NOVEMBER 2010

drainage asset management plan

Knox City Council

KNOX CITY COUNCIL

DRAINAGE ASSET MANAGEMENT PLAN 2010

Executive Summary

Drainage Assets

The Knox drainage network consists of the following assets:

- Pipes and pits (in road reserves, open space and easements)
- Outfall structures (including wing and end walls)
- Retarding basins and dams (including on-site detention systems)
- Rainwater tanks (constructed on Council property)
- Open drains (including table drains)
- Water Sensitive Urban Design (WSUD) treatments (including porous paving, infiltration trenches, rain gardens, gross pollutant traps and litter baskets)

In 2007/08, Council's drainage pits and pipes were formally valued. At this time, this asset class comprised 34,303 pits and 1,123 kilometres of pipe. The replacement cost in 2007/08 was determined to be $203 M. This makes up approximately 40% of the total replacement value of all Council assets. Pipes make up 76% of the drainage asset base in terms of current replacement value.

Drainage Authorities

Knox community wellbeing is affected by the standard and performance of the drainage system. Melbourne Water is the Regional Drainage and the Flood Plain Management Authority for the Greater Melbourne area. Melbourne Water is therefore responsible for the management of designated floodplains. As a responsible drainage authority, Council has prime responsibility for the management of all other areas within the City boundary. Council's primary role is to manage nuisance flows and protect people and properties from inundation. Council is directly responsible for the preparation and management of drainage works in areas not designated as a flood plain.

Other authorities with some responsibility for drainage assets include: VicRoads, Environment Protection Authority (EPA), Rail Authorities, the Department of Sustainability & Environment (DSE) and private property owners.

Condition Audit Results

During the period 2004 – 2009, Council has collected pit and pipe condition data via a number of audits. Given the high costs associated with auditing underground assets, and the difficulties in gaining access to easements, a representative survey approach has been pursued. To this end, only 23% of pits and 2.4% of all pipes have been audited. No easement drains have been surveyed.

55% of audited pipes were found to have a structural mean condition of Poor or Failed, although given the small proportion of data available, this may not be representative of the entire network.

The internal condition of audited pits was much found to be much better than the external condition. 69% of pits had an internal condition rated as Excellent. Only 28% of pits had an external condition rated as Excellent.

Water Management Services

Council's stormwater management services have evolved over many years. Current services provided by Council include:

- Flood mitigation
- Environmental sustainability (stormwater harvest and reuse)
- Water Sensitive Urban Design to slow the flow of stormwater runoff and protect receiving waterways

This Plan documents the Asset Strategy team's assessment of how the organisation's current approach to water management fits with the service delivery model as defined in Council's Asset Management Policy.

Recommended Improvement Projects

Forty four (44) improvement projects have been identified and are summarised in Attachment 8. Implementation of these projects is expected to result in the following desirable outcomes:

- Improved Asset Knowledge and Data Management
- Strategic Investment in Asset Management
- Improved Risk Management
- Improved Integration of Decision Makers
- Improved Community Understanding

Each implementation project has been assigned a risk, responsible Directorate and recommended Project Leader. Preliminary cost and resource estimates are also provided. It is expected that projects flagged in the attachment as "internal" will be able to be undertaken by existing Council resources. Projects expected to require consultant support are flagged as "Consultant".

It is expected that each nominated Project Leader will review the proposed project scope and incorporate the delivery of all projects into their annual business plans. This may require the development of business case applications to seek funding for specialist support.

Sound asset management and long term sustainability are not solely reliant on the provision of funds. Continual improvements in data management to support service and asset management work practices are required to ensure that assets deliver the required level of service in the most cost effective manner. Delivery of the recommended improvement projects has therefore been incorporated into the recommended funding scenario.

Recommended Funding

A predictive financial model was developed to demonstrate the impact of different funding decisions on drainage performance over 20 years. Adoption of the recommended funding scenario detailed in Chapter 10 and summarised in the table below will allow Council to:

- address the capacity issues identified in the Knox Drainage Strategy and undertake annual projects to address extreme and high risk capacity issues as identified by maintenance crews.

- provide renewal funding to address all condition 5 (failed) drainage pits and pipes over a 20 year period
- allow for network growth in maintenance budgets
- focus Council's investment and resources on the introduction of all improvement recommendations over a ten year period including allowance for consulting support for all improvement projects flagged as "Consultant" in Attachment 8.

Recommended Funding ($ '000)					
	2011/12	**2012/13**	**2013/14**	**2014/15**	**2015/16**
Capital Works – New/Upgrade					
Pit & Pipe Upgrades	$342	$1,575	$1,622	$1,671	$1,721
LTFS/Status Quo	$342	$352	$362	$373	$384
Funding Shortfall	**$0**	**$1,223**	**$1,260**	**$1,298**	**$1,337**
Capital Works – Renewal					
Pit & Pipe Renewal (incl. Disposal)	$2,618	$2,693	$2,770	$2,850	$2,931
LTFS/Status Quo	$2,039	$2,039	$2,674	$2,755	$2,837
Funding Shortfall	**$579**	**$654**	**$96**	**$95**	**$94**
Operating Budget – Maintenance					
Pits & Pipes Maintenance	$1,600	$1,654	$1,706	$1,759	$1,812
LTFS/Status Quo	$1,535	$1,587	$1,636	$1,686	$1,737
Funding Shortfall	**$65**	**$67**	**$70**	**$73**	**$75**
Operating Budget – Operational Improvements					
Improvement Projects	$251	$259	$266	$274	$283
LTFS/Status Quo	$0	$0	$0	$0	$0
Funding Shortfall	**$251**	**$259**	**$266**	**$274**	**$283**

However, it should be noted that due to a small sample of audit data that was utilised to undertake this financial modelling it was assumed that the captured information is representative of the condition of the total network (refer to Attachment 6 for modelling assumptions). Future targeted audits will confirm the validity of the identified funding required for the Medium scenario.

By developing systems and processes in conjunction with new data that will be acquired eventually over time, Council will be able to prioritise where funding will be invested to ensure integration with other strategies occurs

(WSUD and Sustainable Water Use), risk is mitigated appropriately and the neediest areas (failed assets) are addressed in a timely manner.

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Chapter 1 Introduction

CHAPTER SUMMARY

- Within the Melbourne metropolitan region, there is a two-tiered system of responsibility for stormwater management.
- Melbourne Water Corporation is responsible for the main drains and waterways.
- Local Councils are responsible for minor drainage systems that protect streets and properties from inundation.
- This Plan only considers drainage assets where Council is the responsible authority.
- Council's drainage assets were formally valued in 2007/08. At the time, this asset class comprised 34,303 pits and 1,123 km of pipe and had a current replacement cost of $203M.
- Constructed assets that form part of Council's drainage network are:
    - Pipes and pits (in road reserves, open space and easements)
    - Outfall structures (including wing and end walls)
    - Retarding basins and dams (including on-site detention systems)
    - Rainwater tanks (constructed on Council property)
    - Open drains (including table drains)
    - Water Sensitive Urban Design (WSUD) treatments (including porous paving, infiltration trenches, rain gardens, gross pollutant traps and litter baskets)
- Implementation of recommended improvement projects (refer Chapter 11, Attachment 8) are expected to contribute to the following desirable outcomes:
    - A more integrated approach to water management
    - Continuous improvement in Council's drainage asset knowledge
    - More strategic investment in asset upgrades, maintenance and renewal works to optimise the useful life and service capability of the drainage network
    - Improved protection and enhancement of natural watercourses
    - Improved knowledge and long-term management of water sensitive urban design treatments, dams and retarding basins
    - Further development of service levels and demand management strategies to ensure water management services meet community expectations.

1.1 Background

This Drainage Asset Management Plan (DAMP) aims to provide Council and the community with a policy and financial framework for the management of Council's drainage assets.

The drainage network captures and removes stormwater runoff from roads and properties and in doing so, makes the municipality a viable place for people to live. The network has been developed over many years. In 2007/08, when Council's drainage assets were formally valued, this asset class comprised 34,303 pits and 1,123 kilometres of pipe. The network was designed and constructed to standards applicable at the time of installation. Replacement cost in 2007/08 was determined to be $203 M.

In addition to pits and pipes, the Knox drainage network also includes retarding basins, overland flow paths and a range of water sensitive urban design (WSUD) treatments that act to detain flows and remove pollutants from stormwater runoff.

As illustrated in Figure 1 below, the municipality is made up of six (6) drainage catchments. Most stormwater runoff captured within the municipality discharges to Dandenong Creek and flows into Port Phillip Bay via Mordialloc Creek. A small portion of Lysterfield drains to Eumemmerring Creek which also flows to Port Phillip Bay via the Patterson River.

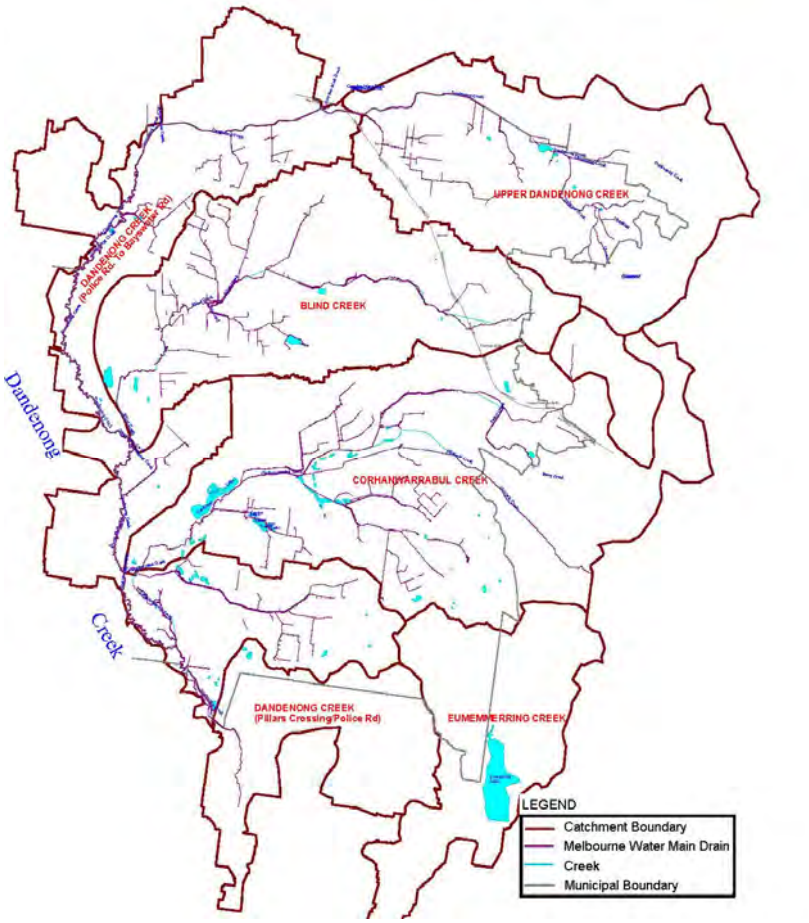

Figure 1 – Knox Drainage Catchments & Waterways

A number of natural watercourses traverse the municipality. Man-made lakes, predominantly in the southern portion of the municipality, add to the aesthetics of the urban landscape and act to detain peak flows during storm events. Significant man-made waterways within the municipality include:

- Caribbean Lake
- Waterford Valley Lakes
- Sutton, Hill and Cogley Lakes

Provision and preservation of an effective drainage network is fundamental for the health and general wellbeing of the local community. Council, as a responsible drainage authority, is expected to manage its drainage system in a way that ensures the capacity is adequate to minimise the likelihood of property damage, personal injury, business disruption and material loss resulting from storm events. Heightened community awareness of the value of water is placing increased pressure on councils to facilitate reuse and minimise adverse impacts that polluted stormwater can have on the natural environment.

1.2 Responsible Drainage Authorities

Within the Melbourne metropolitan region, there is a two-tiered system of responsibility for stormwater management. Melbourne Water Corporation is responsible for the main drains and waterways. Local councils are responsible for minor drainage systems that protect streets and properties from inundation. Figure 1 below illustrates the demarcation of drainage responsibilities, as defined by Melbourne Water.

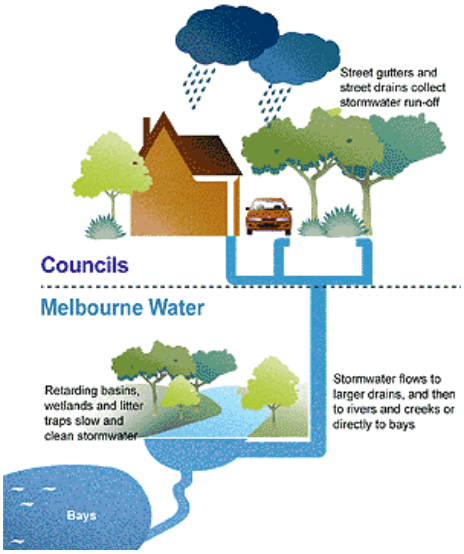

Figure 2 – Drainage Responsibilities

Source:www.melbournewater.com.au/content/drainage_and_stormwater/the_drainage_system/the_drainage_system.asp)

Property drains are the responsibility of private landowners. The legal point of discharge directs rainwater collected from private property into Council's stormwater network. Property drains either connect to the kerb and channel or directly into the piped network. (Attachment 2 describes Council's current policy position regarding the demarcation of maintenance responsibilities for these assets).

Council's drainage system is expected to contain all nuisance flows by limiting the frequency and quantity of surface water to a level that is acceptable to the local community. The effectiveness of the drainage network depends on Council's capacity to:

- proactively maintain, renew and upgrade system components
- understand, predict and respond to changing demands

Effective stormwater management requires Council to work collaboratively with the community and other levels of government, particularly the Melbourne Water Corporation.

1.3 Council's Drainage Assets

This Plan only considers drainage assets where Council is the responsible authority. Constructed assets that form part of the drainage network are listed below.

- Pipes and pits (in road reserves, open space and drainage easements)
- Outfall structures (including end walls and wing walls)
- Retarding basins and dams (including Council owned on-site detention systems)
- Open drains (including table drains)
- Rainwater tanks (constructed on Council property)
- Water Sensitive Urban Design (WSUD) treatments (including porous paving, infiltration trenches, rain gardens, constructed wetlands, gross pollutant traps, litter baskets, swales, bio-retention and bio-retention trenches and pits)

Figure 3 illustrates how typical components of the local drainage network fit together.

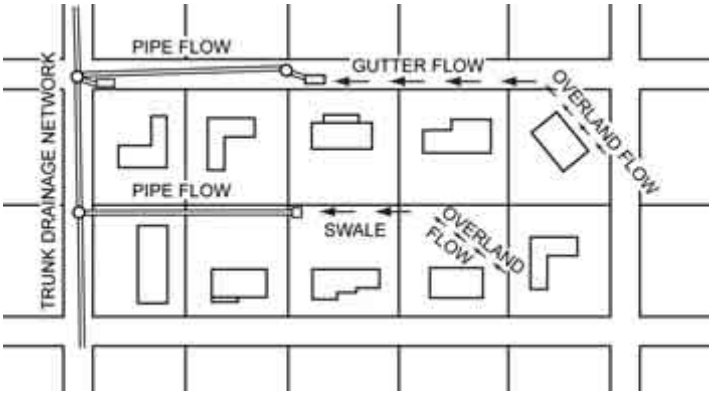

Figure 3 – Typical Drainage Network Components

Only Council pits, pipes and culverts are recognised as assets in Council's financial reports. Culverts are managed in accordance with Council's bridge asset management practices. Open channels, swales and constructed kerb and channel direct stormwater flow by gravity to stormwater pits or directly into receiving waterways. Retarding basins, wetlands and rain gardens provide water quality treatment and landscape amenity and act to attenuate flood waters and provide flood protection of downstream areas. Litter baskets and gross pollutant traps capture litter, debris and coarse sediments to minimise pollution entering receiving waterways.

Council's Water Sensitive Urban Design (WSUD) & Stormwater Management Strategy includes a summary of all known WSUD treatments within the municipality. The current replacement value of these physical assets has not been determined. While it may not be appropriate to recognise WSUD treatments as financial assets, it is considered important that their management be incorporated into Council's overall strategic approach to stormwater management.

1.4 Relevant Council Strategies & Plans

Council's long term strategy for Knox is identified in Knox Vision 2025 and articulated through the Council Plan 2009-13. The strategic Council objectives relevant to the management of Council's drainage assets are:

- Quality Services & Infrastructure
- Sustainable Natural Environment

Implementation of this plan will contribute to delivery of Council's Quality Services & Infrastructure objective by ensuring public drainage assets are managed in a manner that meets community needs and service provision requirements. By supporting more sustainable drainage management and water sensitive urban design practices, implementation of this plan will also see a positive contribution to the quality of our local waterways and delivery of Council's Sustainable Natural Environment objective.

This Drainage Asset Management Plan (DAMP) forms part of Council's suite of strategic asset management documents intended to facilitate delivery of the above Council Plan objectives.

- Asset Management Policy 2009
- Strategic Asset Management Plan 2003-2013
- Footpath & Shared Path Asset Management Plan 2005
- Road Management Plan 2010
- Road Asset Management Plan 2007
- Building Asset Management Plan 2009

Implementation of improvement recommendations presented in this document are expected to support, rather than duplicate, the delivery of complementary Council plans and strategies including:

- Knox Water Sensitive Urban Design (WSUD) & Stormwater Management Strategy (2010)
- Knox Stormwater Drainage Strategy (2002 -05)
- Knox Stormwater Management Plan (2001)
- Draft Knox Domestic Wastewater Management Plan (2010)
- Knox Sustainable Water Use Plan (2006)
- Analysis of Heat Island Effects (2009)
- Business Improvement Project – Drainage – Service & Asset Management (For New & Upgrade Drainage Works (2008))
- Stormwater Drainage Guidelines for Residential, Commercial, Industrial and Broad Acre Subdivisional Developments
- Water Sensitive Urban Design Guidelines for the City of Knox
- Civil Works Guidelines for Development of Broad-acre Subdivisions

1.5 Scope of this Plan

The Auditor General's *Victoria's Performance Audit Report No 144 Managing Stormwater Risks in Melbourne (July 2005)* recommended that agencies develop drainage asset management plans, consistent with best practice and that these plans incorporate the following:

- service levels and community expectations
- a demand management plan
- a condition assessment and monitoring program
- lifecycle costing principles
- a long-term financial plan

This plan incorporates the above factors and provides a number of recommendations to address gaps in Council's current service and asset management practices. The plan focuses on asset management requirements to sustainably provide for Council's drainage pits and pipes. It is recognised that implementation of the improvement projects set out in Attachment 8 will enable the next version of Council's Drainage Asset Management Plan to be more comprehensive and consider other components of the drainage network in more detail.

1.6 Objectives of this Plan

During implementation of this Plan, Council will continue to:

- Invest in the collection and analysis of drainage asset data
- Explore opportunities for working collaboratively with other drainage authorities to improve asset knowledge and address water management issues
- Set flood and water quality management goals, which are linked to community expectations and consistent with Council's broader strategic objectives and budgets
- Support the reclamation and reuse of stormwater
- Measure and report performance in the delivery of drainage asset management improvements

It is anticipated that implementation of recommended improvement projects, summarised in Attachment 8, will contribute to improved delivery of Council's water management services. Drainage asset management improvements can also be expected. Desirable outcomes include:

- A more integrated approach to water management that encompasses sustainability initiatives, water quality and flood management
- Further development and documentation of service levels in consultation with the community
- Improved understanding and implementation of Council's service and asset lifecycle management responsibilities
- Continuous improvement in Council's drainage asset knowledge
- Strategic investment in drainage upgrades, maintenance and renewal works to optimise the useful life and service capability of the drainage network
- Protection and enhancement of natural watercourses

- Improved knowledge and long-term management of water sensitive urban design treatments, retarding basins and dams
- Improved community understanding of how local actions can contribute to flooding risks and pollution of the waterways

Chapter 2 Drainage Assets

CHAPTER SUMMARY

- The Knox drainage system is made up of six (6) catchments.
- Only drainage pits and pipes are recorded in Council's financial reports prepared in accordance with AASB 116. Other components of the drainage network (including water sensitive urban design treatments and retarding basins) are not considered to be financial assets.
- In 2007/08, Council drainage pits and pipes had a combined current replacement value of $203 M. This makes up approximately 40% of the total replacement value of all Council assets. Pipes make up 76% of the drainage asset base in terms of current replacement value.
- Council has adopted an 80 year economic life for drainage pits and pipes. Data provided by the Municipal Association of Victoria suggests that many other Councils have adopted a 100 year life.
- There is no readily available industry standard regarding the expected lives of water sensitive urban design treatments.
- Council's primary role in the management of stormwater is to manage nuisance flows and protect people and properties from inundation.
- A hierarchy has been developed to assist Council in prioritising all drainage asset management activities. The proposed hierarchy is made up of six categories which incorporates surrounding land use and pipe size to reflect asset criticality:
    - Road Reserve Major Drain
    - Habitable Land Major Drain
    - Undeveloped Land Major Drain
    - Road Reserve Minor Drain
    - Habitable Land Minor Drain
    - Undeveloped Land Minor Drain
- 82% of Council's pipe network is made up of pipes that are considered to be minor (that is, smaller than 450 mm diameter).
- Council currently does not have good data regarding all drainage assets for which it is the responsible authority. Ongoing data management work is undertaken by the Works, Project Delivery and Asset Strategy teams to improve data accuracy and ensure new assets are recorded appropriately.
- Council's Lifecycle system, which includes the Work Order System, acts as a central repository for Council's drainage asset knowledge. Council's Geographic Information System (GIS) Latitude is used to provide a spatial view of the data.
- There is currently no GIS Layer that records Council's WSUD treatments. The Project Delivery team is working on a project that aims to capture a reliable asset register and GIS layer.
- A number of improvement projects are proposed to improve Council's approach to data management.

