposed Pipe Rehab				
☐ None ☐ Clean ☐ Rootcut ☐ Rootfoam ☐ Section Repair ☐ Reline ☐ Pipeburst ☐ Other				
Comments:				
Date Rehab Completed:	Completed By			
Junction Details				
Junction Problems (Identify any Junctions with problems):				
Proposed Rehab: ☐ None ☐ Clean ☐ Rootcut ☐ Rootfoam ☐ Repair ☐ Other				

APPENDIX H– 3 Year Sewer Asset Management Plan

INTRODUCTION

This sewer asset management plan allocates budget for sewer renewal work for a three year period for the following financial years;

1. 2010-2011
2. 2011-2012
3. 2012-2013

The management plan considers only contractual work to be completed by Council and does not consider maintenance work to be completed 'in house' by Council staff.

It is recommended that 6 monthly reviews of the program be completed by the responsible Council staff to ensure timeframes objectives can be achieved. A summary of the work included in the program is detailed below.

Project Number	Description	Start Date	End Date	Total Cost ($)
2010-2011 Financial Year				
1	Clean & CCTV DN150, DN225 & DN 300 Sewer mains	June 2010	October 2010	$250,000
2	Manhole Rehabilitation	Early 2011	Mid 2011	$50,000
3	Sewer Main Pipe Bursting (Tamworth/Manilla)	November 2010	February 2011	$500,000
4	Sewer Main Relining (Tamworth)	March 2011	June 2011	$450,000
5	Sewer Main Relining (Barraba)	July 2010	October 2010	$800,000
			Total	**$2,050,000**
2011-2012 Financial Year				
6	Relining 300mm carrier main at Barraba			$200,000
7	Replacement of sewer vents (Tamworth, Manilla and Barraba)			$150,000
8	Condition assessment of large diameter sewer mains (Tamworth)			$300,000

			Total	**$650,000**
2012-2013 Financial Year				
9	Clean & CCTV DN150, DN225 & DN 300 Sewer mains	August 2012	October 2012	$250,000
10	Rehabilitate Large Diameter Sewer Mains	August 2012	October 2012	$1,250,000
			Total	**$1,500,000**
			3 Year Total	**$4,200,000**

SEWER REHABILITATION PROGRAM BUDGET 2010/2011

Project 1

Contract – Clean and CCTV of DN150, DN225 & DN300 Sewer Mains

Location

Tamworth

Objective

Work will enable;

- Reticulated sewer network relining program to be developed and implemented prior to the end of the 2010.
- Identify any obvious sewer infiltration problems in known surcharging catchments. This will enable the next step in infiltration investigations i.e. a smoke testing program to check for storm water/ sewer connections.
- Preparation of a rehabilitation program for dead end sewer mains. This program will require a number of rehabilitation options (due to locations i.e. under structures) including reconstruction, realignment and relining. Any relining option will require the dead end to be converted to a manhole or dug for access prior to relining.

Description

Contract to CCTV approximately 35 kilometres of DN150, DN225 and DN300 sewer main. The Program will CCTV the following;

- Next stage of CCTV program in South Tamworth based on asset age and expected remaining life. This will cover most known sewer surcharge catchments observed during rainfall events.
- CCTV any outstanding catchments that are known to have sewer surcharge events.
- High risk areas downstream of sewer rising main discharge locations. In particular Nemingha and Armidale Road Sewer Pump Stations.

- Dead end mains that have had rehabilitation completed in vicinity but either have no camera work completed or have poor data. Most located in older sewer areas i.e. CBD, East and West.

Current Program Status

All CCTV contract work has been completed and supplied to Council from the Contractor. A review of this work is being completed and all asset information is currently being placed into the sewer CCTV and rehabilitation database.

Tender Release

April 2010

Start Date

June 2010

Work Period

16 weeks

Expected Completion October 2010

Costing

Contract has been awarded with an allocated budget of $250,000

Project 2

Contract – Rehabilitate Sewer Manholes by Insitu Methods

Location

Tamworth

Objectives

Work will;

- Restore structural integrity of severely corroded manholes without the need for excavations.
- Prevent future corrosion as rehabilitation material will be inert.