2.1 Introduction

This chapter outlines Council's existing drainage asset knowledge. A hierarchy is proposed to assist in prioritising drainage asset management programs including: condition monitoring, hazard inspections, maintenance, renewal and upgrades.

Recent history of expenditure for drainage maintenance, renewal and upgrades are examined. The current approach to asset valuations and data management is discussed. Improvement projects are recommended to enable Council to work toward improving its knowledge of this asset class.

2.2 Catchments

The Knox drainage system is made up of six (6) major catchments as illustrated below. A number of catchment boundaries extend beyond the Knox municipal boundary.

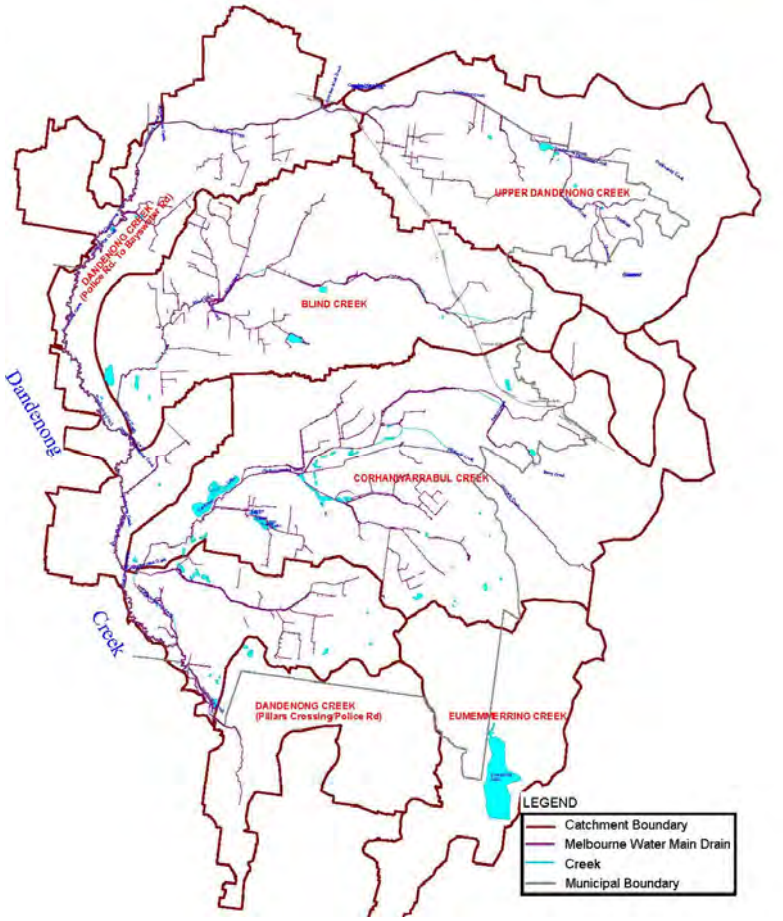

Figure 4 – Knox Drainage Catchments

The size of each major catchment is summarised in Table 1. Each catchment is made up of a number of smaller catchments.

Catchment Name	Approximate Catchment Area (sq. km)
Northern Blind Creek	15.9
Southern Blind Creek	11.8
Upper Dandenong Creek	21.6
Rowville Main Drain	9.9
Corhanwarrabul Creek	33.8
Lower Dandenong Creek	15.3

Table 1 – Knox Drainage Catchments - Land Area

2.3 Drainage Assets

Table 2 below, summarises the known quantities of each component of Council's drainage network. The quantity of water sensitive urban design (WSUD) treatments is based on field inspections undertaken by the Project Delivery team during 2009. Pit and pipe quantities are based on estimated data used for the most recent valuation of Council drainage (2008/09).

Type	Quantity
Pipes	1,136 km*
Pits	34,693*
Retarding Basins & Dams	1**
Outfall structures	Unknown**
Open drains	Unknown**
Rainwater tanks	62
WSUD Treatments	
Rain garden/basin	7
Bio-retention tree pits	56
Swale/filtration trench	6
Swale	1
Infiltration system	6
Wetland	4
Permeable paving	2
Gross Pollutant Traps	11
Sedimentation tank/basin	1
Enviss system	1

Table 2 – Drainage Component Inventory

- * Denotes pit and pipe quantities that were used to determine the 2008-09 valuation of Council's drainage assets.
- ** Quantities of these assets to be verified as part of the recommended improvement project 3.1

It must be noted that only drainage pits and pipes are recorded in Council's financial reports which are prepared in accordance with AASB 116. For the purposes of effective drainage asset management however, adequate funds and resources must be made available to ensure the ongoing functionality of all the physical assets listed in Table 2. It is important that overland flow paths, retarding basins and dams are strategically managed.

2.4 Hierarchy

Council's primary role in the management of stormwater is to manage nuisance flows and protect people and properties from inundation. A drainage hierarchy has been developed to assist Council in prioritising its drainage management activities.

It is important that Council's approach to drainage asset management gives due consideration to the likelihood and consequences of asset failure. For example, given limited funds, the standards applied to a large drain, where failure or blockage would result in widespread flooding, should be higher than those applied to a smaller pipe in the local system, where the consequences of failure may be small.

The proposed hierarchy, outlined in Figure 5, considers the location of each drainage asset in terms of the dominant land use of the surrounding area. The hierarchy classification is not limited to pits and pipes. All components of the drainage network have been assigned to one of the six hierarchy categories. These network components include, but are not limited to WSUDs, overland flow paths, dams, open drains, table drains, wetlands, and detention basins.

Three land use categories have been defined:

- Road Reserve
- Habitable Land
- Undeveloped Land

These categories are described in Table 3 and illustrated in Figure 6. Approximately 630km (53%) of the piped network is located within a road reserve. Within each of the three land use areas, all Council drainage pipes greater than 375 mm in diameter are considered to form a 'major drain'. Maintaining the functionality of these pipes (and all connected drainage assets) is considered critical for the integrity of the whole drainage network.

All pipes 375 mm diameter (and smaller) are considered to form a minor drain. 82% of Council pipes have a diameter of 375 mm (or smaller). Pits, and all other drainage assets, connected to a 375 mm diameter (or smaller pipe) are also classified as part of a minor drain. The extent and impact of flooding caused by failure of minor drains is likely to be less than that for drains classified as major.

From a risk management perspective, major drains in the road reserve are considered to be the highest priority. Asset failure can result in road pavement collapse if water escapes the drain and weakens the pavement structure. Blockages of these drains can lead to ponding of water on roadways which can be hazardous to all road users. It is considered important that all side entry and grated pits within a roadway, for which Council is the responsible road authority, are also considered to form part of the Road Reserve - Major

Drain classification. Functionality of these pits facilitates removal of water from the roadway.

Hierarchy Classification	Priority	Land Use[1]	Pipe Sizes	Pit Type	Other Drainage Assets[2]
Road Reserve - Major Drain	1	Drainage asset is located within land designated as road reserve. Road is listed in Council's public road register and Council is the nominated responsible road authority.	All pipes > 375 dia.	All side entry pits and grated pits This includes side entry and grated pits along VicRoads Arterial Roads, only if the pit is connected to the municipal drainage network.	All other drainage assets including: open /table drains along roads, where Council is the responsible road authority
Habitable Land - Major Drain	2	Drainage asset is located within an easement on land used for residential/ commercial / industrial purposes.	All pipes > 375 dia.	All pits connected to a pipe> 375 dia.	All other drainage assets connected to a pipe > 375 dia.
Undeveloped Land – Major Drain	3	Drainage asset is located within land designated as public open space or an easement located on undeveloped or rural land.	All pipes > 375 dia.	All pits connected to a pipe > 375 dia.	All other drainage assets connected to a pipe > 375 dia.
Road Reserve - Minor Drain	4	Drainage asset is located within land designated as road reserve and listed in Council's public road register and Council is the nominated responsible road authority.	All pipes =< 375 dia.	All pits excluding side entry pits and grated pits. This includes pits along VicRoads Arterial Roads only if the pit is connected to the municipal drainage network.	All other drainage assets connected to a pipe =< 375 dia.
Habitable Land - Minor Drain	5	Drainage asset is located within an easement on land used for residential/ commercial / industrial purposes.	All pipes =< 375 dia.	All pits connected to a pipe =< 375 dia.	All other drainage assets connected to a pipe =< 375 dia.
Undeveloped Land - Minor Drain	6	Drainage asset is located within land designated as public open space or an easement located on undeveloped or rural land	All pipes =< 375 dia.	All pits connected to a pipe =< 375 dia.	All other drainage assets connected to a pipe =< 375 dia.

Figure 5 – City of Knox – Drainage Hierarchy Classifications

1. Where a drainage asset crosses multiple land use areas the higher priority classification should be allocated to the asset. The land use categories are defined in Table 3 and illustrated in Figure 6.

2. Other Drainage Assets include, but are not limited to, WSUD treatments, table drains, overland flow paths, dams, open drains, wetlands, and detention basins

Land Use	Description	% Drainage Network[#]
Road Reserve	Roads that are declared to be public roads and are listed in Council's public road register. Council is the nominated responsible road authority.	53.52
Habitable Land		
Residential	Land is predominantly used for residential housing.	39.34
Commercial	Land is predominantly used for commercial purposes including retail and professional services.	1.79
Industrial	Land has an industrial zoning and is predominantly used for manufacturing including warehousing.	2.34
Undeveloped Land		
Rural / Undeveloped Land	Land primarily contains large properties with low population density. Land may be unused or used for agriculture.	0.41
Open Space	Land is primarily used for formal and informal recreation activities with access generally open to the public.	2.60

Table 3 – Knox Land Use Descriptions

This table should be read in conjunction with the Land Use Map illustrated in Figure 6.

[#] % drainage network was calculated as the length of pipe located within each land use classification

To support use of the hierarchy described above, the map provided in Figure 6 and Attachment 3, illustrates the location of each land use area.

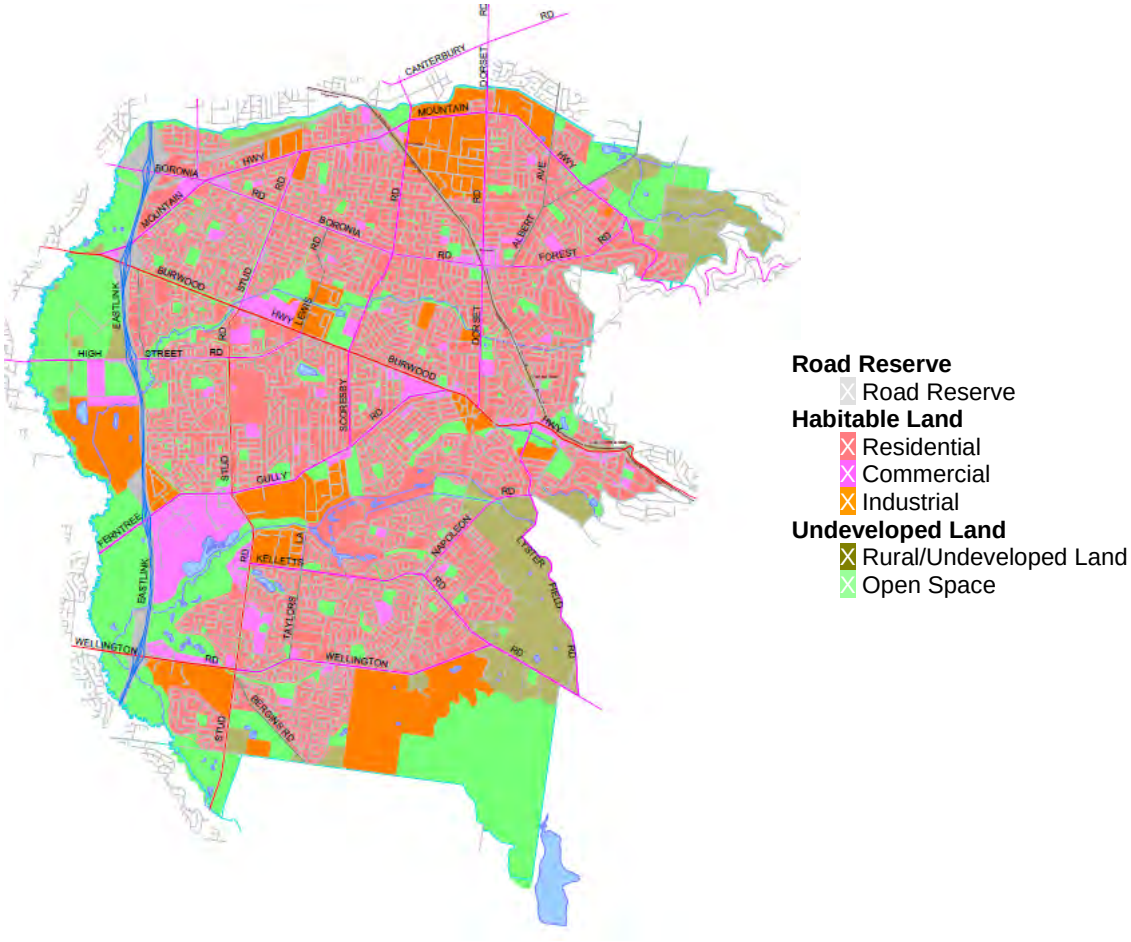

Figure 6 – Land Use Map

Adoption of the proposed hierarchy is expected to encourage more efficient drainage asset management practices. Once adopted, the hierarchy should be used to prioritise delivery of the following programs:

- Condition auditing (including CCTV pipe audits)
- Hazard inspections
- Renewals
- Upgrades

The hierarchy could also be used to refine current drainage maintenance service levels. In particular, target timelines for rectification of drainage issues could be adjusted to prioritise repair of drainage assets that have a higher priority hierarchy classification.

It must be noted that the Knox Road Management Plan, sets out Council's service levels for hazard inspections and drainage maintenance. The proposed hierarchy includes two classifications that have been developed to classify all road related drainage within the municipality:

- Road Reserve - Major Drain
- Road Reserve - Minor Drain

It is therefore important that any changes to Council's approach to inspection and maintenance of these road related assets are reflected in Council's Road Management Plan.

2.5 Annual Asset Valuations

Council assets are formally valued every third year and indexed according to inflation, taking account of additions and disposals, in the intervening years. Depreciation is determined and incorporated into Council's profit and loss statements, leaving a written down value for each asset grouping. The Average Annual Asset Consumption (AAAC) is calculated using the economic life of each asset category. For drainage, Council has historically used an economic life of 80 years for both pits and pipes.

Drainage pit and pipe valuations are reported in Council's financial reports under the Infrastructure asset category. Rainwater tank valuations are incorporated as part of buildings and are recorded in Council's financial reports under the Land and Buildings category. Other physical drainage assets including WSUD treatments are not recognised as drainage assets in Council's financial reports.

Valuations are based on the assumption that each asset is constructed on undisturbed ground (green field site). Rates for drainage pits (per item) and pipes (per metre length) are derived from first principles and applied to the known quantity of the network to produce the current replacement value. The principle of straight line depreciation is currently applied to determine the written down value, based on an assessment of consumed economic life.

Council's financial reports are prepared in accordance with AASB 116. In accordance with this standard, assets purchased or constructed, which have a value above the prescribed threshold level, are recorded as non-current assets. Assets with a value below the threshold level are treated as expenditure in the year of purchase. Council's adopted threshold for drainage assets is $5,000.

In 2007/08, when last formally valued, Council drainage pits and pipes had a combined current replacement value of $203 M. This makes up approximately 40% of the total replacement value of all Council assets. The table below summarises the current valuation of the drainage network. Pipes make up 76% of the drainage asset base in terms of current replacement value.

Drainage Pipes				
Diameter (mm)	**Length (m)**	**%**	**Replacement Value**	**Written Down Value**
90	102.5	0.01%	$5,446	$4,765
100	103,554.7	9.22%	$7,588,507	$4,263,582
150	125,148.2	11.14%	$7,846,659	$4,713,400
225	265,183.5	23.61%	$24,008,598	$15,303,669
300	323,412.6	28.79%	$37,749,315	$24,834,692
375	100,434.7	8.94%	$14,716,319	$9,510,056
450	64,933.8	5.78%	$11,791,242	$7,609,422
525	37,517.8	3.34%	$8,034,592	$5,309,785
600	27,918.8	2.49%	$6,893,287	$4,581,534
675	13,834.0	1.23%	$4,206,833	$2,674,938
750	15,808.4	1.41%	$5,478,369	$3,558,784
825	8,364.6	0.74%	$3,406,766	$2,122,643
875	86.0	0.01%	$44,512	$25,519
900	6,929.8	0.62%	$3,384,093	$2,164,561
975	3,259.8	0.29%	$2,004,007	$1,199,674
1050	4,577.2	0.41%	$2,741,792	$1,774,797
1150/1200	7,765.0	0.69%	$5,709,651	$3,645,733
1350	3,649.6	0.32%	$3,218,239	$1,948,180
1425	411.0	0.04%	$432,858	$238,592
1500	1,169.1	0.10%	$1,264,134	$763,690
1725/1750	3,136.7	0.28%	$4,494,015	$3,093,266
Unknown	6,037.6	0.54%	$574,502	$374,074
Total	**1,123,235.6**		**$155,593,737**	**$99,715,359**

Drainage Pits				
Type	**Number**	**%**	**Replacement Value**	**Written Down Value**
Side Entry Pit	22709	66.2%	$32,621,251	$21,244,269
Junction Pit	11594	33.8%	$14,915,333	$9,539,239
Total	**34303**		**$47,536,585**	**$30,783,508**

Table 4 – Current Replacement Value

All data is based on the 2007/08 Knox City Council Annual Report.

Pits and pipes are assumed to have an economic life of 80 years

81.7 % of Council pipes have a diameter of 375 mm (or smaller). These pipes are classified as minor drains in Council's drainage hierarchy

2.5.1 Economic Life Assumptions – Drainage Pits & Pipes

Economic life assumptions should recognise the durability and stability characteristics of the asset under average conditions. Council has adopted an 80 year economic life for drainage pits and pipes. Benchmarking data provided by the Municipal Association of Victoria (MAV) in 2008, is presented in Figure 7 and Figure 8 below.

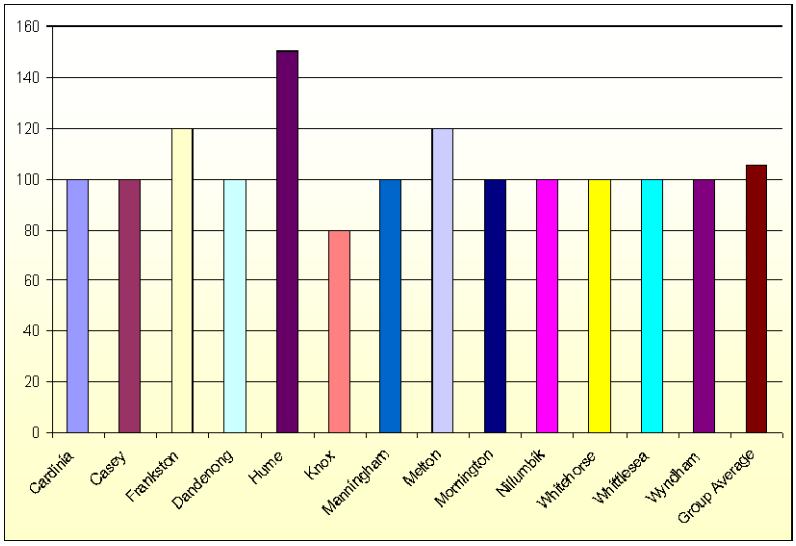

Figure 7 – Benchmarking of Economic Life Assumptions - Drainage Pipes

Source: Municipal Association of Victorian Benchmarking Study (2008)

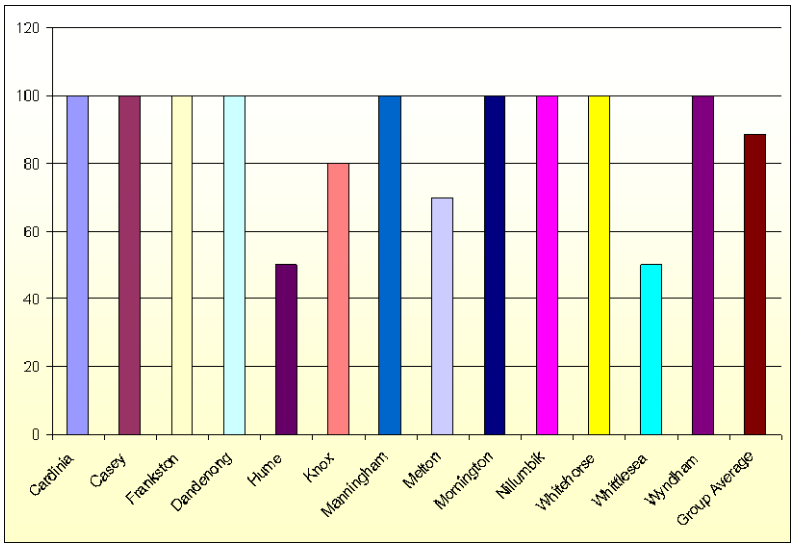

Figure 8 – Benchmarking of Economic Life Assumptions - Drainage Pits

Source: Municipal Association of Victoria Benchmarking Study (2008)

Knox was the only Council among the 14 Councils participating in the benchmarking study, to have adopted an economic life below 100 years for drainage pipes. Only four other participating Councils have adopted an economic life of less than 100 years for pits. The City of Hume and Wyndham have both adopted a 50 year economic life.

It should be noted that Council does not have sufficient historic data, regarding asset deterioration rates, to verify the appropriateness of the current economic life assumption for pits and pipes within the municipality. It is possible (in light of the above MAV data) that Council may be underestimating the economic life of these assets.

The recent audit (discussed in more detail later in this document) assessed the condition of 23% of Council pits and 2.4% of Council pipes. The audited sample of drainage pipes is considered too small to be considered representative of the entire network. Approximately 30% of the audited pits were found to have an external condition that was considered poor or failed

while 73% of audited pits were found to have a good or excellent internal condition, despite these assets having an average age of 30 years (based on the year of construction of the surrounding roadways). If the audited sample is representative of all Council drainage pits, then the results suggest the economic life may be longer than 80 years. However, given that the timing of drainage renewal works is not recorded against individual assets in Council's asset register, it is difficult to know the true age of Council's drainage pits.

Increasing the adopted economic life to 100 years, would have significant impact on the valuation of these assets and therefore should only be undertaken when Council is confident that increasing the economic life assumption is appropriate. It is therefore considered prudent, to leave the adopted economic life of drainage pits and pipes unchanged at this time. Drainage assets are due to be formally valued in 2010/11. Due consideration should then be given to the adopted economic life assumptions. If a change is considered appropriate, the predictive financial model (presented in Chapter 10) should be updated to reflect the impact on future renewal funding needs.

Regardless of the adopted economic life, the actual life of any individual drainage pit or pipe may vary considerably. The life of an underground drainage system element is difficult to predict and is affected by local conditions, including, but not limited to:

- Workmanship (connections, bedding, cover, backfilling)
- Construction materials
- Maintenance practices
- Type of joints (butt joint, rubber ring joints)
- Proximity and type of tree planting
- Flow velocities
- Geology
- Soil types (acidity, changes in moisture levels)
- Groundwater levels
- Land use (industrial, residential, rural, commercial)
- Number and type of entry points/openings
- Design and construction standards at the time of installation
- Location (easement, road reserve)
- Surface loading (including traffic volume and composition during and after construction)

2.5.2 Useful Life - WSUD Treatments

There is no readily available industry standard regarding the expected lives of water sensitive urban design treatments. Discussion during the development of Council's WSUD & Stormwater Management Strategy suggests that the expected life of most WSUD treatments is in the range 15-50 years as illustrated in the table below. It must be noted that the life of these asset classes is also influenced by environmental factors. In commercial areas, where pollutant and litter loads are high, the life of individual assets can be much lower than those reported in the table below. The frequency of Council's proactive routine maintenance programs also impact on the effective serviceable life of these assets.

WSUD Treatment	Expected Useful Life
Rain garden/basin	10-15 years
Bio-retention tree pits	10-15 years
Swale/filtration trench (filter media)	10-15 years
Infiltration system	10-15 years
Wetland	25-50 years
Permeable paving	20 years
Gross Pollutant Traps	50 years
Litter Baskets (Stainless Steel)	30 years
Sedimentation tank/basin	25-50 years
Enviss system	30 years

Table 5 – Estimated Useful Life – WSUD Treatments

Useful life estimates were made by Council's Project Delivery team during development of the Knox WSUD & Stormwater Management Strategy.

Until recently, there has been little consideration for the ongoing maintenance and renewal programs required to retain the functionality of WSUDs. It is expected that the implementation of the Knox City Council WSUD & Stormwater Management Strategy and this Asset Management Plan will go some way towards addressing this gap. Further research is required to refine the estimated life and determine the current replacement cost of these assets so that appropriate levels of funding can be ascertained.

2.6 Drainage Data Management – Information Systems

Council currently does not have a complete dataset regarding all drainage assets for which it is the responsible authority. Ongoing data management work is undertaken by the Works, Construction, Project Delivery and Asset Strategy teams to collate and verify data discrepancies and ensure new assets are recorded appropriately.

Council's Lifecycle system, which includes the asset register and Work Order System, acts as a central repository for Council's drainage asset knowledge. Council's Geographic Information System (GIS) Latitude is used to provide a spatial view of the data.

2.6.1 Geographic Information System (GIS) Latitude

Key GIS drainage layers are listed and described in Table 6 below. It must be noted that as Council attempts to progressively improve its drainage asset knowledge a number of these GIS layers are in a state of flux.

GIS Layer	Layer Title	Description
11	Knox Drainage	Pits and pipes that are the responsibility of Knox City Council or VicRoads. This layer should be read in conjunction with Layer 358 which shows drainage assets for which VicRoads is the responsible authority.
12	Melbourne Water Drainage	Pits and pipes that are the responsibility of Melbourne Water
30	Creeks and Lakes	Water bodies within the municipality
158	Overland Flow	Indication of overland flow paths based on data collected by the Dandenong Valley Authority (DVA). This layer defines linear paths only with no extents. Will be superseded by a complete layer 167.
159	Flood Plains – Melbourne Water	This layer is a predecessor of Layer 213. Layer 159 is historic and should be removed from GIS
161	Retarding Basins – MWC	Illustrates the16 retarding basins within the municipality that are the responsibility of the Melbourne Water Corporation
162	Major Catchments	Indicates the limits of the 6 major drainage catchments that fall within the municipality
163	Minor Catchments	Indicates the limits of the minor drainage catchments that fall within the municipality
167	Knox 1% Overland Flow Path	An incomplete layer based on flood mapping for 3 catchments undertaken by Melbourne Water. Once complete, it could form the basis of a Special Building Overlay and supersede the information in layer 158.
173	Melbourne Water – Imperviousness	Data represented on this layer forms the basis for some of the hydraulic calculations undertaken for drainage upgrades and WSUD (certain percentages of imperviousness are prioritised for disconnection from the drainage system by way of WSUD treatments) This layer was provided by Melbourne Water in 2009, at no cost to Council. Updating the data can be expected to incur a significant cost.
213	Land Subject to Inundation Overlay	The land affected by the Land Subject to Inundation Overlay has been identified by Melbourne Water as being liable to inundation from an *open watercourse*, during a severe storm of 1 in 100 year intensity.
214	Special Building Overlay (SBO1)	The land affected by the Special Building Overlay has been identified by Melbourne Water as being liable to inundation as a result of capacity issues in Melbourne Water drainage infrastructure, during a severe storm of 1 in 100 year intensity.

GIS Layer	Layer Title	Description
358	Drainage Responsibility	Pits and pipes that are the responsibility of VicRoads
360	New Drainage layer with corrected pits and pipes from the 2007 Drainage Audit	These are working layers used by Asset Strategy and Project Delivery staff to verify the locations of drainage assets recorded on layer 11.
384	New Drainage layer with corrected pits and pipes from the 2009 Drainage Audit	
385	Stream Health	A new and incomplete layer intended to capture water quality data. It is sourced from 2007 Melbourne University research on stream health and is based on the percentage of directly connected impervious surfaces.

Table 6 – GIS Drainage Layers

There is currently no GIS layer that records Council's WSUD treatments. To support the implementation of Council's WSUD & Stormwater Management Strategy, the Project Delivery team is working on a project that aims to capture a reliable inventory of these treatments and create a GIS layer that demonstrates how the WSUDs interconnect with elements of the traditional drainage network.

A number of other GIS layers should also be developed to assist decision makers. It is recommended that new layers be developed to illustrate the following information:

- Sites with a known flooding history (i.e. multiple customer requests raised during multiple storm events)
- Proposed drainage asset renewal program
- Proposed drainage asset upgrade program
- Sites where opportunities to introduce environmental controls (including WSUDs) have been recommended in the Knox Drainage Strategy and the WSUD & Stormwater Management Strategy

2.6.2 Lifecycle – Asset Register

Table 7 below, summarises the drainage pipe information stored against all pipes in Council's asset register.

Field	Description
Pipe ID	Unique identifier of all Council drainage pipes
Pipe Diameter	Diameter of pipe section
Pipe Length	Length of pipe section
YOC	Year of Construction - based on date the surrounding road network was constructed

Table 7 – Drainage Pipe Data stored in Lifecycle

Whilst GIS layers are updated continuously, the pit and pipe details are only updated in the asset register every three years to coincide with the timing of formal asset valuations.

Table 8 outlines the data fields stored in the asset register for all Council drainage pits.

Field	Description
Pit ID	Unique identifier of all Council drainage pits
Pit Location	Location of pit relevant to address – outside, opposite, adjacent
Pit Address	Address of pit (eg. 22 Albert street)
Trees5m	Indicates if trees where present within 5m of pit at the time of the audit
AHD	Australian height datum (metres above sea level)
Pit Type	Indicates the type of pit – the following types have been defined side entry pit (SEP), grated pit (GP), junction pit (JP)
Cover Type	Type of cover – concrete, terrafirma, grate, gatic
Surround Type	Type of surround – concrete, none, other
Lintel Type	Type of lintel – concrete, none, steel, missing, other
Throat Mesh	Type of throat mesh – standard, non standard, no
YOC	Year of construction - based on date the adjoining road network was constructed
Comments	Miscellaneous notes regarding the pit

Table 8 – Drainage Pit Data stored in Lifecycle

Following on from the recent pit and pipe audits, discussed later in this report, Council's Asset Strategy team is working to progressively update the asset register so that the following pit and pipe condition data are also stored in Lifecycle for all audited pits and pipes.

Pit condition data collected for audited pits (23% of the network):

- Invert/Depth Level (in metres)
- Internal Dimension X (in metres)
- Internal Dimension Y (in metres)
- No. of Step irons
- Access to Pit (Good, Fair, Poor)
- Root Intrusion (Yes, No)
- Pit Basket Present (Yes, No)
- Sediment Present (Yes, No)
- Sediment Type (Leaves, Silt, None, Rubbish, etc)
- Sediment Depth (in metres)
- Subsidence (Yes, No)
- Subsidence Depth (in metres)
- Internal Condition (1 Excellent to 5 Failed)
- External Condition (1 Excellent to 5 Failed)
- Overall Condition (1 Excellent to 5 Failed)
- Condition Audit Comments

Pipe condition data collected for audited pipes (2.4% of the network):

- Pipe Material (Concrete, PVC, Vitrified Clay)
- Pipe Flow (1 – from start pit to end pit, 2 – from end pit to start pit)
- Section Length audited (in metres)
- Pit From (Pit ID)
- Pit To (Pit ID)
- Pipe Diameter (in millimetres)
- Pipe Shape (Circular)
- Pipe Cleaned (Cleaned, Not Cleaned)
- Structural Mean Score (Total structural defect score/ section length)
- Structural Avg. Score (Total structural defect score/ number of defects)
- Structural Peak Score (Structural defect score in worst metre assessed)
- Service Mean Score (Total service defect score/ section length)
- Service Avg. Score (Total service defect score/ number of defects
- Service Peak Score (Service defect score in worst metre assessed)
- Pipe Audit Abandoned (Yes or No)
- Condition Audit Comments

The condition audit methodology is described in Attachment 4 for further reference.

It is anticipated that future drainage condition audits, if funded, will improve Council's asset knowledge. It is desirable that this asset knowledge be collected systematically and made accessible to all Council Officers via GIS. This will require linking the asset register (Lifecycle) to GIS.

The drainage hierarchy proposed in this Chapter should be used to prioritise the timing of future condition audits.

2.6.3 Lifecycle- Work Order System

The Knox Work Order System stores all drainage hazard inspection and reactive maintenance data. It is used to facilitate the delivery of maintenance activities and ensure a consistent response to customer requests. The system measures delivery of current maintenance service levels. It also includes functionality that tracks progress regarding maintenance requests that have been referred from maintenance crews to teams responsible for drainage asset upgrades.

2.7 Drainage Data Management – Protocols & Practices

Council's drainage data management protocols and practices have evolved over a long period of time. The aim is to progressively identify discrepancies in the existing data whilst ensuring that ongoing data updates capture all new assets and reflect the impacts of all works undertaken to alter the existing assets.

Data discrepancies are identified in two key ways:

- Formal asset audits
- Works Services Maintenance officers (while undertaking other works in the field)

Drainage assets are created, disposed or otherwise modified, as a result of the following activities:

- Asset Contributions – Private Sector Developments
- Capital Works Programs – New & Upgrades
- Capital Works Program – Drainage Renewal

In this section, Council's approach to rectification of data discrepancies and capture of asset changes is summarised. The objective is to identify improvement opportunities.

2.7.1 Rectification of Data Discrepancies

Formal asset audits

A number of pit inventory audits have been undertaken by the Asset Strategy team during the past five years. Using global positioning system technology, contractors have determined the coordinates of all Council drainage pits in road reserves. This data is currently being digitally matched against Council's GIS drainage layer data. Throughout this matching process, the Asset Strategy team verifies the data, identifies unmatched pits and determines their true location. Corresponding drainage pipes (which connect these pits) are adjusted accordingly. This is a laborious task which involves cross checking of construction drawings and inspection of commercially available photographic records. Updates to Council's GIS drainage layer as a result of this are implemented via a staged process, working systematically through the municipality.

At the time of writing, approximately 30% of the pits on GIS Layer 11 have been verified. Some 1000 labour hours of work are estimated to be required to complete the data verification exercise.

Discrepancies identified when undertaking works in the field

Works Services officers typically identify discrepancies in the GIS drainage data when responding to community requests for drainage maintenance. As inconsistencies are identified on site, corrections are marked up on hard copy GIS printouts. These are sent through to the Project Delivery team whereupon Council's GIS drainage layer (11) is updated accordingly. When formal valuations of Council's drainage assets occur (every 3 years) the Asset Strategy team update the asset register to reflect the updated GIS layer.

2.7.2 Capturing New Assets & Asset Modifications

Contributed Assets – Private Developments

New drainage assets resulting from private sector land development projects are processed by the Planning team and inspected by the Asset Preservation team. As part of the handover process, (Refer EI100/01 Handover Process for Subdivisions presented in Attachment 5) the Project Delivery team is informed of new assets and amends Council's GIS drainage layer (11) accordingly. When formal valuations of Council's drainage assets occur (every 3 years) the Asset Strategy team update the asset register to reflect the updated GIS layer. The figure below illustrates the basic process as it applies to drainage pits and pipes.

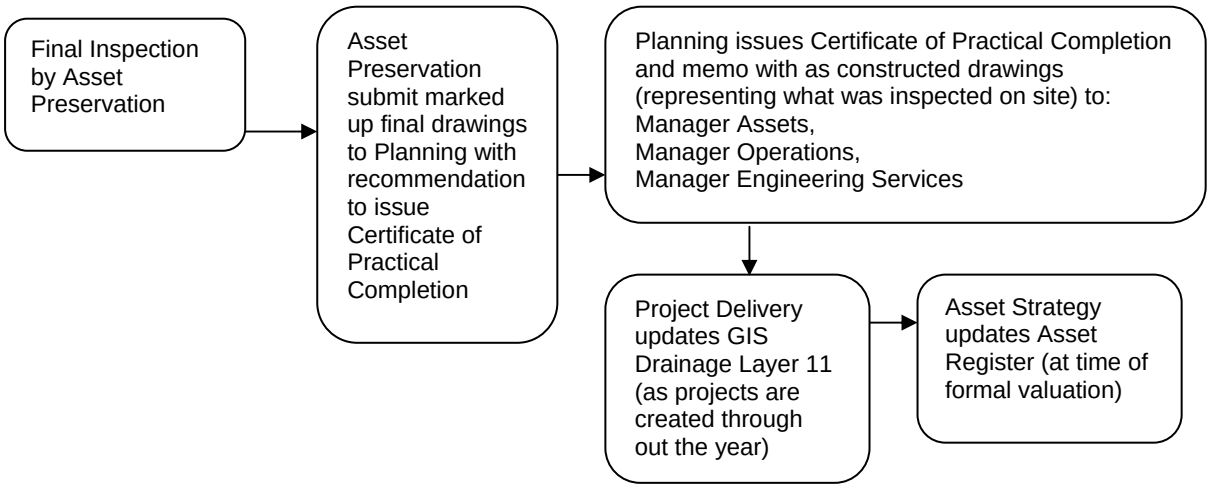

Figure 9 – Recording New Asset Data

Anecdotal evidence suggests that implementation of this process has been less successful for small scale unit developments than for subdivisions.

Council Capital Works Projects

Amendments to Council's GIS drainage layer (11), as a result of Council managed capital works projects and upgrades, are undertaken in an informal manner.

Drainage upgrade works are generally funded under capital works program *4017 - Drainage Upgrades*. A formalised process (or assigned responsibility) doesn't exist to ensure all associated drainage asset data is updated. Other capital works programs (such as those listed below) often impact on drainage assets, or result in the construction of new WSUD treatments. The inventory of new and altered drainage assets resulting from these (and various other capital works programs) is rarely captured in an inconsistent fashion.

- 3000 – Major Projects
- 4007 – Road and Bridge Construction
- 4015 – Place Management
- 4016 – Streetscape Upgrades
- 4018 – Sustainability Initiatives

The above programs are managed by various Council teams including:

- Project Delivery
- City Development
- Strategic & Economic Development
- Parks Services
- Sustainability
- Facilities

Project managers sometimes do not realise the importance of updating the GIS drainage layer, and asset register. As a result, updates are often missed and only occur following informal notification to the Project Delivery or Asset Strategy team. While some process improvements have occurred, there are opportunities to further improve the transfer of data to ensure that both the

asset register and GIS layer reflect the work that has been completed via the Capital Works Program.

Renewal Projects

Council's drainage renewal program (*1003 – Drainage)* is managed by the Construction team. A sub-project for WSUD rehabilitation is proposed for the 2010/11 financial year and will be managed by the Project Delivery team.

The result of renewal works on Council's drainage assets, recorded by the Construction team, have historically not always been captured in Council's asset register. Spatial changes to GIS layers, resulting from new pipe sizes or altered lengths, are typically notified informally to Project Delivery in a similar fashion to capital upgrades. However, where works involve no spatial change (ie. pit or pipe renewals with no size or location amendment), capturing of non-spatial information (such as dates) has been inconsistent. This has resulted in a significant gap in Council's knowledge of the age of pits and pipes within the municipality. It is recommended that a more formal approach be developed to capture all future renewal works.

2.8 Asset Age

2.8.1 Drainage Pits & Pipes

Given the poor history of renewal record keeping, it is difficult to know the age profile of all Council pits and pipes. A reasonable approximation, based on the year of construction of the road network, has been used as a basis for determining the age of Council's drainage network. Figure 10 below, shows that the majority of Council's drainage network was constructed 30 to 40 years ago with some of the network constructed as early as 1933.

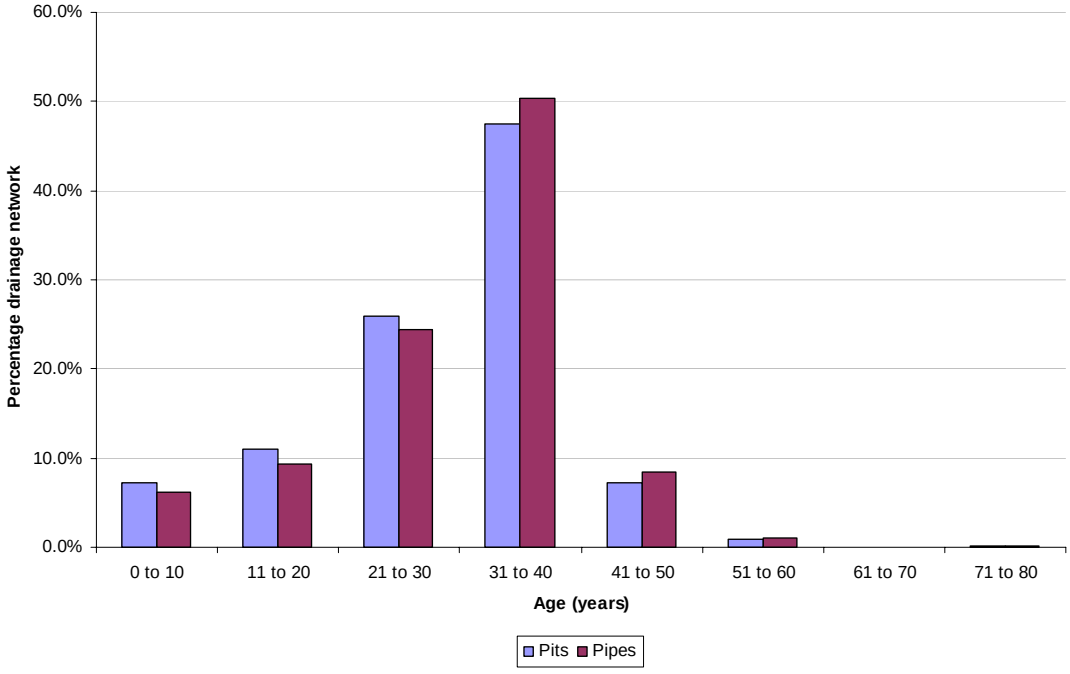

Figure 10 – Age Profile - Drainage Pits & Pipes

Drainage pit and pipe age has been estimated based on the year of construction of the surrounding road network

Prior to the late 1970s, local drainage systems were designed to accommodate runoff from storms with a 5 year average recurrence interval (ARI). A major storm in the mid 1970s resulted in a reassessment of drainage design standards and included the introduction of the Drainage of Land Act (1975). Land developments constructed prior to the enactment of this Act were not required to provide for overland flow paths. As a result, these areas are more likely to be prone to flood damage during major storms with an ARI in excess of 1 in 5 years.

Areas of the municipality, developed prior to 1975, that have not been subject to significant redevelopment tend to have a reduced overland flow capacity. Figure 11 below, illustrates the portion of the municipality constructed prior to 1975.