Description

A number of sewer manholes have been identified as having severe gas attack. To date approximately 20 manholes located near sewer pump main discharge points and industrial wastewater discharge sites have been identified as require repair to ensure future operation. At this stage it is believed that the majority of these assets can be renewed using insitu rehabilitation techniques.

Current Program Status

A technical specification is required to be developed for these works. The specification is to cover the differing levels of deterioration of the assets as the varying levels of asset deterioration will determine the required rehabilitation technique.

Expected Tender Release

Early 2011

Expected Start Date

Early- Mid 2011

Work Period

5 Weeks

Costing

As TRC has not completed this work previously no rates are available. Rates will vary depending on the method chosen for rehabilitation. A total budget has been established at $50,000.

Project 3

Contract – Rehabilitate and Upsize Sewer Mains by Pipe Bursting

Location

Tamworth/Manilla

Objectives

Work will;

- Restore structural integrity of severely deteriorated mains that cannot be relined.
- Increase capacity of existing sewer network.

Description

A review of previous relining contracts undertaken by Council and review of the sewer rehabilitation database has identified five lengths of DN150 main totalling 200m have been identified as not possible to reline.

Recent CCTV work has identified asbestos cement DN150 and DN 225 sewer mains of approximate total length of 800 metres are in poor condition. The mains are located downstream of an industrial discharge site and pipe bursting has been determined as the best rehabilitation method. This program will aim to upsize existing DN150 to DN225 to increase the sewer hydraulic capacity.

Current Program Status

Pipe bursting technical specification has been prepared. Decision on final asset listing and upsizing options is required.

Expected Tender Release

November 2010

Expected Start Date

February 2011

Work Period

Estimated 6 Weeks

Costing

$500,000

Project 4

Contract – Rehabilitate Sewer Mains by Insitu Relining

Location

Tamworth

Objectives

Work will;

- Renew structural and service condition of identified deteriorated mains.

Description

This project is dependent upon the outcomes of project one i.e. CCTV condition assessment of 35 kilometres of sewer mains. However, based on the asset condition age, material, location and previous condition assessment work it is expected 20% of the assets will require renewal. As such, it is estimated that the CCTV work completed for DN150 and DN225 will produce approximately 5 kilometres of work. It is expected that gravity mains (mainly asbestos) located downstream of pump main discharge points will require relining.

Current Program Status

CCTV is required prior to the contract document being prepared.

Expected Tender Release

December 2010

Expected Start Date

March 2010

Work Period

10 weeks

Costing

The following cost breakdown is based on average tender rates from recent relining contracts completed i.e. last 5 years.

Diameter	**Length(m)**	**Lining Rate ($)**	**Total ($)**
DN150	4000	$85	340,000
DN225	1000	$110	110,000
Total	**5000**		**450,000**

Project 5

Contract – Rehabilitate Sewer Mains by Insitu Relining

Location

Barraba

Objectives

Work will;

- Renew structural and service condition of identified deteriorated mains.