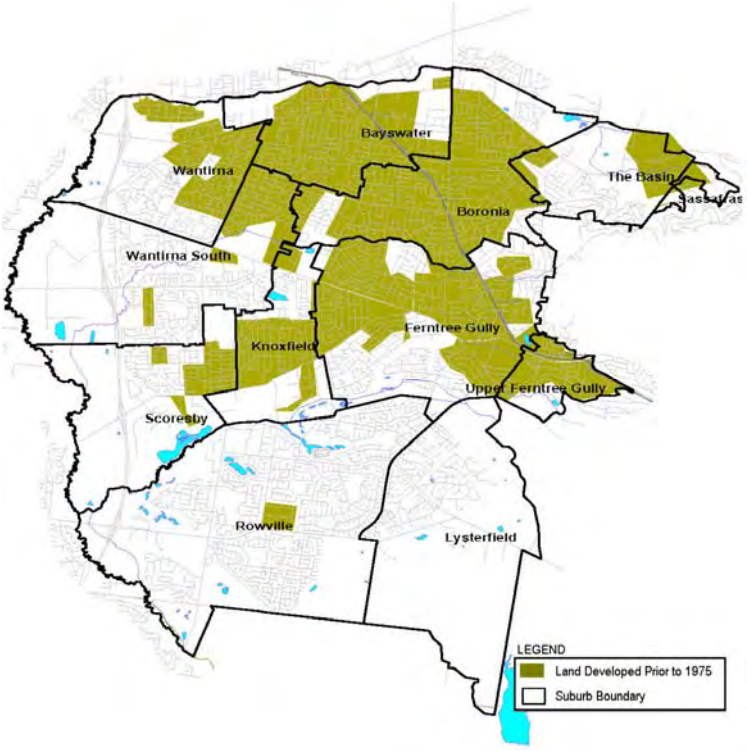

Figure 11 – Land Developed Prior to 1975

The Knox drainage network is generally an underground piped system. Current standards ensure that the piped network is designed to cater for storms with a 5 year average recurrence interval (ARI) in residential areas and 10 year ARI in commercial and industrial areas. The local road network and open space drainage reserves are now designed to provide for overland flows associated with 1 in 100 year storm events. All new land development projects also include measures to ensure there is no increase in downstream flooding risk.

Table 9 below, illustrates the rate of growth in the drainage network since 2003/04.

Year	Total Pipe Length (km)	Growth (%)	Total Pits (No.)	Growth (%)
2003-04	1,294.8		37,363	
2004-05*	1,106.8	-17.0%	33,593	-11.2%
2005-06	1,117.7	1.0%	33,923	1.0%
2006-07	1,123.5	0.5%	34,101	0.5%
2007-08*	1,123.2	0.0%	34,303	0.6%
2008-09	1,136.0	1.1%	34,693	1.1%

Table 9 – Recent Growth

* Denotes year of formal asset valuations. Other years are estimates only.

In 2004-05 a review of Council's drainage asset data, at the time of formal asset valuations, revealed that Council had included a significant number of Melbourne Water assets in its inventory. These assets are not owned, or maintained by Council, and were subsequently derecognised.

Drainage assets have generally been created by developers and handed over to Council upon completion of land development works. Given that the municipality contains some undeveloped green field sites, and the growing trend of multi-unit development, the current rate of growth can be expected to continue in future years. Growth in the network imposes increased drainage maintenance and renewal obligations on Council.

2.8.2 WSUD Treatments

There is no data available to determine the age distribution of WSUD treatments. It is worth noting however, that Council, recognising the importance of managing stormwater quality, began installing water sensitive urban design features such as gross pollutant traps as early as 2000.

Given that regular maintenance and renewal of all water sensitive urban design features is required to ensure their continued functionality, it is important that Council create a register of these assets (including year of construction). This register can then be used to more confidently inform appropriate renewal and maintenance programs and the associated funding requirements.

2.9 Recent Expenditure

Funding allocations at each stage of the asset lifecycle impact on the standard to which the asset class is able to perform. Lifecycle cost components are illustrated in Figure 12 and described below.

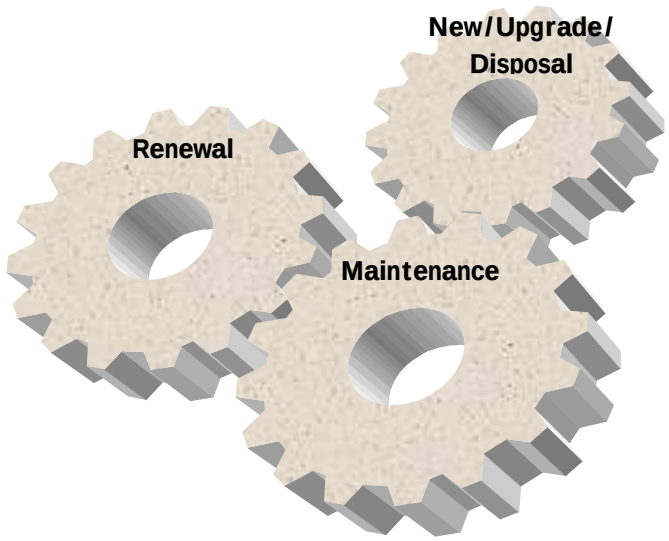

Figure 12 – Lifecycle Cost Components

- *Maintenance expenditure* is required to ensure Council's drainage network is safe and functional.
- *Renewal expenditure* is required to reinstate or rehabilitate drainage network components that have deteriorated to such an extent that they have become unserviceable.
- *New/Upgrade/Disposal expenditure* results from ongoing strategic assessment of the functionality of the network. Upgrades enable an increase in capacity and can lead to a reduction in demand for maintenance. Costs associated with the disposal of drainage assets are generally absorbed into the expenditure for asset renewal or upgrade.

Financial sustainability requires a balance between the maintenance, renewal and disposal of existing assets and the delivery of new and upgraded assets.

2.9.1 Maintenance, Renewal & Upgrade Expenditure - Pits & Pipes

The tables in this section of the report summarise recent trends in Council expenditure for maintenance, renewal and upgrade of the drainage pit and pipe network.

Maintenance

Council undertakes a routine hazard inspection program for drainage pits located in the road network. Pipes are not inspected for hazards. A number of reactive and routine drainage maintenance activities are also provided. The inspection frequencies and maintenance service level standards are documented in the Knox Road Management Plan.

Maintenance funding, as illustrated in Table 10, has been increasing since 2006/07. Current funding levels allow Council to spend an average of $39 per year on each pit and $1,187 on each kilometre of drainage pipe.

Year	Total Length (km)	Total Pits (No.)	Maintenance Funding**		
			($'000)	$/km	$/ Pit
2003-04	1,294.8	37,363	1,133	875	30
2004-05*	1,106.8	33,593	1,095	989	33
2005-06	1,117.7	33,923	1,242	1,111	37
2006-07	1,123.5	34,101	1,206	1,073	35
2007-08*	1,123.2	34,303	1,275	1,135	37
2008-09	1,136.0	34,693	1,348	1,187	39

Table 10 – Maintenance Expenditure History

All expenditure data has been obtained from Council Annual Reports and verified by Finance.

* Denotes year of formal asset valuations. Other years are estimates only.

** Denotes funding provided under the following operating budget line items

- 34260 Drainage Pipe Cleaning - $282,408 in 2008/09
- 34273 Drainage Pit Cleaning - $211,285 in 2008/09
- 34207 Lintels Installations - $105,410 in 2008/09
- 34222 Outfall Drainage Channel Maintenance Contracts - $50,479 in 2008/09
- 34205 Drainage Maintenance - $493,786 in 2008/09

Drainage maintenance budgets are managed by the Works Services team. Discussions with Work Services suggest that while there is some variation in the requirements for each of the separate maintenance accounts, Council's overall budget allocation for drainage maintenance is considered adequate. Advocating for additional maintenance funding is not considered necessary. The Works Services team has also confirmed that a significant proportion of drainage maintenance works are effectively pipe replacements, whereby small sections of collapsed pipes are removed and replaced.

Renewal

Council's long-term target is to ensure renewal funding for drainage is set at a level which enables Council to provide the community with a serviceable network that meets current and future community needs. The capacity to achieve this is dependant on Council budget constraints and the anticipated rate of asset deterioration in future years.

Recent renewal funding levels are illustrated in Table 11. The data suggests that despite an increase in funding, the renewal rate falls short of the anticipated rate of asset deterioration (based on an economic asset life of 80 years).

Year	Renewal Funding ($'000)	Pipe Length Renewed* (km)	Current Repl. Value ($'000)	Annual Depr'n ($'000)	Depr'n / Current Repl. Value (%)	Renewal Rate (%)
2003-04	34	0.2	212,083	2,510	1.18%	0.02%
2004-05	30	0.2	184,896	2,057	1.11%	0.02%
2005-06	721	4.3	186,711	2,347	1.26%	0.39%
2006-07	703	4.2	187,694	2,365	1.26%	0.37%
2007-08	880	4.9	203,130	2,376	1.17%	0.43%
2008-09	1,658	9.2	205,439	2,550	1.24%	0.81%

Table 11 – Renewal Expenditure History, Value and Consumption

All renewal expenditure data has been obtained from Council Annual Reports and verified by Finance

* denotes an estimated value

Despite significant funding allocations, the approach to drainage renewal is still somewhat embryonic in nature. Renewal ranking criteria are rarely used due to a lack of data, with works planned using the discretion and local knowledge of Council officers responsible for program delivery. Renewal works in the past haven't been recorded in a systematic manner to enable accurate updating of Council's asset register.

Discussions with the Construction team, responsible for delivery of the renewal program, suggest that recent works have incorporated replacement of concrete pit lids with Terra Firma lids. These lids are lightweight and make pit maintenance easier. In 2008/09, approximately 70% of renewal funding was directed towards pipe and pit renewal. Approximately 20% of renewal funding was used on CCTV pipe audits, while the remainder of funding was allocated to pit lid replacements (Terra Firma) and lintel repairs. Approximately 50 pit lids were replaced in 2008/09.

Since 2009, the Construction team has been using a portion of the capital renewal budget to fund some CCTV audits of Council pipes. These CCTV audits are managed by the Construction team, and focus on areas where historical data (analysed by the Asset Strategy team) has suggested renewal works are likely to be found. Assessing a cross section of pipe sizes was also attempted in initial audits. However, a more strategic approach to pipe condition auditing is recommended to be continued. Future pipe condition audits should be conducted according to a prioritised program that considers the criticality of assets within each hierarchy classification.

Previously, the Construction team did not have the tools to record the relevant details of drainage renewal expenditure on the asset class. The length of pipe and number of pits actually renewed has not been supplied to Asset Strategy therefore has not always been captured in Council's asset register. An appropriate system must be developed to improve the approach to renewal record keeping. Over time, this will provide useful data for the review of the

estimated economic life of these assets and enable more informed assessment of the adequacy of renewal practices and funding levels.

New/Upgrade

Drainage upgrades are funded under capital works program *4017 – Drainage Upgrades*. Projects delivered under this program may involve construction (or modification) of flood ways and retarding basins, and minor or major works to modify or create new pipes and pits. Officers have historically found it difficult to report on asset quantities upgraded.

Recent funding and expenditure is summarised in Table 12. Since 2006/07, expenditure on drainage upgrades has consistently fallen well short of allocated funding.

Year	Upgrade Funding* ($'000)	Upgrade Expenditure ($'000)
2005-06	355	346
2006-07	133	56
2007-08	327	296
2008-09	619	105
2009-10	739	Not yet known

Table 12 – Drainage Upgrade Expenditure History

All figures are based on Capital Works programs and data maintained by Project Delivery

* upgrade funding including any carry forwards and mid year budget review variations

Funding was increased in response to major storms during 2007 which highlighted deficiencies in Council's drainage network. The increased funding was intended to enable the Project Delivery team to work towards addressing capacity issues that were identified in the Knox Drainage Strategy and were assessed as posing intolerable risks to the community. Following the major storms in 2007, twenty eight (28) projects (approximately $5M in value) were considered to be necessary to address an intolerable risk. Council's approach to defining intolerable flooding risks is discussed further in section 7.7.3 of this report.

To address all capacity issues identified in the Knox Drainage Strategy (2005), and as a result of the 2007 storms, a prioritised listing of some 348 capacity issues was developed and presented to Council in October 2008. Additional funding ($560,000 per year) was sought to address projects that were defined as posing an intolerable risk within a 10 year timeframe.

Since 2007, only four projects have been implemented, however several more are in progress. As the drainage issues list is dynamic and responsive to customer requests and drainage referrals that occur when maintenance crews identify drainage capacity constraints in the field, the number of issues, including those deemed to pose an intolerable risk, continues to grow.

Discussions with the Project Delivery team, responsible for delivery of this capital works program, suggest that the team has always found it difficult to deliver. Completion of design and construction of flood mitigation projects

within the available timeframes has been difficult. In 2008/09 the increased funding was only made available at the mid year budget review. Competing team priorities and difficulties with solutions proposed by design consultants, made it impossible to deliver the capital program. Further analysis is required to determine the underlying reasons and ensure the organisation is better able to deliver drainage system upgrades in the future.

2.9.2 Maintenance, Renewal & Upgrade Expenditure - WSUD Treatments

Until recently, expenditure on other components of the drainage network (including WSUD treatments) has not been tracked by Council making it difficult to assess its adequacy.

Maintenance

The table below summarises the departments with responsibility for maintaining WSUD treatments. Council has not measured actual expenditure on maintaining these assets.

WSUD Treatment	Quantity	Current Maintenance Responsibility
Rain garden/basin	7	Parks/ Works*
Bio-retention tree pits	56	Parks/ Works*
Swale/filtration trench (filter media)	6	Parks/ Works*
Swale	1	Parks
Infiltration system	6	Parks/ Works*
Wetland	4	Parks
Permeable paving	2	Works
Gross Pollutant Traps	11	Works
Sedimentation tank/basin	1	Parks
Enviss system	1	Works

Table 13 – Maintenance Responsibility - Water Sensitive Urban Design Features

* Parks Services team maintain the horticultural elements of the WSUD feature. Works Services maintain the constructed elements of the asset.

Note that rainwater tanks are managed by Council's Facilities team.

Historically, expenditure on maintenance of WSUD features has been absorbed into the maintenance of general open space and existing drainage maintenance accounts. The costs associated with permeable paving maintenance has been absorbed into general footpath and shared path maintenance.

The 2010/11 budget introduced dedicated funding for the maintenance of WSUD features and a routine maintenance program for the cleaning and maintenance of rainwater tanks.

A discussion with the Reference Group (refer Attachment 1 for a list of participants) suggests that even though WSUD maintenance has not been previously provided, it has historically amounted to a small proportion of total

maintenance funding. However as WSUD treatments become more common and begin to age, maintenance requirements are likely to pose increasing demands on maintenance crews.

Currently, most requests for WSUD maintenance are for nuisance issues, such as clearing litter from rain gardens and unblocking of sediment pits. Operations Centre staff note that there is insufficient performance history to be able to accurately predict future maintenance demands.

Renewal

In recognition of the need to fund the ongoing rehabilitation of WSUD treatments capital funding has been sought as a sub-program under the *1003 - Drainage Renewal* program. The sub-program will be managed by Project Delivery. In the past WSUD rehabilitation works were unfunded.

With regard to rainwater tanks, the recent introduction of lifecycle costing to capital works projects is intended to provide additional renewal funding to Council's Long Term Financial Plan. While not yet implemented fully, the intention is that additional funding will be allocated to the Facilities team's renewal budget to allow for management of future renewal liabilities.

New/Upgrade

Since 2005, it is estimated that some $735,000 has been spent introducing WSUD features into Council's drainage system. These works have generally been funded under capital works programs *4017 – Drainages Upgrades* and *4007 – Road and Bridge Construction*. Some funding assistance has been received from Melbourne Water to support delivery of selected projects. The ongoing maintenance and renewal costs required to ensure continued functionality has not yet been defined.

Table 14 lists recent projects where significant WSUDs have been installed.

Year	Project	Upgrade Expenditure ($'000)
2005	Koolamara Waters, Ferntree Gully	$318
2005	Rowville Community Centre	$30
2006	Knox Civic Centre	$8
2008	Arboretum Car Park	$10
2008	Coleman Rd/Lewis Rd shops	$11
2009	Jenola Reserve, Rowville	$9
2009	Fairway Drive Reserve, Rowville	$8
2009	Boronia Place Management, Dorset Square, Boronia	$21
2009	Carrington Park, Knoxfield	$320
2009	Wantirna Road Car Park	$0 (incorporated as part of other works)

Table 14 – Recent Expenditure on Water Sensitive Urban Design Features

A further $858,000 has been spent on rainwater tank installations between 2002 and 2010. Council now has capacity to store and reuse some 3.8 mega litres of stormwater runoff. This was funded from the capital works budget *4018 – Sustainability Initiatives*.

2.10 Improvement Recommendations

PROJECT 2.1. Creation & Maintenance of WSUD Asset Register & GIS Layer

Given that Council has a responsibility to ensure their continued functionality, it is important that the register of WSUD assets is maintained. It is recommended that Project Delivery establish and maintain this register and the associated GIS Layer.

In the first instance, data fields to be populated should include:

- a unique asset identifier
- WSUD type
- the expected life
- replacement cost
- and year of construction.

Collation of data for all WSUDs should enable future versions of the predictive financial model (presented in Chapter 10) to include lifecycle management costs associated with these assets.

Once the WSUD asset register has been established, it should be expanded upon to include records of other physical drainage assets that affect the delivery of Council's stormwater management service. The following assets should be considered for inclusion: rainwater tanks, retarding basins, open drains and dams.

PROJECT 2.2. Update Drainage GIS Layer & Asset Register – New / Upgrades

It is important that all alterations to Council's drainage assets that occur as a result of capital works projects undertaken by Council are reflected in the GIS drainage Layer (11) and Council's asset register (Lifecycle). This project should be led by Engineering Services.

Recognising that Council's current approach to asset record keeping has not been consistent, it is recommended that a change in approach be implemented. The asset register should remain centralised within Lifecycle and continue to be managed by Asset Strategy. However, responsibility for keeping the data contained in the register up to date should be decentralised.

To facilitate this approach, the Asset Strategy team should develop template electronic data entry forms to be used to populate Council's asset register. The Project Delivery team (and all other Project Managers responsible for new/ upgrade capital projects) should be trained in the use of these forms. These officers should also be charged with responsibility for adding new records and recording asset modifications that result from all capital projects.

It is recommended that the current process be formalised and aligned to be similar to that used to record assets constructed by private developers (*EI-100 – Asset Handover Process*). A simplified representation of the proposed

process is outlined in the figure below. Officer responsibilities must be assigned. It is also important that implementation of the agreed process be monitored (by Asset Strategy) to ensure the data is systematically and accurately entered into the system and transferred between relevant departments.

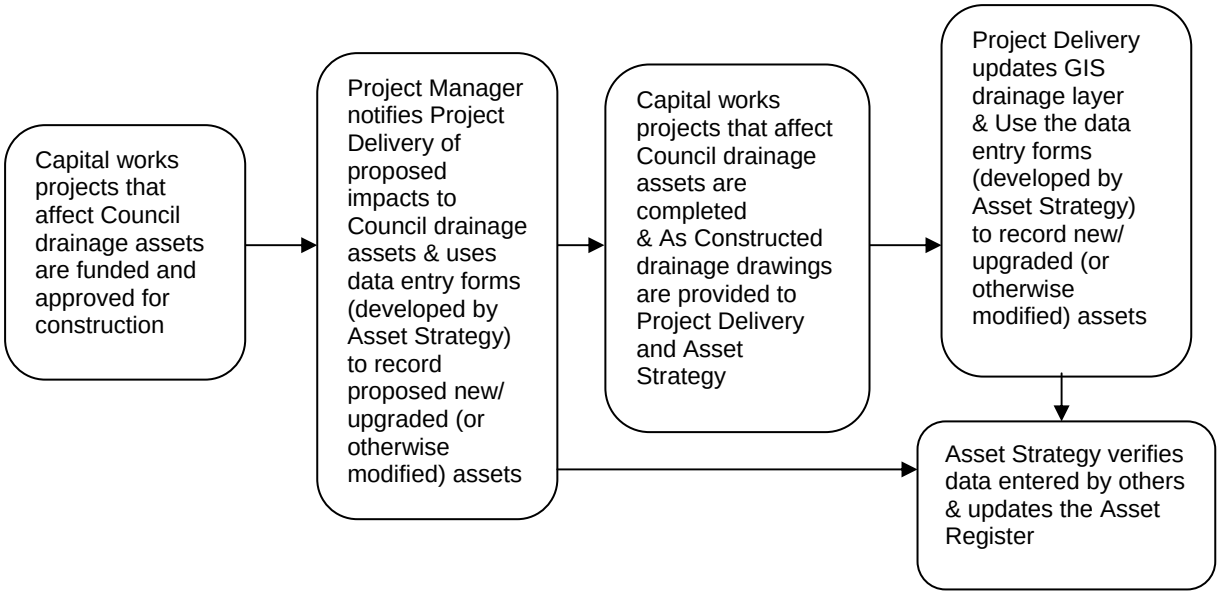

Figure 13 – Asset data management process – Council Capital Works

Data updates should not be limited to drainage pits and pipes, but should also include all WSUD treatments and rainwater tanks.

PROJECT 2.3. Update Drainage GIS Layer & Asset Register – Renewals

It is recommended that a process be developed to ensure all renewal works that affect Council's drainage assets, are reflected in the GIS drainage Layer (11) and the asset register. This project should be led by the Construction Team.

Recognising that Council's current approach to asset record keeping has been inconsistent, it is recommended that a formal change in approach be implemented. The asset register should remain centralised within Lifecycle and continue to be managed by Asset Strategy. However, responsibility for keeping the data contained in the register up to date should be decentralised.

To facilitate this approach, the Asset Strategy team should develop template electronic data entry forms to be used to record the impacts of all renewal work in Council's asset register. The Construction team (responsible for all drainage renewal works) should be trained in the use of these new electronic data entry forms and be responsible for updating the data.

It is recommended that a 5-10 year renewal program be developed (by the Construction Team), and updated annually to reflect new asset data and changes in priorities, (refer Project 10.1). The renewal program must be stored electronically and prioritised based on objective, measurable parameters. It should include consideration of the proposed hierarchy. Once developed, the renewal program should be communicated to the organisation via a GIS Layer that illustrates the proposed program (and timing) of works (refer Project 2.4ii).

As the renewals are undertaken in the field, the Construction team would be responsible for providing data to maintain both the GIS Layer and the asset register to indicate the renewed (and otherwise modified) assets. Data management responsibilities must be assigned and the implementation must be monitored to ensure data is systematically and accurately recorded.

PROJECT 2.4. Creation & Maintenance of GIS Layers to Support Decision Makers

New GIS layers should be developed to assist coordination of decision makers. It is recommended that this project be led by Council's GIS officer. It is recommended that new layers illustrate the following information:

i) Sites with a known flooding history (i.e. multiple customer requests raised during multiple storm events)

   This layer should be developed by Asset Strategy. It should be updated by the following teams:

   - Asset Strategy – use maintenance history stored in the Work Order System to highlight issue locations
   - Project Delivery – remove issues that have been addressed by upgrades
   - Construction team – remove issues that have been addressed by renewal works

ii) Proposed drainage asset renewal program

   This layer should be developed by the Construction team (with support from Asset Strategy). It should illustrate the forward program for drainage pipe condition audits and drainage asset renewals (for the next five years). The data should be updated by the Construction team as the projects are delivered.

iii) Proposed drainage asset upgrade program

   This layer should be developed and updated by Project Delivery to show a live listing of sites that have been found to require a drainage upgrade and have been assessed as posing an intolerable risk.

iv) Sites where opportunities to introduce environmental controls (including WSUDs)

   This layer should be developed and updated by Project Delivery. The initial highlighted sites should reflect those reported in the Knox Drainage Strategy and the High Value Catchment Areas as defined in the WSUD & Stormwater Management Strategy. Project Delivery should ensure all capital works project managers are aware of this layer and make use of it when incorporating WSUDs into their projects.

PROJECT 2.5. Condition Audits – Prioritised Rolling Programs

It is recommended that further work be undertaken to improve Council's knowledge of the capacity and condition of the following assets:

- Pits
- Pipes
- Water Sensitive Urban Design (WSUD) treatments (including porous paving, infiltration trenches, rain gardens, bio-retention pits, bio-retention trenches, gross pollutant traps, litter baskets)

- Open drains
- Retarding basins
- Rainwater tanks
- Dams

Prioritised programs for all asset condition audits should be developed and administered by the Asset Strategy team taking into account the proposed drainage hierarchy.

The delivery of CCTV audits, could continue to be administered by the Construction team, but must be delivered in accordance with a hierarchy based prioritised program developed in consultation with Asset Strategy. Audit results must be progressively added to Council's asset register and linked to GIS, so the data is readily available for decision makers. Responsibility for this project should rest with Asset Strategy.

PROJECT 2.6. Embed Hierarchy into Prioritisation Processes for Renewal & Upgrade Programs

Following adoption of this plan, and prior to the preparation of business cases for the following year, all ranking criteria that is used to prioritise capital works, new/upgrade and renewal projects must be updated to include consideration of the drainage hierarchy.

If a 100 point scoring system is used to prioritise works then the drainage hierarchy should account for at least 20 points. The scores to be assigned to each hierarchy classification are suggested below.

- Road Reserve - Major Drain 20 points
- Habitable Land – Major Drain 15 points
- Undeveloped Land – Major Drain 10 points
- Road Reserve - Minor Drain 8 points
- Habitable Land – Minor Drain 6 points
- Undeveloped Land – Minor Drain 4 points

Responsibility for this project should rest with Project Delivery and Construction as the responsible teams for the upgrade and renewal programs respectively.

PROJECT 2.7. Review Economic Life Assumptions

As part of the next formal valuation of Council drainage pits and pipes (due in 2010/11), it is recommended that the Asset Strategy team review the economic life assumption for these assets.

PROJECT 2.8. Review Financial Reporting of WSUDs & Other Drainage Components

It is recommended that the Manager Assets, with support from Finance, Engineering Services and Operations review Council's approach to the financial reporting of Water Sensitive Urban Design treatments and other drainage components that are not currently recorded in Council's financial reports. This project should include a review of Council's approach to financial reporting for rainwater tanks.

Other Council asset reporting practices should be considered in this review and advice should be sought from relevant authorities such as the Municipal Association of Victoria.

Chapter 3 Drainage Authorities

CHAPTER SUMMARY

- Melbourne Water is the Regional Drainage and Flood Plain Management Authority for the Greater Melbourne area.
- Part 9, Division 1 of the Local Government Act (1989) notes Council's specific functions, powers and restrictions regarding:
  - Sewers and drains vested in Council
  - Conservation or diversion of drainage
  - Drainage of land
- Each of the authorities listed below impact on the success of Council's stormwater management practices:
  - Melbourne Water
  - Private land owners
  - Neighbouring Councils
  - VicRoads
  - Rail Authorities
  - Department of Sustainability & Environment
  - Environment Protection Authority
- Unlike Melbourne Water, Councils do not have a statutory responsibility for floodplain management.
- Council plays a significant role in land-use planning and management of the local stormwater drainage system.
- Management of property inundation, in areas outside designated floodplains, is the prime responsibility of Council. Council is directly responsible for the preparation and implementation of drainage works within these areas.
- Council collaborates with other responsible authorities and specialist groups to remain abreast of industry developments.
- The Department of Sustainability & Environment (DSE) has recently reviewed dam safety regulation and management practices. The review highlighted the need for:
  - regulatory reform that could be applied to dams and dam like structures such as retarding basins.
  - improved inter agency communication
  - more proactive dam safety management practices
- The following improvement projects are recommended:
  - Implement more strategic dam and retarding basin management practices
  - Develop a Knox Dam Safety Emergency Management Plan
  - Staff education regarding Council and other drainage authority responsibilites.

3.1 Introduction

This chapter outlines key Council and Melbourne Water obligations. Drainage management responsibilities of others, listed below, are also outlined.

- VicRoads
- Environment Protection Authority (EPA)
- Department of Sustainability & Environment (DSE)
- Neighbouring Councils
- Rail Authorities
- Private land owners

Each of these bodies can impact on the success of Council's stormwater management practices.

3.2 Melbourne Water Obligations

By delegation from the Minister responsible for the Water Act (1989), Melbourne Water is the Regional Drainage and Flood Plain Management Authority for the Greater Melbourne area. Melbourne Water also has a role as a referral authority.

Melbourne Water operates under the Melbourne Water Corporation Act 1992. The rights and powers of Melbourne Water, as a drainage authority, are detailed in:

- Section 3 and Part 10, Melbourne and Metropolitan Board of Works Act -1958; and
- Division 4 of Part 10, Water Act 1989.

Council's GIS layer 12 illustrates the drainage pits and pipes, within the City of Knox, for which Melbourne Water is the responsible drainage authority.

All planning applications for urban subdivisions and other developments impacting directly on the main drainage system are referred to Melbourne Water. This enables Melbourne Water to comment on applications and, if necessary, place conditions on planning permits to ensure new developments include drainage systems that function to protect Melbourne's waterways.

Planning controls are imposed on developments within areas covered by Melbourne Water planning overlays. Figure 14 highlights the special building overlay and land within the municipality that has been identified by Melbourne Water as subject to inundation. Specific floor level controls can only be placed on development of land covered by these overlays.

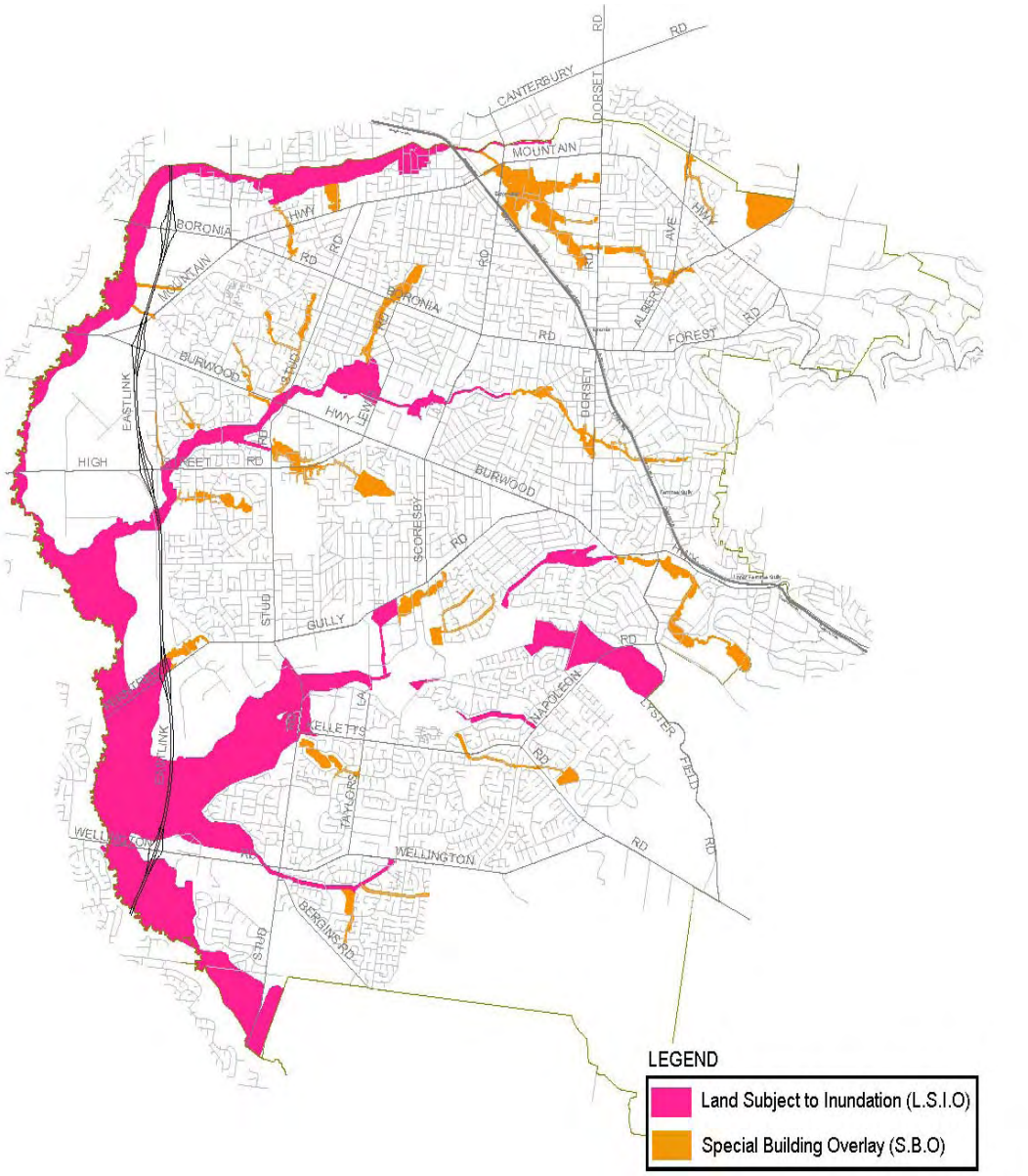

Figure 14 – Land Subject to Inundation & Special Building Overlay

3.3 Council Obligations

Provision of essential drainage infrastructure by Council is a fundamental element of good governance. The Local Government Act provides the legal framework to assist Councils in providing services to the community. It suggests that a Council is required to provide equitable and appropriate services and facilities for the community and to ensure those services and facilities are managed efficiently and effectively. Part 9, Division 1 of the Local Government Act (1989) notes Council's specific functions, powers and restrictions regarding:

- Sewers and drains vested in Council
- Conservation or diversion of drainage
- Drainage of land

Other relevant legislation includes:

- Catchment and Land Protection Act (1994)

- Emergency Management Act (1986)
- Planning and Environment Act (1987)
- Water (Governance) Act (2006)
- Water Act (1989)

The Drainage of Land Act (1975) was repealed and replaced by the Water Act (1989). The Water Act (and other relevant legislation) makes no specific mention of the drainage system obligations imposed in the Drainage of Land Act (1975). However, the design philosophy, which incorporates provision of overland flow paths, has continued in practice, and forms part of guidelines, reports and specifications from drainage authorities, as well as being referred to in Australian Standard AS3500.3 (Plumbing and Drainage – Stormwater Drainage).

3.3.1 Responsibilities within Designated Floodplains

The *Victoria Flood Management Strategy (1998)* developed by the Department of Natural Resources & Environment identifies the management of floodplains, including the identification of roles and responsibilities of various levels of government within the floodplain areas.

Unlike Melbourne Water, Councils do not have a statutory responsibility for floodplain management. However, Council plays a significant role in land-use planning and management of the local stormwater drainage system.

The State Government, through the Department of Sustainability and Environment (DSE), has prime responsibility for development of policies and the approval of flood management strategies within floodplain areas. Catchment Management Authorities (Melbourne Water for Melbourne Metropolitan area) advise the Government (DSE) in relation to policies and priorities, and implement flood management plans.

Council's role, within designated floodplains, is principally to manage statutory planning schemes, and to prepare and implement local floodplain management plans. In accordance with a regional floodplain management strategy, Council is expected to monitor significant inundation events, and to manage and maintain local approved works and measures.

3.3.2 Outside Designated Floodplains

Council's prime responsibility is the management of property inundation in areas outside designated floodplains. Council is directly responsible for the preparation and implementation of drainage works within these areas.

3.3.3 Emergency Management

In an emergency event, Victorian Government Agencies, Local Government, volunteer organisations and communities work together to respond, save lives and property using trained personnel and specialised equipment. Under the Emergency Management Act 1986, municipal councils may co-operate in relation to emergency management. Councils must prepare and maintain a municipal emergency management plan and appoint a municipal emergency response officer. Responsibility for the immediate response to a flooding emergency rests with the Victorian State Emergency Service, but Council supports recovery activities such as the clean-up of debris. When a widespread municipal emergency is declared, the municipal emergency response officer coordinates Council's immediate response.

3.4 Other Authority Responsibilities

3.4.1 VicRoads

In accordance with the Code of Practice: Operational Responsibility for Public Roads, developed to support the Road Management Act (2004), VicRoads is responsible for the management of drainage assets that have been constructed to capture runoff from the surface of arterial roads. Council GIS layer (358) indicates drainage pits and pipes within the municipality that, in accordance with the code of practice, are deemed to be the responsibility of VicRoads.

3.4.2 Environment Protection Authority (EPA)

The EPA is responsible for protection of the quality of Victoria's environment by application of the statutory powers described in the Environment Protection Act 1970. The EPA regulates the protection of water quality and manages the licensing of waste discharges.

3.4.3 Neighbouring Municipal Councils

Boundary agreements that set out the demarcation of maintenance responsibilities with neighbouring Councils are documented in the Knox Road Management Plan. These include reference to management responsibilities for underpasses (major culverts) that form part of Council's shared path network.

3.4.4 Rail Authorities

The Rail Safety Act 2006 requires all parties with responsibility at road-rail crossings to attempt to enter into Safety Interface Agreements (SIAs) by 1 July 2010. The SIA is intended to incorporate demarcation of maintenance responsibilities (including drainage) relating to rail reserves. This agreement is currently being developed between Council and Metro Trains and once finalised, will be documented in the Knox Road Management Plan.

3.4.5 Property Owners

Private sector land owners and occupiers are responsible for the legal discharge of stormwater from their properties into Council's drainage system. Attachment 2 contains an extract of the Knox Road Management Plan which defines the demarcation of Council and property owner responsibilities.

3.4.6 Department of Sustainability & Environment (DSE)

Under the Emergency Management Manual of Victoria (EMMV) the DSE is listed as the Control Agency with overall responsibility for managing dam safety. Council's approach to dam safety management has been found to be deficient. Two recent examples are outlined below.

Heany Park Dam – In January 2005 the DSE contacted Council seeking information regarding Council owned dams. Later in 2005 the DSE expressed concerns with Council's approach to the management of Heany Park Dam. In 2007 the failure of Heany Park Dam was included in Council's risk register. Remedial works were completed in March 2010.

Cardiff Street Reserve – In 2009 a DSE review raised concerns regarding an on-site detention (OSD) system designed and constructed by Council at the Cardiff Street Reserve. Council had not been aware of DSE requirements regarding these systems and had therefore not assessed compliance of the design with the DSE's requirements. Having been made aware of this

oversight compliance was assessed and found to be adequate. Staff are now aware of a need to ensure all future OSD designs are compliant with DSE requirements. A formal methodology for checking and certifying compliance is yet to be developed.

Dam Safety Review – In early 2009 the DSE engaged MWH to undertake a Dam Safety Regulatory Review on public dams. The review was intended to provide public dam owners with an opportunity to reflect on their dam management practices and provide the DSE with recommendations on how to approach a future regulatory framework. Knox City Council participated in this review by way of an interview with the Manager Engineering Services on the 12 May 2009.

The review found that dam safety information for local government was more than likely to be inadequate. Limited interaction and information exchange occurs between the DSE and local government. The interaction of dam safety regulation with other government regulatory instruments was also found to require further clarification. Explicit dam safety regulation instruments are lacking and applied inconsistently. There is not an explicit requirement for public dam owners to report on dam safety.

If a well defined regulatory instrument was implemented it would create clarity for local government and initiate uniformity in its application across the industry. This framework could also be applied to dam like structures such as retarding basins.

Public dam owners have expressed a desire to work in partnership with the DSE. In terms of safety and technical advice, the preference is for the DSE to provide direction, training, mentoring and feedback to public dam owners.

Awareness of dam safety has been historically low within local government. Like most local government authorities, Knox City Council does not have Dam Safety Emergency Plans (DSEP) in place and has relied upon the municipal emergency management plan (MEMP). The MWH review recommends that all public dam owners initiate the development of DSEPs for their dams.

At Knox, the Manager Engineering Services has responsibility for dam management. To date, Council has relied on support from external consultants due to minimal in house dam safety expertise. Officers have an understanding of hydraulic design and flood calculations but need to outsource complex dam safety engineering issues to specialists. At present Council would invoke its MEMP in the event of a dam structure failure.

As a result of Council's participation in the MWH review, dam safety awareness is gradually improving at Knox. A number of initiatives have been instigated:

- Discussions with Melbourne Water have commenced with the objective of initiating a project that rationalises and confirms responsibilities regarding retarding basins within the municipality
- A Regional Drainage Interest Group has been set up for the region to discuss drainage matters of which Melbourne Water has been a supportive organisation. Council has found it difficult to maintain a commitment to this group.

Since the review Council has acknowledged the need for a more proactive approach to dam management. Improvement opportunities that have been acknowledged include:

- Clarifying ownership of a number of dams and retarding basins within the municipality
- Review of planning overlays (with reference to vegetation controls) in the vicinity of dams and retarding basins
- Determine whether the design intent of existing dams (and retarding basins) has been compromised. This is considered to be particularly important for retarding basins with dual purpose of recreation and retaining water
- A need to be prepared to manage the impact of climate change (increased likelihood of more intense storms) on the effectiveness of Council's retarding basins and dams
- Develop an in-house drainage management reference group that meets regularly to improve coordination of decision makers.

3.5 Examples of Council Collaboration with Others

Council's participation in groups such as the Regional Drainage Interest Group and Stormwater Industry Association enables decision makers to remain abreast of new stormwater management initiatives.

3.5.1 Regional Drainage Interest Group

Council is a member of the Regional Drainage Interest Group. This group includes representatives of eleven (11) south-east Melbourne Councils. Participation provides an opportunity to:

- Share useful information
- Develop memoranda of understanding with neighbouring Councils
- Make joint applications for funding
- Collectively pursue support for common issues with other authorities:
  - Melbourne Water
  - Department of Sustainability & Environment
  - VicRoads
- Benchmark Council practices, standards and policies
- Develop regional standards

3.5.2 Stormwater Industry Association

Participation in the activities of the Stormwater Industry Association (SIA) enables Council Officers to learn about innovative stormwater management practices and technologies. The SIA provides a platform which encourages interaction between all parties, engaged in the industry. It encourages the development and understanding of new technologies. It also provides opportunities for Council to promote innovative projects.

3.5.3 Melbourne Water – Potential Partnerships

Melbourne Water has provided Council with flood maps relevant to the municipality. The Project Delivery team has also been in discussions with Melbourne Water to work together to map Blind Creek (or other) catchments for the 5 year, 10, 20, 50, 100 year events and the probable maximum precipitation (PMP) event.

The cost of the project has been roughly estimated to be in the order of $400,000 with Council expected to contribute some $200,000 to pay for:

- consultant fees for mapping and modelling ($100,000)
- floor level survey work ($50,000)
- field survey work ($50,000)

Significant Council time and resources would be required to collate and verify Council's drainage and terrain data.

Benefits Council can expect to derive from this type of project include:

- provide information to support the development of flood safety criteria
- assistance in emergency management planning
- reduce subjectivity involved in the assessment of risk (personal safety and property damage) when prioritising drainage upgrades
- form the basis for creation of a Knox Special Building Overlay (SBO) layer which can then be used to impose planning controls to restrict floor levels when development occurs in areas subject to flooding

It must be noted that the quality of the flood maps that would result from this type of project will depend on the quality of data used. It is therefore considered important to focus on improving Council's asset data.