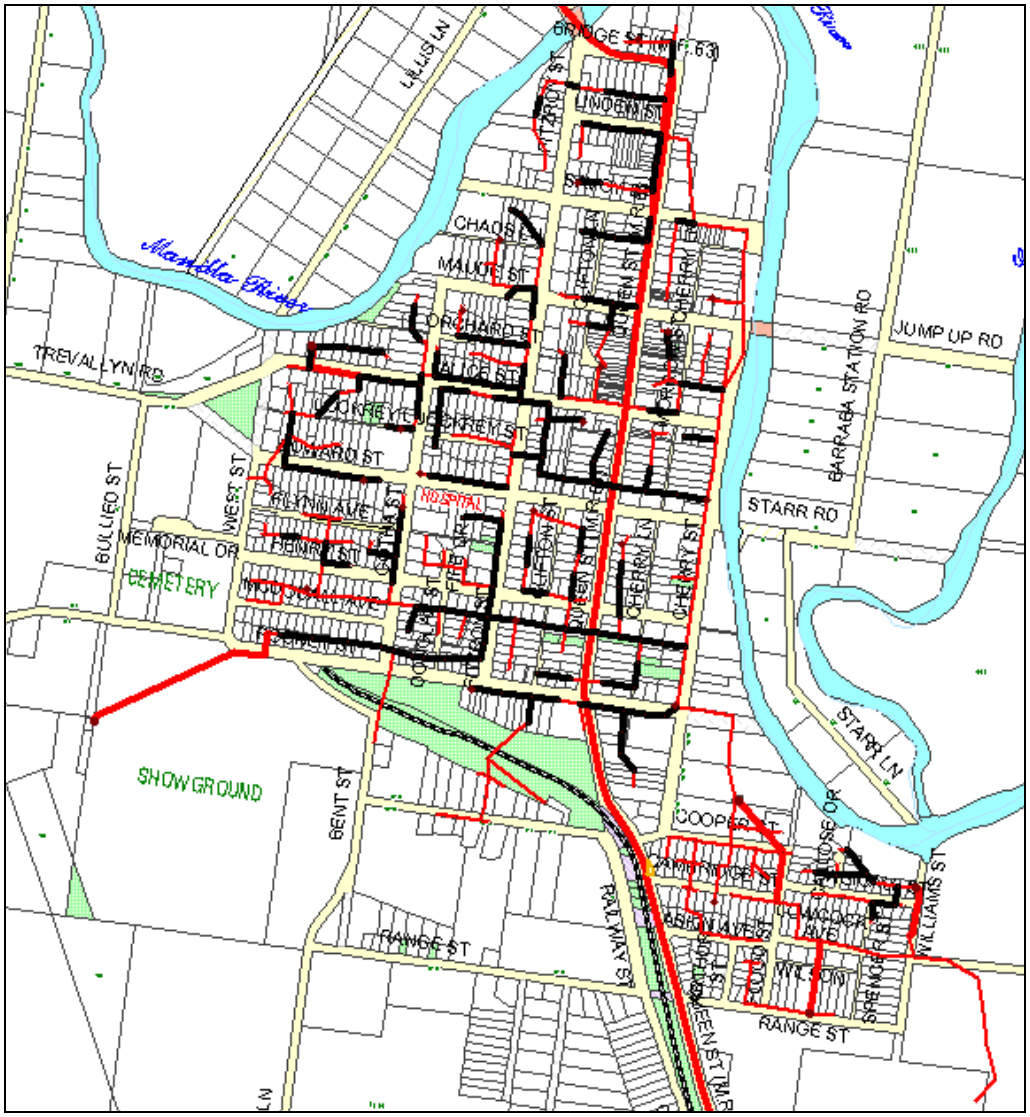
Description

The CCTV condition assessment of the Barraba sewer network was completed in January 2009. This assessment identified a large proportion of assets were in a poor operating state in the order. The assessment determined approximately 50 percent of the sewer transportation system required renewal. The following table provides sizes and lengths of assets requiring renewal;

Size	**Approximate Length**
150 mm diameter sewers	7920 metres
225 mm diameter sewers	625 metres

Current Program Status

Tenders were awarded in April 2010 with all work completed by October 2010. The following figure details the work completed in this project



It was identified during the course of these works the DN300 carrier main also requires renewal and has been allocated as project six to be completed in the 2011-2012 financial year.

Tender Release

April 2010

Start Date

July 2010

Work Period

10 weeks

Costing

A budget of $800,000 was established for completing this contract and other associated works.

SEWER REHABILITATION PROGRAM BUDGET 2011/2012

Project 6

Contract – Rehabilitate DN300 Carrier Sewer Main by Insitu Relining

Location

Barraba

Objectives

Work will;

- Renew structural and service condition of identified deteriorated mains.

Description

This project was identified from CCTV completed in Barraba in January 2009 and relining work completed during the 2010-2011 financial year.

Current Program Status

Contract documents are required to be developed and budget allocation approved

Expected Tender Release

June 2011

Expected Start Date

August 2011

Work Period

5 weeks

Costing

The following cost breakdown is based on average tender rates from recent relining contracts completed i.e. last 5 years.