3.6 Improvement Recommendations

PROJECT 3.1. Implement More Strategic Dam & Retarding Basin Management Practices

It is recommended that the Manager Engineering Services drive the organisation toward a more proactive approach to dam management. Key tasks to be undertaken include:

- Continue the DAMP Reference Group (refer Attachment 1). This group should meet monthly to discuss and resolve all water management issues.
- Clarify ownership of dams and retarding basins within the municipality including those currently used as sporting ovals
- Clarify and communicate Council's responsibilities as a dam (and retarding basin) owner
- Investigate risks and management strategies associated with dam failures.
- Develop a process for checking and certifying On-site Detention System design and construction projects to ensure compliance with DSE requirements
- Seek further guidance, standards and feedback from the DSE on dam safety management techniques
- Review of planning overlays (with reference to vegetation controls)
- Assess the functionality of Council's dams and retarding basins to ensure that the original design intent has not been compromised
- Prepare for the impact of more intense storms (as a result of climate change) on the effectiveness of Council's retarding basins and dams.

- Implement a regular dam and retarding basin condition assessment inspection program
- Consider the introduction of an early warning system to support emergency management

PROJECT 3.2. Develop Dam Safety Emergency Management Plan

In consultation with the DSE, the Engineering Services team should develop a Dam Safety Management Plan for all dams and retarding basins for which Council is the responsible authority.

The role of all stakeholders, including Melbourne Water, DSE and Council, need to be clarified. To ensure the safety of all dams and retarding basins within Council's management responsibility, this project should clarify ownership of all dams and retarding basins.

Management responsibilities for all retarding basins within the municipality should be defined. Sites to be considered should include (but not be limited to) the following locations: Lewis Park, Liverpool Road and Lakewood Drive wetlands. Where necessary demarcation of management responsibilities should be documented and agreed with other relevant authorities, including Parks Victoria.

PROJECT 3.3. Staff Education – Drainage Authority Responsibilities

It is recommended that Engineering Services arrange a staff briefing to improve awareness of Council's stormwater management responsibilities. It is considered important that all decision makers are aware of Council and other drainage authority obligations relating to stormwater management. The scope of the briefing should include dam and retarding basin management responsibilities.

PROJECT 3.4. Develop Demarcation Agreements

It is recommended that the Manager Engineering Services, in consultation with the Operations Centre, drive the development of demarcation agreements with other responsible drainage authorities including Melbourne Water, Department of Sustainability and Parks Victoria.

These agreements should seek to clarify each organisation's responsibilities regarding drainage assets at the interface between Council drains and the major drainage network.

It is recommended that a new GIS Layer be developed for this purpose. Both Operations and the Engineering Services departments should be responsible for maintaining this new GIS Layer. Operations should use the GIS layer to highlight areas where further investigation of drainage responsibilities is required. The Engineering Services team can then use this layer as the basis for discussion with other authorities and the development of documented agreements for sites that are known to be causing confusion. As each agreement is reached, the Engineering Services team should register the agreement in Dataworks and update the GIS Layer with a link to the Dataworks reference number for the agreement.

Chapter 4 Understanding Demand

CHAPTER SUMMARY

- Knox community wellbeing is affected by the standard and performance of Council's drainage system
- Demand forecasting has not been undertaken. Council informs itself of community expectations regarding stormwater management indirectly via:
  - Local Government Community Satisfaction Survey (LGCSS)
  - Review of trends in customer requests for drainage maintenance
- Most customer requests received since 2005 have required the following maintenance activities:
  - Drainage Pit Lid/ Structure Repair (excluding lintels)
  - Clear Blocked Drainage Pipes & Culverts
- The volume and quality of water that must be managed within the municipality is affected by changes in the following aspects of the local environment
  - Built
  - Natural
  - Social and Cultural
  - Legal and Political
- The following built environment features impact future demand:
  - Asbestos lined pipes
  - Legacy of poorly designed land development projects
  - Increasing dwelling density
  - Privately owned on-site detention systems.
- Changed weather patterns have increased the frequency of intense storm events as well as the severity of droughts.
- Councils are expected to harvest and reuse water.
- The National Asset Management and Financial Planning Framework (currently in draft form) is expected to require Councils to provide more consistent asset reporting and demonstrate the link between current and proposed service levels and community expectations.
- Council has a range of tools available to manage service demand. These include:
  - Planning controls
  - Advocacy / partnership with others
  - Community awareness and education campaigns
  - Asset inspections and local law enforcement
  - Realigning and regrading roadways, kerbing, footpaths and driveways
  - Construction of vegetated swale drains, bio-retention trenches
  - Stormwater harvesting via construction of upstream storage (retarding basins and wetlands)
  - Introduction of porous surfaces to replace impervious surfaces
  - Re-grading / realignment of existing table drains
- A number of improvement projects are recommended (refer Attachment 8)

4.1 Introduction

Community wellbeing is affected by the standard and performance of the drainage system. Council aims to ensure that the system is managed in a way that provides the best possible outcomes for current and future Knox communities. Constrained by a lack of resources assigned to strategic water management, however, has meant that demand forecasting has not been undertaken.

More work is required to ensure current and future community expectations, with regard to stormwater management, are well understood and can be translated into meaningful and transparent service level standards. Key stakeholders include:

- Residents
- Property owners
- Business operators
- Visitors to the municipality
- People passing through the municipality
- State and Federal government agencies (including Melbourne Water; Department of Sustainability & Environment; Vicroads; Environmental Protection Authority)
- Insurers
- Neighbouring Councils

This chapter discusses the importance of strategic management of stormwater. Council's current understanding of community expectations is also outlined. Some of the factors affecting demand are highlighted, and a number of potential demand management strategies are provided. Further work is recommended to develop a more detailed demand management plan for the City of Knox.

4.2 Why stormwater must be strategically managed?

Council's approach to the management of stormwater has environmental social and economic implications. As a responsible drainage authority, Council is expected to manage its existing drainage network and act in a manner that ensures current and future development is appropriately managed to:

- Minimise flood damage
- Mitigate significant rises in flood levels and flow velocities
- Allow the passage and temporary storage of flood waters
- Protect the quality and biodiversity of receiving waters

Key functional objectives for Council's drainage network can be summarised as follows:

- Retain and detain peak flows
- Ensure stormwater flows freely at safe flow rates, velocities and depths
- Provide safe and easy access for maintenance crews
- Ensure debris and pollutants are not released to receiving waters

Council's approach to water management should seek to address the environmental, social and economic impacts that can be expected if stormwater is not managed effectively. Each of these impacts is outlined briefly below.

Environmental Impacts

The environment and wildlife can be adversely affected by stormwater runoff that is not appropriately managed. Degradation of water quality is generally caused by erosion and contamination.

Rapidly flowing stormwater, during major storm events, can cause significant scouring and other damage to landscaped areas, creeks and streams. Eroded soil increases potential drainage pit and pipe blockages and increases the turbidity of receiving waterways.

Stormwater can be contaminated with microbiological content resulting from crossovers and overflows from wastewater systems. Herbicides, pesticides and fertilisers, rubbish and other contaminants illegally discharged into the stormwater system can cause major issues downstream. Sediments, oils, greases, metals, animal waste and organic material washed from roads and other impervious areas accumulate in the drainage system and need to be managed.

Social Impacts

Public health and community wellbeing can be diminished if the drainage system fails. Typical issues include:

- System blockages leading to overflows and flooding of properties and buildings.
- Road and pathway access restrictions due to localised flooding
- Loss of amenity during clean up following a storm
- Mosquito breeding, odours and algal blooms in stagnant water

Restoration of lost amenity can often take a long time after flood waters recede and clean up is able to commence. It is therefore important that Council ensure public health and safety risks are mitigated as soon as possible. Effective processes are required to:

- monitor weather patterns
- proactively mitigate expected issues and associated risks
- manage the clean up promptly
- keep the community informed

Economic Impacts

The community accrues significant costs that result from flood damage and the discharge of contaminated stormwater into waterways. Property damage is often expensive to repair and can result in significant business disruption. Investment in proactive stormwater management practices can be expected to reduce this risk.

4.3 Levels of Service

In recent years, the Local Government and Planning Ministers' Council have been working toward the development of a nationally consistent framework for asset planning and management. The *Local Government Financial Sustainability Nationally Consistent Frameworks - Framework 1 - Criteria for Assessing Financial Sustainability and Framework 2 - Asset Planning*

Management (currently in draft form) highlights the Federal government's intention for State and Territory governments to develop mechanisms to ensure Councils:

- Define levels of service in consultation with the community
- Establish cost and quality standards for services delivered from Council assets
- Regularly review services in consultation with the community to determine the financial impact of a change in service levels

Customer service levels relate to how the community expects to receive services in terms of factors such as quality, reliability, responsiveness, and efficiency. Council has not specifically engaged with the community to establish these service level expectations for water management.

During 2008, a business improvement project was undertaken by the Engineering & Infrastructure Directorate to review Council's approach to management of the drainage service and assets. The review focussed on services provided by the Project Delivery team. As part of this project, Council has defined service levels for the creation and upgrade of Council's drainage system. These are included in the Drainage – Service and Asset Management Report (June 2008) and have been translated into specific measurable performance targets. Service level targets for stormwater quality management have been set in the Knox WSUD & Stormwater Management Strategy.

In accordance with the expectations of the Municipal Association of Victoria (MAV) Broadened STEP Program, further work is required to meet the Federal Government's asset management expectations. Defining service levels and ensuring that these are aligned with community expectation is a difficult task. Particularly given that the standard to which Council's drainage system is able to perform during major storms events is limited by the performance of drainage assets for which Melbourne Water, VicRoads and others are responsible.

4.4 Customer Expectations

Council generally expects that local residents and businesses will not tolerate flooding of habitable buildings and will expect flood waters to dissipate quickly after a storm. A common (untested) assumption amongst Council officers is that the general community does not have a thorough understanding of how current drainage systems work and that overland flow during significant rainfall events is to be expected. The limits of Council's responsibilities with regard to flood mitigation are also assumed to be poorly understood.

Council informs itself of community expectations regarding stormwater management indirectly via:

- Local Government Community Satisfaction Survey
- Review of trends in customer requests

It is recommended that community expectations and satisfaction levels continue to be monitored.

4.4.1 Community Satisfaction Surveys

The Local Government Community Satisfaction Survey (LGCSS) provides Council with feedback on community satisfaction each year. Council performance is benchmarked against the performance of 78 other Victorian

councils. Although the survey is pitched at a relatively high level, it does provide Council with information about how their performance is rated over time by the communities they represent.

Apart from the LGCSS (coordinated by the Department of Planning and Community Development), no proactive surveying of community satisfaction is undertaken. The absence of industry-wide satisfaction measures for stormwater management however, makes it difficult for Council to use this survey to gain an understanding of community satisfaction levels. The only key result area that can be used to indirectly measure satisfaction regarding stormwater management is the Local Roads and Footpaths category. The relevance to satisfaction regarding drainage, however, is loose.

Council's performance regarding the Local Roads and Footpaths category, declined in the period 2001 to 2005, followed by improvement between 2005 and 2008, as illustrated in Figure 15 below. Satisfaction levels dipped in 2009 to 2007 levels.

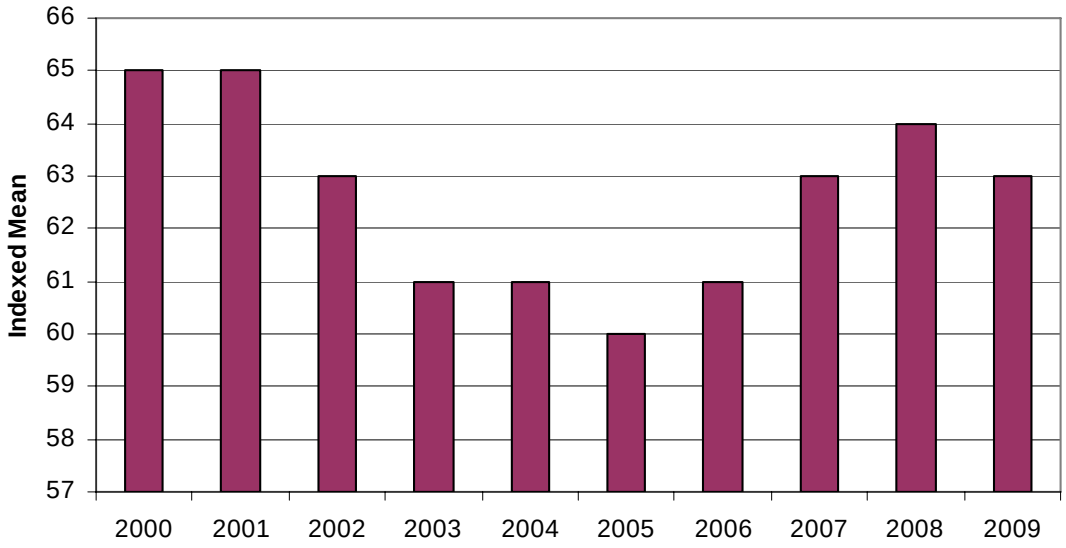

Figure 15 – LG Community Satisfaction Survey (local roads and footpaths)

The LGCSS includes an open ended question "Reasons why Council needs to improve on local roads and footpaths" which provides respondents with an opportunity to indicate areas where they believe Council performance could be improved. In 2009, 5% of the 98 respondents noted that improvement could be achieved by "more frequent maintenance/cleaning of roadside drains and culverts" suggesting some level of dissatisfaction with the current maintenance service standard.

4.4.2 Customer Request Trends (Jan 2005 - Dec 2009)

Trends in customer requests regarding drainage issues is an indicator of community satisfaction with Council's approach to stormwater management. The graph below shows a history of customer requests regarding drainage issues over the past 5 years. This graph excludes major storm events. It indicates that the number of customer requests has generally been declining.

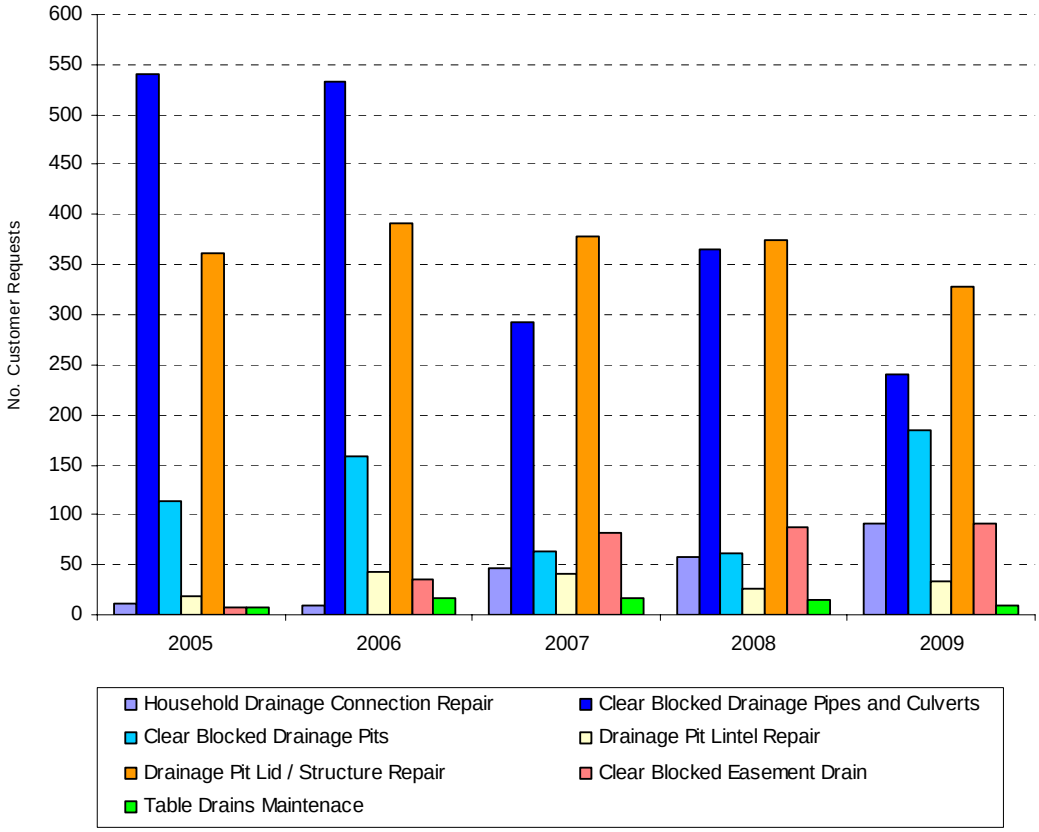

Figure 16 – Trends in Customer Requests regarding Drainage Issues

Source: Work Order System (LifeCycle)

Trend data excludes the number of requests received during major storm events. Dates excluded 2nd to 4th Feb 05; 3rd to 7th Dec 07; 20th to 28th Dec 07; 22nd to 27th Nov 09 (Refer section 8.7 of this report)

Figure 17 below presents a summary of customer requests received during the period January 2005 to December 2009. This data suggests that most customer requests require the following maintenance activities:

- Drainage Pit Lid/ Structure Repair (excluding lintels)
- Clear Blocked Drainage Pipes & Culverts

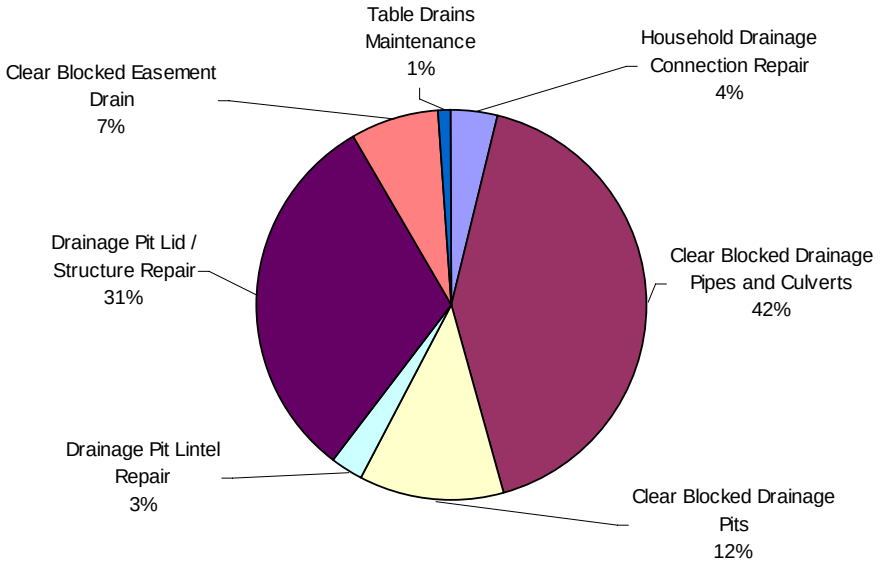

Figure 17 – Customer Requests - 01 Jan 2005 - 31 Dec 2009

Source: Work Order System (Lifecycle)

4.5 Demand Management Plan

Demand analysis includes assessment of current service needs and prediction of future service demands. It is important for Council to make a concerted effort to predict demand in order to know which elements of demand can be accommodated within the existing capacity of resources and assets, and which elements cannot. Armed with this knowledge, appropriate demand management strategies can be devised and implemented.

The Victorian Auditor General's recommendations, outlined in the report *Managing Stormwater Flooding Risks in Melbourne* (2005), suggested a comprehensive demand management plan be developed by drainage authorities covering the following:

- Details of expected growth
- Anticipated changes in community expectations
- Expected impacts on asset use and performance
- Impacts of changing technology
- Non-asset solutions to reduce the impact of changes in demand

The rest of this Chapter attempts to address some of the Auditor General's expectations. Factors affecting demand are highlighted and a number of potential demand management strategies are provided. Further work is required to assess the feasibility of the proposed strategies and develop a drainage demand management plan for the City of Knox.

4.5.1 Demand Drivers

The table below outlines key demand drivers and the expected impact on Council's drainage services. Further work is required to better predict and prepare to deal with the expected changes. This work may be able to be done by Council in partnership with Melbourne Water, and other local Councils in the region.

Demand Driver	Expected Change	Expected Impact
Demographics	Increasing density of dwellings resulting from subdivision of residential lots and Government policy (Melbourne 2030 & Melbourne @ 5 million plans) (ABS Forecast provided by ID Consulting predicts a 17% increase in the number of dwellings in the City of Knox between 2010 and 2030. The number of dwellings is predicted to increase from 55,993 to 65,556)	Increased runoff during all storm events Reliance on private sector on-site detention to mitigate floods Increased multi-unit development in areas with inadequate overland flow paths.
Climate Change	More intense and frequent storms Severe drought periods	Increased overland flows for short periods during intense storms Increasing localised on site rainwater storage for household and commercial reuse. Loss of biodiversity due to reduction in water levels in natural waterways
Environment	New approaches to water treatment and re-use	Potential proliferation of untested water sensitive urban design treatments that need to be maintained Altered demand on drainage maintenance resources Increased trials of new products and designs and an opportunity to learn and develop innovative solutions
Legislation	Increased asset reporting requirements –Introduction of a National framework for asset management and reporting Increased attention (and possible regulation) on dam (and retarding basin) safety management practices	Council will need to demonstrate improved asset knowledge and asset data management. There will be an expectation that Council can demonstrate clear links between service levels and current and future community expectations A more proactive approach to the management of dams and retarding basins will be expected
Ageing Assets	Deteriorating condition of assets Capacity issues	Increased renewal and upgrade demand Asbestos-lined pipes, installed many years ago, may begin to fail and require replacement and disposal in a manner that manages the potential health risks

Table 15 –Demand Drivers

4.6 Factors Affecting Demand

The volume and quality of water that must be managed within the municipality is affected by changes in the following aspects of the local environment:

- Built
- Natural
- Social and Cultural
- Legal and Political

Changes in stormwater volumes impact on the ability of the system to manage flows and flood levels. Changes in pollution sources impact on Council's ability to improve water quality and biodiversity.

4.6.1 Built Environment

The Knox Planning Scheme identifies the long term direction for land use and development within the municipality. It provides the rationale for zone and overlay requirements. Council is responsible for the local planning system and can introduce flooding overlays (map of stormwater flow paths) to automatically trigger more appropriate development constraints in flood-prone areas. To date, Council has not introduced such planning controls.

The existing built environment within Knox is the result of a long history of urban development as the municipality evolved from farmland and undeveloped open space into a vibrant metropolitan area with more than 155,000 residents. Table 16 below indicates that the majority of Knox has been developed for residential use, with a significant land mass providing for public open space.

Land Use	Area (sq. km)	% of Knox
Residential	59.8	52.5
Public Open Space	16.1	14.1
Industrial	6.5	5.7
Road	7.1	6.2
Services	6.4	5.6
Extractive Industry	5.2	4.6
Rural Living	3.9	3.4
Private Community, Recreation, Educational & Religious Purposes	3.0	2.6
Other Use	6	5.3

Table 16 – Land Use

The following built environment factors impact future demands on Council:

- Asbestos lined pipes
- Poorly designed land development projects
- Increasing dwelling density
- Privately owned on-site detention systems.

Asbestos Lined Pipes

Manufacture of asbestos lined pipes ceased in 1987. Given that much of the piped network (82%) was constructed prior to 1987, it is possible that a significant proportion of the existing drainage network is made up of asbestos lined pipes. Replacement of these pipes, as they become due for renewal, must be undertaken with care and in accordance with relevant regulations.

Poorly designed land development projects

A legacy of poorly designed developments exists within the municipality. As discussed previously, suburbs constructed before the mid 1970s, which have not had significant redevelopment, are prone to flooding during major storm events. Developments in these areas were constructed at a time when the management of overland flow paths was not regulated.

A number of sites within the municipality do not have adequate overland flow paths or on-site detention and can therefore introduce flooding risks. For example garages constructed below the adjoining road level funnel stormwater into buildings rather than around them. Private landscaping features, constructed without adequate consideration of overland flow paths, also result in an increased risk of localised flooding.

Increasing Dwelling Density

A tendency toward increased medium-high density housing is likely to impact the future management of Council's drainage network. Urbanisation increases runoff, reduces infiltration, and places increased demands on Council's drainage assets.

Subdivision of residential blocks and other construction (such as paving) increase the proportion of land that cannot absorb stormwater. These changes increase the volume of run-off and increase the demands on the piped drainage system both in the immediate vicinity and further downstream.

More intensive development within the municipality is expected to continue in future years. Figure 18 below, illustrates predicted growth in dwelling density within the municipality as forecasted by the Australian Bureau of Statistics. This will put pressure on the local drainage system.

To manage increased demand Council must ensure it is in a position to predict how these changes will affect flooding risks in new and established areas and ensure measures are put in place to mitigate these risks. Future flood mapping should focus on areas where the highest rate of growth in dwelling density is predicted to occur. This will enable the introduction of planning controls to reduce future risks of habitable buildings being flooded.

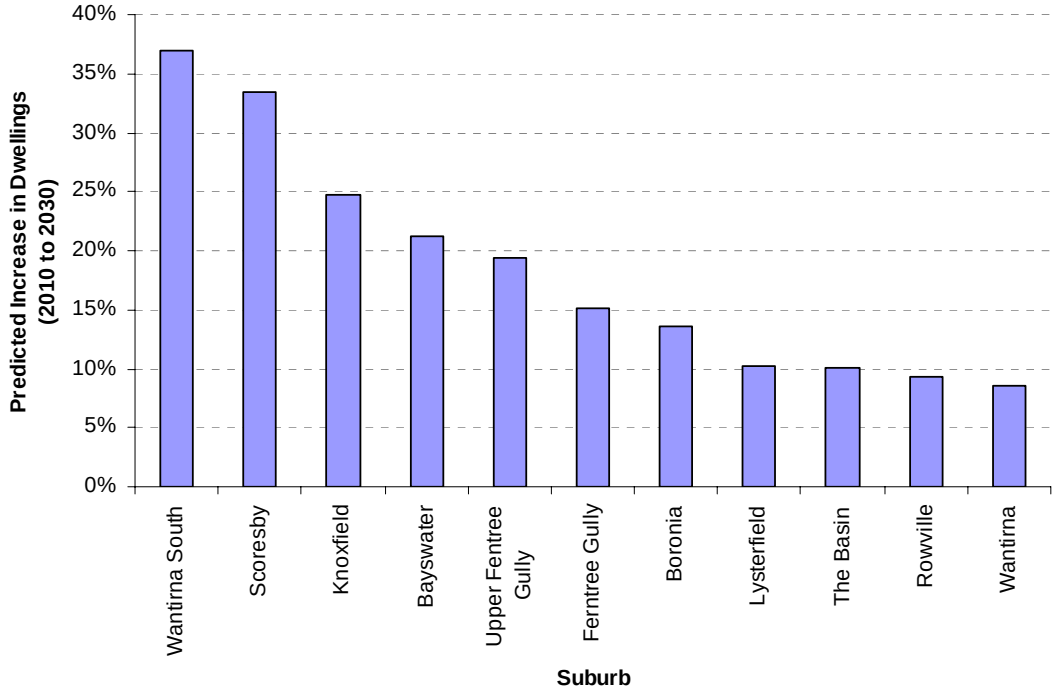

Figure 18 – Predicted Growth in Dwellings (2010 to 2030)

Source: Australian Bureau of Statistics and Forecasts by ID Consulting (Date January 2010)

Risks of Privately Owned On-Site Detention Systems

Private on-site retention systems, where some or all of the captured runoff is retained for reuse, provide a number of benefits:

- net reduction in stormwater volume
- reduction in demands on reticulated water supply
- reduction in gross pollutants and organic matter released to natural water bodies

These systems, however, can have a number of shortcomings:

- Lack of excess capacity to absorb high intensity storm events because the available storage is often compromised by the need for relatively long term storage of water for re-use.
- Effectiveness is reliant on regular maintenance of capacity

As noted in the Knox Drainage Strategy, it is possible that in certain circumstances, particularly long duration storm events, onsite detention can increase the peak flows experienced within the local drainage system. For example, because on-site detention delays the draining of flood waters, it is possible that peak flows entering the local catchment from neighbouring catchments may coincide with high flows retained within the local catchment leading to a higher peak than that which would be experienced prior to the installation of significant scale on-site detention systems.

In the long term, there is some concern that future land owners may not maintain the tanks, or may remove them, creating an increased load on Council's drainage system. If maintenance rests with the property owner, ongoing community education is important to ensure the systems remain operational. If maintenance responsibilities are to be supported by Council,

issues relating to access to private property and the costs of future inspection and maintenance must be considered.

4.6.2 Natural Environment

Changed weather patterns have increased the frequency of intense storm events. This potentially puts Council's flood management practices into the spotlight whenever an intense storm occurs. Given that the community expects severe storms to be appropriately managed, it is reasonable to expect the insurance industry will become increasingly interested in the appropriateness of Council's flood management practices.

In recent years, the community has become more aware of climate change and its impacts on modern society. Residents and businesses throughout the municipality are now dealing with drought conditions by capturing and reusing stormwater. Strategies to collect and store stormwater have become common. It is expected that the community will continue to capture rainwater for re-use reducing the base load on Council's stormwater system and local creeks and waterways. Other risks associated with privately owned rainwater tanks were mentioned in section 4.6.1.

Given the high level of community interest in stormwater re-use, the community expect councils to act to ensure public facilities remain viable and sustainable. Councils are expected to harvest and reuse stormwater in a manner that does not adversely affect the local environment.

Technologies that support the treatment and re-use of stormwater can be expected to become more sophisticated in future years. It is likely that the community will continue to expect councils to make use of new technologies and provide leadership in this area.

4.6.3 Social & Cultural Environment

In recent years, the community has reduced its tolerance toward pollution of our natural waterways. This provides Council with a platform from which to further educate land owners on how their land management practices impact the quality and quantity of stormwater discharged from their property.

4.6.4 Legal & Political Environment

Federal and State Government strategic directions, policies, regulations, standards and guidelines all influence Council's approach to service delivery. Political influence regarding stormwater management is exerted through:

- Regulations and legislation
- Grant funding conditions
- Community education campaigns

The *Local Government Financial Sustainability Nationally Consistent Frameworks - Framework 1 - Criteria for Assessing Financial Sustainability and Framework 2 - Asset Planning Management* (currently in draft form), mentioned previously, is an example of how the Federal government can impose obligations on Councils to demonstrate better asset management and improve the link between current and proposed service levels and community expectations. The introduction of this Framework will impose more stringent controls on Council's approach to asset management planning, funding and reporting. Good quality asset data will be expected.

4.7 Demand Management Strategies

Non-asset demand management strategies are alternatives to the creation of new assets. Council has a range of tools at its disposal to ensure effective and efficient management of stormwater. These tools include:

- Planning scheme controls
- Local law enforcement
- Advocacy
- Community education / awareness campaigns
- Asset inspections

In some instances Council will be unable to avoid retrofitting new assets to the existing system.

4.7.1 Planning Scheme Controls

Council's current drainage guidelines require developers to either upgrade the existing outfall drainage system or install an onsite detention system. This is consistent with the recommendation of the Council Engineering & Infrastructure Report (October 2007) and supporting opportunities for Drainage Infrastructure Report (September 2007). Most developers construct the onsite detention system as it is often the cheapest option.

Results of Melbourne Water's flood mapping have been included in the Knox Planning Scheme as a Special Building Overlay (SBO) and Land Subject to Inundation Overlay (LSIO). New developments located in LSIO and SBO areas are controlled by Melbourne Water. Floor levels within SBO areas have been defined by Melbourne Water and are 300mmm above the calculated flood level.

Demand management tools available under the Victorian Planning Provisions include:

- Creation of Local Floodplain Development Plans
- Redevelopment controls
- Property buy-back plans
- Introduction of development contributions

It is recommended that the Knox Municipal Strategic Statement be amended to give effect to the Knox Stormwater Drainage Strategy recommendations which include the introduction of developer contributions and local flood plain development plans, including introduction of an additional special building overlay that is based on local floodplain mapping data.

Based on recent correspondence between the Project Delivery team and Melbourne Water, it is expected that if Council decides to undertake flood mapping in partnership with Melbourne Water, Council will be required to contribute funds in excess of $200,000 per catchment. Discussions with Project Delivery Team Leader – Engineering Services however, suggest that flood mapping could be undertaken in-house using existing staff and modelling software at a cost of around $30,000. The cost differential is significant and requires further investigation as part of recommended improvement project 8.4.

If a local special building overlay is to be created, this will enable introduction of floor level controls for new developments and redeveloped sites. The likelihood of property damage within these areas can then be reduced

resulting in a corresponding reduction in demands on Council resources during major storm events.

Depending on the details of how it is defined, a developer contribution plan (DCP) can apply to both building and town planning applications. Levies can be applied in conjunction with on-site detention system requirements. Implementation of a DCP will require administrative resources and effort.

A DCP could be developed without the need to fund an expensive flood mapping project. An effective DCP would impose charges on developers for increases in impervious areas, or provide incentives for reducing impervious areas. Funds collected would enable Council to fund works required to mitigate current and future flooding risks.

4.7.2 Local Law Enforcement

Council should consider introducing proactive inspection and enforcement of building controls on easements in high risk flood-prone areas. A drainage easement gives Council long-term access for maintenance and the eventual replacement of drainage assets. Easements are recorded on the relevant property title and have conditions attached that limit the property owner's rights over this land. For easements to work effectively, they must be clear of obstructions. There are many examples of property owners building across easements, planting, or otherwise restricting access, and causing damage to the buried assets. Many property owners are unaware of their obligations, whilst others ignore the restrictions.

4.7.3 Advocacy/Partnership with Others

Given that Council is only one of a number of authorities with responsibility for stormwater management within the municipality, it is important that Council work with other authorities to manage and better understand demand. Melbourne Water support should be sought for:

- Research into community demands and expectations
- Assistance with the development of water management service objectives and asset management service levels
- Flood mapping
- Communication regarding the responsibilities of all drainage authorities
- Education regarding overland flows and land subject to inundation
- Clarification of dam (and retarding basin) responsibilities

With support from the Municipal Association of Victoria (MAV), Council should also take an active role in lobbying, on the community's behalf for the upgrade of Melbourne Water's main drains and floodways to reduce the occurrence and severity of peak overland flows.

4.7.4 Community Education/Awareness Campaigns

It is generally recognised that community education regarding water management is necessary but difficult. To date, Council's Sustainability team has been involved with some drain stencilling projects with local schools. These projects have been at the request of the schools and do little to educate the community regarding stormwater management.

It is recommended that targeted community awareness campaigns be launched. Increased awareness of environmental impacts and flooding effects

caused by various land use activities can be expected to reduce demands on Council over time.

Education campaigns should build on current community interest in stormwater reuse. The intention should be to inform residents how they can better manage their own land use to minimise flooding and reduce contaminants entering the stormwater system. Some recommended topics to be considered include:

- Landscaping impacts on stormwater
- Stormwater harvesting and re-use
- Maintenance of on-site water storage tanks
- Responsibilities for drainage easements

4.7.5 Retrofitting the Existing System

Given that much of the City of Knox was developed during the past 40 years, Council has limited opportunities to improve the capacity of existing systems without causing significant disruptions to traffic flows, residents and local businesses. The types of work Council can undertake to improve flood mitigation include:

- Upgrading or duplication of reinforced concrete pipes through Council reserves, roadways and easements
- Installation of additional (or larger) inlet pits such as grated side entry pits. (This is expected to be effective at low points and in downhill court bowls where the roadway slopes down toward private property)
- Diversion of overland flows using various approaches that increase the capacity of the overland flow paths:
- Realigning and regrading roadways, kerbing, footpaths and driveways (as these assets fall due for renewal)
- Construction of vegetated swale drains, bio-retention trenches
- Stormwater harvesting via construction of upstream storage (retarding basins and wetlands)
- Introduction of porous surfaces to replace impervious surfaces
- Re-grading / realignment of existing table drains

4.8 Improvement Recommendations

PROJECT 4.1. Develop & Implement a Demand Management Plan

Understanding demand for the entire portfolio of Council services is an essential forward planning exercise that will enable Council to respond to changing community needs, in an efficient way, leveraging the inter-relationships between services and assets.

Development of a Drainage Demand Management Plan that includes prediction of demand for drainage services should be led by the Engineering Services team. The plan should meet the Auditor General's expectations and incorporate the following:

- Detail expected growth
- Anticipate changes in community expectations
- Predict impacts of changing technology and other factors on asset use and performance

- Identify non-asset solutions that can be implemented to reduce the impact of changes in demand

The plan should also seek to meet the requirements of the *Local Government Financial Sustainability Nationally Consistent Frameworks - Framework 1 - Criteria for Assessing Financial Sustainability and Framework 2 - Asset Planning Management (*currently in draft form). The plan should demonstrate that current and desirable service levels are aligned with community expectations. Research support for this project should be sought from Melbourne Water, and the Regional Drainage Interest Group.

It is recommended that initial efforts focus on validating the information presented in this chapter and developing an appropriate means of implementing feasible demand management strategies including consideration of those outlined in Section 4.7 of this document.

As part of the water management service review recommended later in this plan (refer PROJECT 7.2) consideration should be given to the creation of a dedicated water management team. This team could be charged with the development of a demand management plan.

PROJECT 4.2. Develop & Implement Targeted Community Education Programs

Council, with support from other responsible authorities, should seek to introduce targeted community awareness campaigns.

- Develop practical advice that helps stakeholders understand their responsibilities in relation to drainage assets
- Use existing communication forums to regularly disseminate information
- Consider specific programs to educate property owners regarding:
  - Responsibilities for drainage easements
  - Landscaping impacts on stormwater
  - Stormwater harvesting and re-use
  - Techniques for property owners to protect their properties from flood damage

It is recommended that Engineering Services be responsible for delivery of this project and seek support from the Strategic Communications team as appropriate.

PROJECT 4.3. Investigate Feasibility of Enforcing Asset Repair Reimbursement

Council currently has a process to seek reimbursement when developers damage Council assets when undertaking works within the municipality. There is no formal process for imposing fines for damage caused at other times.

Consistent with Council's updated local law 48 Defacing Damaging Land, and section 6.2 of Councils Asset Management Policy, Council should investigate the feasibility of enforcing the imposition of fines on utility companies (and others) found to be responsible for damaging Council drainage assets. The feasibility study will require an assessment of expected costs and benefits.

It is recommended that Assets be responsible for this project.

PROJECT 4.4. Investigate the Feasibility of Introducing Developer Contributions & Knox Special Building Overlay

Council's current Planning Scheme does not include a developer contribution plan or a Knox special building overlay. It is recommended that this position be reconsidered as a means of better managing development in flood prone areas. Project outcomes should include a recommendation regarding Council's position on the feasibility of implementing changes to Council's planning controls considering the following issues:

- Developer contributions
- Floor level restrictions based on creation of a Knox specific special building overlay

The starting point for this review should be the Council (Engineering & Infrastructure) Report (October 2007) and supporting report External Funding Opportunities for Drainage Infrastructure (version September 2007) – (Dataworks No. 1600051). In the event that this review finds that Council should continue to recommend on-site detention (OSD) systems, it is considered important that the application of this approach be enhanced to ensure OSDs are appropriately maintained. This may include introduction of an inspection program and requirements for developer provision of:

- a maintenance schedule and Section 32 certificate
- installation of OSD signage

If the introduction of developer contributions and/or a special building overlay is found to be feasible, a staged introduction of planning scheme amendments is recommended.

The introduction of amendments and the supporting flood mapping exercise should initially focus on areas where dwelling density is predicted to increase. (ABS Data presented in this Chapter suggests dwelling density in the following suburbs will increase by 20% by 2030: Wantirna South, Scoresby, Knoxfield and Bayswater).

It is expected that the Engineering Services team lead this project in consultation with the Urban Planning team.

This project should precede any investment in flood mapping (refer PROJECT 8.3)

PROJECT 4.5. Develop Safe Work Practice for Asbestos Lined Pipes

Given that much of Council's drainage network was constructed before the use of asbestos lined pipes was banned, it is considered important that the Operations Centre develop a safe work practice for drainage asset renewal, upgrade and maintenance works. The safe work practice should set out the recommended work practices to minimise potential risk to workers and ensure pipes are disposed of appropriately (or managed appropriately if they are not removed from the ground).

Implementation of the safe work practice should include an ongoing education program for all relevant staff.

PROJECT 4.6. Investigate Long-term implications of Privately-Owned Rainwater Tanks

It is recommended that the Engineering Services team, with support from other drainage authorities, undertake a study to investigate the long term risks associated with private rainwater tanks (and other on-site detention systems) on private property. The project should detail potential risks and provide advice to assist Council with the management of these risks into the future.

This project could inform the investigation described in PROJECT 4.4.

Chapter 5 Drainage Strategy Findings

CHAPTER SUMMARY

- The Knox Stormwater Drainage Strategy was developed over a number of years and is now six years old.
- Many recommendations have not been funded and have not been implemented.
- The relevance and feasibility of Drainage Strategy recommendations should be reviewed in the context of an overall review of Council's water management services.
- In 2004, engineering consultants (URS Corporation Australia) estimated the cost ($81.5 M) to upgrade all easement drains (241.5 km) considered to be undersized. This now equates to approximately $97.3M, allowing for 3% inflation.
- Implementation of the following recommendations would support delivery of the Strategy:
    - Replace 150mm diameter pipes with 225mm diameter pipes when renewing these assets.
    - Adjust planning approval conditions to ensure all 150mm diamenter pipes are upgraded by developers.

5.1 Key Findings

The Knox Stormwater Drainage Strategy (Stage 2) was completed by engineering consultants, URS Corporation Australia, in December 2004. To date, implementation of the strategy has been largely unfunded.

Stormwater management objectives, presented in Table 17 below, were classified in terms of the following programs:

- Stream health
- Sustainability
- Flooding
- Amenity
- Drainage

The objectives listed here remain valid today.

Program	Objectives
Stream health/ sustainability	To minimise the effects on streams due to urbanisation and drainage systems
Stream health/ amenity	To protect waterways from pollution
Sustainability	To encourage sustainable management of stormwater
Drainage	To ensure that run off collection systems have sufficient capacity to minimise adverse impacts for minor storms
Flooding	To protect existing habitable buildings from flooding in major storms
	To ensure that no new habitable buildings are flood prone in major storms
Flooding/ Drainage	To protect the community from unsafe flooding conditions in major storms

Table 17 – Knox Drainage Strategy Objectives

(Extract from Knox Stormwater Drainage Strategy Stage 2)

Recommended risk mitigation works were classified as follows:

- Environmental Focus – WSUD, retarding basins, wetlands
- Drainage Focus – diversion of overland flows (typically via the road and open space networks)
- Flood Focus – additional pipe capacity

Structural and non-structural actions were recommended. Structural responses included: construction of new infrastructure, such as WSUDs, works to divert overland flows, pits, pipes, culverts and onsite detention systems. Recommended non-structural responses included: - maintenance programs, education campaigns, the development of new design standards and the introduction of planning scheme amendments (Special Building Overlays and Development Contribution Plans).