Diameter	**Length(m)**	**Lining Rate ($)**	**Total ($)**
DN150	1000	$200	200,000
Total	**1000**		**200,000**

Project 7

Contract – Demolish and Replace Existing Concrete Sewer Vents

Location

Tamworth/Manilla/Barraba

Objectives

Work will;

- Remove the risk of failure or damage from falling vents
- Improve ventilation of sewer network aimed at reducing corrosion damage

Description

Council has been undertaking an ongoing program to remove existing concrete sewer vents and replace with stainless steel replacements

Current Program Status

Vents have previously been assed in relation to structural condition. A technical specification has been prepared for the removal and installation. A final asset listing is required and site investigation of each asset to determine access and site conditions prior to contract release.

Expected Tender Release

October 2011

Expected Start Date

December 2011

Work Period

4 weeks

Costing

Based on previous work completed of $10, 000 per vent has been established. Previous work have replaced up to 15 vents, as such a total budget of $150,000 shall be established.

Project 8

Contract – Clean and CCTV Large Diameter Sewer Mains

Location

Tamworth

Objectives

Work will;

- Provide assessment of large diameter sewer mains to enable future planning of asset renewal programs

Description

Contract to CCTV all sewer mains DN450 or greater that are greater than 20 years old and have not been rehabilitated by relining or had condition assessment completed in the past 10 years.

Current Program Status

Contract documents will require preparation with the finalisation of asset listing. Access issues particularly associated with the Plain Street and Timbumburi Creek carrier mains need to be assessed. This program is to commence in conjunction with the completion of Tamworth's upgraded wastewater treatment facility

Expected Tender Release

December 2011

Expected Start Date

April 2012

Work Period

16 weeks

Costing

Based on rates previous work completed and indicative quotes from providers rates vary between $15-$20/m for cleaning and $5-$10 for CCTV. At total rate of $25/m for cleaning and CCTV has been used for all pipe diameters in the following;

Diameter	**Length(m)**	**Cleaning Rate ($)** **CCTV Rate ($)**	**Total ($)**
DN450	3400	$25/m	85000
DN525	3800	$25/m	95000
DN600	650	$25/m	16250
DN900	3400	$25/m	85000
Total	**11250**		**281250**

Estimated Program Total Amount approximately $300,000

SEWER REHABILITATION PROGRAM BUDGET 2012/2013

Project 9

Contract – Clean and CCTV of DN150, DN225 & DN300 Sewer Mains

Location

Tamworth

Objective

Work will enable;

- Reticulated sewer network rehabilitation program to be developed and implemented

Description

Contract to CCTV approximately 35 kilometres of DN150, DN225 and DN300 sewer main. The Program will CCTV the following;

- Next stage of CCTV program in Tamworth based on asset age and expected remaining life.
- Assets identified from review of customer complaints during the period since the last asset assessment project.

Current Program Status

All CCTV contract work has been completed and supplied to Council from the Contractor. A review of this work is being completed and all asset information is currently being placed into the sewer CCTV and rehabilitation database.

Tender Release

August 2012

Start Date

October 2012

Work Period

16 weeks

Costing

Contract has been allocated budget of $250,000 as per previous project work.

Project 10

Rehabilitate Large Diameter Sewer Mains by Relining.

Location

Tamworth

Objectives

Work will;

- Restore structural integrity of severely deteriorated mains that cannot be relined.
- Increase capacity of existing sewer network by improve flow hydraulic

Description

This contract will complete asset renewal works by relining of large diameter sewer pipes identified as requiring renewal from the 2011-2012 financial year.

Current Program Status

Contract documents and asset list will need development based on completed asset assessment work.

Tender Release

August 2012

Start Date

October 2012

Work Period

16 weeks

Costing

It is expected that this work will consume the remaining budget for the allocated financial year ($1,250,000) due to high lining cost per linear meter. Estimated rates are provided below based on previous works undertaken by Council and indicative prices from prospective suppliers.

Diameter (mm)	Price $/m
525	430
600	540
625	580
900	980
1050	1200
1200	1500

It should be noted that these prices will vary and depend heavily on site condition such as access, depth, traffic etc.