The strategy identified a need to upgrade 100 and 150 mm diameter easement drains generally located at the rear of residential properties. These drains were designed to cater for flows at the time of original development. Infill development generates a need for these easement drains to be

upgraded to at least 225 mm diameter to cater for the increased flows generated by multiunit developments. In 2004, URS estimated the cost to upgrade all known easement drains (241.5 km) to be $81.5 M. (This now equates to approximately $97.3M, allowing for 3% inflation). These costs should be borne by the developers when sites are redeveloped.

5.2 Improvement Recommendations

In addition to the projects listed in the previous chapter, the following changes to current work practices are recommended to support the implementation of the Knox Drainage Strategy.

PROJECT 5. 1 Upgrade 150 mm pipe (when renewing these assets)

When undertaking renewal work it is recommended that the Construction team actively seek to upgrade 150 mm diameter pipes to a minimum pipe size of 225 mm. This should be a general objective, not limiting the discretion of officers to use 150 mm diameter replacements where other factors (such as access) necessitate them.

Discussions with the Construction team suggest that 145 mm diameter PVC pipes have been used to replace 150 mm diameter pipes using the cracking method. Whilst this limits the impact of construction work on residents, it reduces the capacity of pipes which the Knox Drainage Strategy considered to be deficient. It is therefore recommended that pipe reductions, as a result of renewal works, only occur at sites where the existing pipe can be demonstrated to have excess capacity.

PROJECT 5. 2 Adjust Planning Approval Conditions - Upgrade 150 mm pipe

Consider the introduction of a standard planning permit condition for all multi-unit developments sites. The condition should ensure that private sector developers upgrade existing 150 mm diameter pipes to no less than 225 mm diameter pipes in accordance with the recommendations of the Drainage Strategy.

Chapter 6 Environmental Sustainability

CHAPTER SUMMARY

- The Council Plan (2009-2013), sets out a strategic objective, under the Sustainable and Natural Environment initiative, “to protect and enhance the natural environment and reduce our environmental footprint through various strategies including improving water quality in local waterways with sustainable drainage management and Water Sensitive Urban Design (WSUD).”
- Since 2001, two (2) strategic documents have been prepared that define Council’s current position regarding stormwater quality management:
    - Knox Stormwater Management Plan (2001) prepared by WBM Oceanics
    - WSUD & Stormwater Management Strategy (2010)
- Many of the recommendations set out in the Knox Stormwater Management Plan (2001) have not been implemented. The implementation approach has been piecemeal. The following priority risk issues were identified:
    - Community liaison, education and enforcement
    - Improved interdepartmental communication
    - Improved interagency communication
    - Staff training and education
- In recent years, the focus has been on the development of Council’s WSUD policy, strategy and guidelines.
- The WSUD & Stormwater Management Strategy suggests the proportion of directly connected impervious (DCI) surface area is a reliable measure of waterway health. If the effective impervious area of a catchment is low (less than 0.5%) then the health of the waterways is expected to be very good.
- Independently from the WSUD & Stormwater Management Strategy, Council has invested in the introduction of rainwater tanks at sporting facilities and preschools to improve the sustainability of these Council sites.
- The following improvement projects are recommended:
    - Review/implement Stormwater Management Plan (2001)
    - Revise approach to prioritising stormwater harvesting projects
    - Manage the implementation of the WSUD ‘Hotspot & Opportunistic Retrofit’ program
    - Pursue potential water harvesting partnerships

6.1 Introduction

The protection of water quality in Victoria is legislated under the State Environment Protection Policy (Waters of Victoria). A number of regional management strategies and action plans have identified urban stormwater management as a key priority for protecting the environment of Port Phillip Bay and its catchments.

Knox City Council's Council Plan (2009-2013) sets out a strategic objective, under the Sustainable and Natural Environment initiative, "to protect and enhance the natural environment and reduce our environmental footprint through various strategies including improving water quality in local waterways with sustainable drainage management and Water Sensitive Urban Design (WSUD)."

Pollution in creeks and waterways is a significant concern for Knox and one of the management challenges under Knox City Council's 2008-2018 Sustainable Environment Strategy (August 2008). Expectations are defined as follows:

- Waterways (rivers, creeks and streams) - should be healthy ecosystems, clear of pollution and weeds and which support indigenous freshwater species and increased numbers of platypus, as well as reflect increases in water quality.
- WSUD - become a mandatory consideration for new developments and that WSUD will reduce pollution entering waterways, provide water to the water table and reduce flooding during heavy rains.

This chapter draws on information as presented in the Knox Stormwater Management Plan, prepared by WBM Oceanics in 2001, and Council's approach to water sensitive urban design. Further work is required to implement the recommendations of both the Stormwater Management Plan and the WSUD & Stormwater Management Strategy.

The following water management practices are also outlined in this chapter:

- Stormwater quality measurement
- Storage and harvesting
- Environmental management plans for construction sites

6.2 Stormwater Management Plan

As early as 2001, Council developed a Stormwater Management Plan that identified actions to improve the environmental management of urban stormwater and to protect the environmental values and beneficial uses of receiving waters. The State Government's White Paper, Securing Our Water Our Future, outlines that Local Government, together with Melbourne Water, is responsible for managing drainage assets and ensuring that the quality of stormwater meets waterway health objectives and satisfies broad community aesthetic and amenity values.

Council's Stormwater Management Plan (2001) was developed in response to the Victorian State Government initiative to develop a "Stormwater Agreement" between the various parties involved in stormwater management (Melbourne Water, Environmental Protection Authority (EPA) and the

Municipal Association of Victoria (MAV)). This included establishment of a framework for stormwater management planning *(Urban Stormwater Best Practice Environmental Management (BPEM) Guidelines).*

During development of the plan, values and threats that relate to stormwater management were identified and are reproduced in Table 18 and Table 19 below. These values and threats are still valid today.

Value Category	Specific Value Types	Description
Environmental	In-stream Habitat	In-stream ecological values based on water quality, habitat quality and diversity, flora and fauna species, extent of invasion by exotic species and general in-stream condition and stability.
	Riparian Habitat/Flora	Waterway condition and ecological values based on extent and quality of remnant (native) vegetation, weed infestation and stability of riparian zone.
Amenity	Recreational Amenity	Public access and utilisation for passive and active recreation including shared trails, formal linkages, utilisation for activities involving primary and secondary contact, extent of open space, facilities such as car parks and picnic areas, continuity of open space and visual attractiveness.
	Visual/Landscape Amenity	Aesthetic appreciation of the natural and built environment including consideration of natural and man made structures, landscapes and places of importance, visual access and relationships to adjacent facilities.
Cultural	European Cultural Heritage	Places and sites of European Heritage value, possibly including sites of pioneering significance, historical buildings and infrastructure, trails and transport routes.
	Indigenous Cultural Heritage	Places and sites of Indigenous Heritage value such as artefact scatters, landscape and places of significance (e.g. relating to story telling), ceremonial sites (e.g. Bora Rings), camp sites and trails.
Stormwater	Flood and Conveyance	Contribution to protection against flooding including consideration of waterway capacity, designated flood ways and flood protection infrastructure (e.g. levees)
	Water Quality Treatment	Contribution to water quality management (including Stormwater). This may include existing wetlands or other infrastructure that has been developed to improve water quality.
Economic	Property	Property value associated with proximity to water. This may include values associated with visual amenity, access and amenity.

Table 18 – Values

Extract Knox Stormwater Management Plan (2001)

Threat	Cause	Key Pollutants and Impacts
Residential Land Use Runoff	Atmospheric deposition and build up from traffic, washing cars, fertiliser application, poor waste management (domestic refuse), lawn clippings and vegetation.	Increased flow, sediment, nutrients, litter, oxygen depleting material, hydrocarbons, pathogens, trace metals, pesticides, surfactants
Industrial Land Use Runoff	Atmospheric deposition and build up from traffic, poor waste management, accidental spills and illegal discharges.	Increased flow, sediment, nutrients, litter, oxygen depleting material, hydrocarbons, pathogens, trace metals, pesticides, surfactants
Commercial Land Use Runoff	Atmospheric deposition and build up from traffic, poor waste management practices.	Increased flow, sediment, nutrients, litter, oxygen depleting material, hydrocarbons, pathogens, trace metals, surfactants
Major Road Runoff	Atmospheric and vehicular deposition and accumulation.	Sediment, litter, trace metals and hydrocarbons
Land and Infrastructure Development (Residential, Industrial & Major Roads)	Poor sediment and erosion control, uncontrolled wash down of equipment, deposition of sediments vehicles and spills from construction process (e.g. concreting).	Sediments, nutrients
Building Site Runoff (Lot Scale)	Poor management of building site waste and materials.	Sediment and litter
Unstable and Degraded Waterways	Poorly controlled stock and recreational access, weed infestation, damage from waterway works, development encroachment, vegetation loss, eroded and unstable riparian zones.	Sediment, nutrients, oxygen depleting material
Agriculture	Wash off of sediments, nutrients, organic material and wastes	Sediment, nutrients
Unsealed Road Runoff	Erosion of unsealed road surfaces	Sediments
Upstream and External Inflows	Poor quality stormwater flowing into the catchment, upstream from adjacent catchments and externally from adjacent municipalities.	Various depending on upstream land use and management practices
Golf Course Runoff	Wash off of nutrients, organic material and pesticides/herbicides	Nutrients, oxygen depleting material, herbicides and pesticides

Table 19 – Threat to local waterways

Extract Knox Stormwater Management Plan (2001)

Stormwater management improvement actions were defined and classified into the following types:

- Education and awareness initiatives
- Structural and non-structural best management practices
- Regulation and enforcement programs

- Changes to existing planning schemes and policies
- Internal and external coordination improvements
- Planning and design improvements

The following priority risk issues were also identified:

- Community liaison, education and enforcement
- Improved interdepartmental communication
- Improved interagency communication
- Staff training and education

It is generally accepted that many of the recommended improvement actions have not been implemented.

6.3 Water Sensitive Urban Design (WSUD)

Although it is recognised that the Stormwater Management Plan needs to be reviewed and implemented, the focus, in recent years, has been on the development of Council's WSUD policy, strategy and guidelines. An interim WSUD policy was adopted in July 2008. The policy revolves around the premise that all capital works projects should incorporate WSUD principles where appropriate. The WSUD & Stormwater Management Strategy was adopted in June 2010.

Council's WSUD policy and strategy set targets that guide Council to maintain its commitment to protect the local waterways. Private developers are strongly encouraged to implement water sensitive urban designs. Permit conditions state that WSUD treatments 'be considered.' However, such conditions are not enforceable.

Urbanisation of the municipality results in a reduction in permeable land and an increase in the volume of runoff entering local creeks and waterways. Pollutants created by a modern community have potential to contaminate local waterways unless they are effectively treated. Measures are required to capture contaminants, solids and fines suspended in the stormwater runoff before it is delivered to receiving waterways.

The Water Sensitive Urban Design (WSUD) & Stormwater Management Strategy aims to protect and improve the health of Knox's streams and creeks for our future generations, whilst improving the amenity value and sustainability of today's urban stormwater infrastructure.

Water sensitive urban design practices have been in place at Knox for many years. This approach to urban development is consistent with the principles of environmental sustainability whereby development meets the needs of current generations without impacting the ability of future generations to meet their own needs. WSUD treatments play a big part in mitigating many of the threats to water quality identified in the Stormwater Management Plan and listed in Table 19 above.

Historically, gross pollutant traps (GPTs) have been used as a primary pollution control measure. However, not all outlets to creeks and waterways within the municipality have been fitted with GPTs and there is no current program to install GPTs on all outlets. The WSUD & Stormwater Management Strategy proposes a more diverse approach to water quality management.

Council has developed WSUD guidelines to be used internally and by private developers. Use of current standards however, has been inconsistent across

Council. These WSUD design standards have recently been revised and are before the Standards Committee for review prior to formal adoption. It is expected that the new standards will result in a more consistent approach across the municipality.

6.4 Stormwater Quality Testing

Melbourne Water tests the water quality of all significant waterways. Interpretation of this data to inform a strategic approach to the management of waterways in the municipality is difficult. Waterways can contain high quality water, yet lack the biodiversity that make the waterways valuable.

Recent research by Melbourne University, Associate Professor Chris Walsh, discussed in the WSUD & Stormwater Management Strategy suggests the proportion of directly connected impervious (DCI) surface area is a reliable measure of waterway health. If the effective impervious area of a catchment is low (less than 0.5%) then the health of the waterways is expected to be very good.

The DCI measure can be used to inform Council's decision makers and enable more effective prioritisation of initiatives to manage the health of the waterways. Implementation of the WSUD & Stormwater Management Strategy is expected to focus on high value catchments where the waterways have significant environmental value and can be protected at relatively little expense.

6.5 Stormwater Storage & Harvesting

Council's investment in stormwater storage and harvesting has increased in the past three years. Significant discussion has taken place to ensure a maximum amount of stormwater runoff from the surrounding catchments is provided to the stormwater harvesting sites.

If stormwater harvesting projects are aligned with flood mitigation works it is likely that more water can be captured for re-use and the risk of flood damage can be minimised at the same time. A more transparent approach to the prioritisation and alignment of these projects is recommended.

Discussions with the Reference Group suggested that there may be opportunities to combine stormwater harvesting and flood mitigation works through partnerships with the Department of Education. Schools could maximise stormwater capture while Council could divert overland flows to the storage tanks and thereby reduce flood risks in the surrounding area. This suggestion should be investigated further.

6.5.1 Current Initiatives

Water Harvesting – Council Buildings & Sports fields

Projects funded under the following capital works programs, *Sustainability Initiatives – 4018* and *Sports field Irrigation – 4021*, have resulted in Council having the capacity to store and reuse some 4.52 megalitres of stormwater runoff.

Under the Sustainability Initiatives program, rainwater tanks have been progressively installed and publicly promoted at Council buildings, including sports pavilions and Early Years facilities. The Sports field Irrigation program has provided stormwater harvesting infrastructure at many Council sportsgrounds.

As illustrated in the table below, most of the captured stormwater runoff is used to irrigate sportsgrounds and provide for toilet flushing in Council buildings. Smaller volumes of water are recycled for other non- potable water uses.

Stormwater Reuse	Capacity (Mega Litres)
Ground Irrigation	2.68
Toilet Flushing	1.46
Water Recycling (including backwash and the Depot wash bay)	0.36
Water Play	0.02

Table 20 – Stormwater Harvesting Capacity - 2009/10

In order to maximise water capture, while addressing known flooding risks, it is recommended that future initiatives consider opportunities to address known drainage system capacity constraints.

Rainwater tanks - New Private Development Projects

In terms of private developments, permit conditions have long recommended consideration and construction of on site detention systems as a flood mitigation measure. These systems have typically been installed underground at considerable cost to developers.

Through a partnership with a private consultant, Council now offers access to an online empirical calculator, whereby developers can propose rainwater tanks in lieu of on site detention systems to meet planning permit conditions. Rainwater tanks provide a similar detention function while at the same time allowing for domestic water re-use. Although still in its early stages, this opportunity is encouraging installation of rainwater tanks for new developments and is administered by Council's Planning Department.

As discussed previously (refer section 4.6.1) the introduction of private rainwater tanks poses a number of potential future risks which need to be managed:

- Long-term effectiveness is reliant on regular maintenance
- Base water loads in receiving waterways is reduced with potential adverse affects on biodiversity

6.6 Environment Management Plans – Construction Sites

Council's guidelines for the development of environmental management plans for building sites were adopted in 2001 to highlight the importance of implementing measures to mitigate environmental risks during construction. Council's requirements in this regard are consistent with the following EPA guidelines:

- Environmental Management Guidelines for Major Construction Sites, EPA Publication 480
- Construction Techniques for Sediment and Pollution Control, EPA Publication 275
- Doing it Right on Subdivisions, EPA Publication 960

6.7 Improvement Recommendations

PROJECT 6.1. Review/Implement Stormwater Management Plan Recommendations

The WSUD & Stormwater Management Strategy is expected to go some way toward replacing some aspects of the Stormwater Management Plan. Despite this, it is recommended that the recommendations of Stormwater Management Plan be reviewed for currency and relevance.

All recommended improvement actions contained in the Stormwater Management Plan that have not been implemented should be summarised, and prioritised. Responsibilities and timelines for delivery should be assigned. Recommendations that are considered no longer relevant should be recorded as such.

It is recommended that this review be undertaken by Engineering Services (in consultation with the Sustainability team and other internal stakeholders). The review should occur ahead of budget preparations for the 2011/12 year so that funding submissions, necessary to implement high priority actions can be made. Business plans of each department, considered responsible for delivering specific actions, should include reference to the relevant recommended action.

PROJECT 6.2. Revise Approach to Prioritising Stormwater Harvesting Projects

It is recommended the Engineering Services team (in consultation with Sustainability) revise the ranking criteria used to prioritise stormwater harvesting projects. The following additional criteria and scores are suggested to maximise the likelihood of implementing projects that have potential to support flood mitigation activities.

Criteria	**Score**
1. Project is in the vicinity of an Intolerable Risk drainage upgrade project (as prioritised by Project Delivery)	
• Yes	20
• No	0
2. Project is in the vicinity of an Tolerable Risk drainage upgrade project (as prioritised by Project Delivery)	
• Yes	10
• No	0
3. Number of properties, in the vicinity of the project site, that have been affected by an extreme or high risk drainage issue during the past 5 years (as recorded in Council's Work Order System –Lifecycle)?	
• 5 - or more properties	20
• 3 - 4 properties	15
• 1 – 2 properties	10

PROJECT 6.3. Manage the Implementation of the WSUD "Hotspot & Opportunistic Retrofit" Program

This document supports the implementation of all recommendations contained in the recently adopted WSUD & Stormwater Management Strategy. This improvement project is intended to support implementation of the recommended 'Hotspots' program and 'Opportunistic Retrofit' program.

The Engineering Services team have taken a leadership role in the implementation of the WSUD & Stormwater Management Strategy. The current intention is to set up a WSUD advisory team with representatives from relevant departments including Assets, Operations, Engineering Services, and Sustainability. This team will bring together all relevant drainage information including: catchment analysis, knowledge of flood prone areas, WSUD data, vegetation information known system capacity issues, water harvesting locations, maintenance requirements and constraints.

To ensure that opportunities to introduce WSUDs have been considered and actioned where feasible, it is expected that the WSUD advisory team will review the concept designs of all capital work projects and provide advice on all WSUD proposals. This review should form part of Council's business case approval process.

In order to support delivery of the' Hotspots' program and 'Opportunistic Retrofit' programs, it is recommended that the WSUD advisory team provide all project managers with a list of the high risk locations for litter loads that were identified in the Knox Drainage Strategy. (Recommended WSUD treatments, considered appropriate for each site, are currently listed in the Knox Drainage Strategy.) Dissemination of this information should occur via a GIS Layer that is created, and kept up to date, by the Engineering Services team (as recommended in PROJECT 2.4iv).

PROJECT 6.4. Pursue Potential Water Harvesting Partnerships

The Reference Group suggested that there are opportunities to combine stormwater harvesting and flood mitigation works. For example, Wantirna Secondary College is an example of a site where, if the school were to introduce significant stormwater storage capacity, flood risks in the surrounding area could also be reduced.

Council may benefit from supporting a project that includes diversion of overland flows toward the water storage units. The diversion of runoff could effectively address localised flooding issues in the surrounding area and enable the school to maximise the volume of water collected and water the grounds more often. Opportunities to work with the Department of Education, and others, should be investigated further. The recently initiated WSUD advisory team, mentioned in Project 6.3 above, is expected to play an important role in the implementation of this recommendation.

Chapter 7 Service & Asset Lifecycle Management

CHAPTER SUMMARY

- Council's current water management services have evolved over many years. They have been formulated, established and adjusted incrementally in response to changes in the operating environment.
- Water management activities provided by Council include:
  - Flood mitigation
  - Environmental sustainability (stormwater harvest and reuse)
  - Water sensitive urban design to slow the flow of stormwater runoff and protect receiving waterways
- This Chapter illustrates the Asset Strategy team's interpretation of how the organisation's current approach to water management fits with the service delivery model as defined in Council's Asset Management Policy.
- The service delivery model was introduced to Council in 2008/09 and has not yet been used by staff to inform their service and asset management practices.
- Since the development of the Knox Strategic Asset Management Plan 2003-2013, Council has made a concerted effort to improve all asset lifecycle management practices.
- Integration Functions and service lifecycle management responsibilites are generally not well understood. There is generally a lack of detailed service targets that are measureable and aligned with community needs.
- What seems to be missing, from Council's current approach, is the link between asset management and the delivery of service objectives to meet community demand. Clarification of roles and responsibilities is considered necessary.
- A number of improvement recommendations are proposed. These include:
  - Staff education to ensure all staff have an understanding of the roles and responsibilities implied by the service delivery model
  - Review of all Council's water management services using the service delivery model as a conceptual tool to guide the analysis. This review should consider creation of a dedicated water management team.
  - Review routine maintenance programs to ensure overland flow paths are appropriately managed
  - Encourage developers to provide CCTV footage of underground assets
  - Create a GIS layer to assist with the integration of Council's drainage renewal and upgrade programs
  - Implement business improvement project suggestions to streamline planning approval processes for drainage assets
  - Review Standards Committee terms of reference to ensure all product trials are reviewed by a broad group of specialist officers
  - Review and amendment to landscaping design standards to minimise impacts on the drainage network
  - Management of the construction of WSUDs in road reserves to meet Council's obligations under the Road Management Act
  - Review drainage inspection and maintenance practices and update the Knox Road Management Plan accordingly.

7.1 Introduction

Stormwater management services provided by Council have evolved over many years and continue to be refined so that Council can respond effectively to changing community expectations. Ongoing work is leading to continuous improvements in the management of all Council assets including drainage.

In this chapter, the service delivery model, illustrated in Figure 19 below, has been used as a basis for the assessment of Council's current approach.

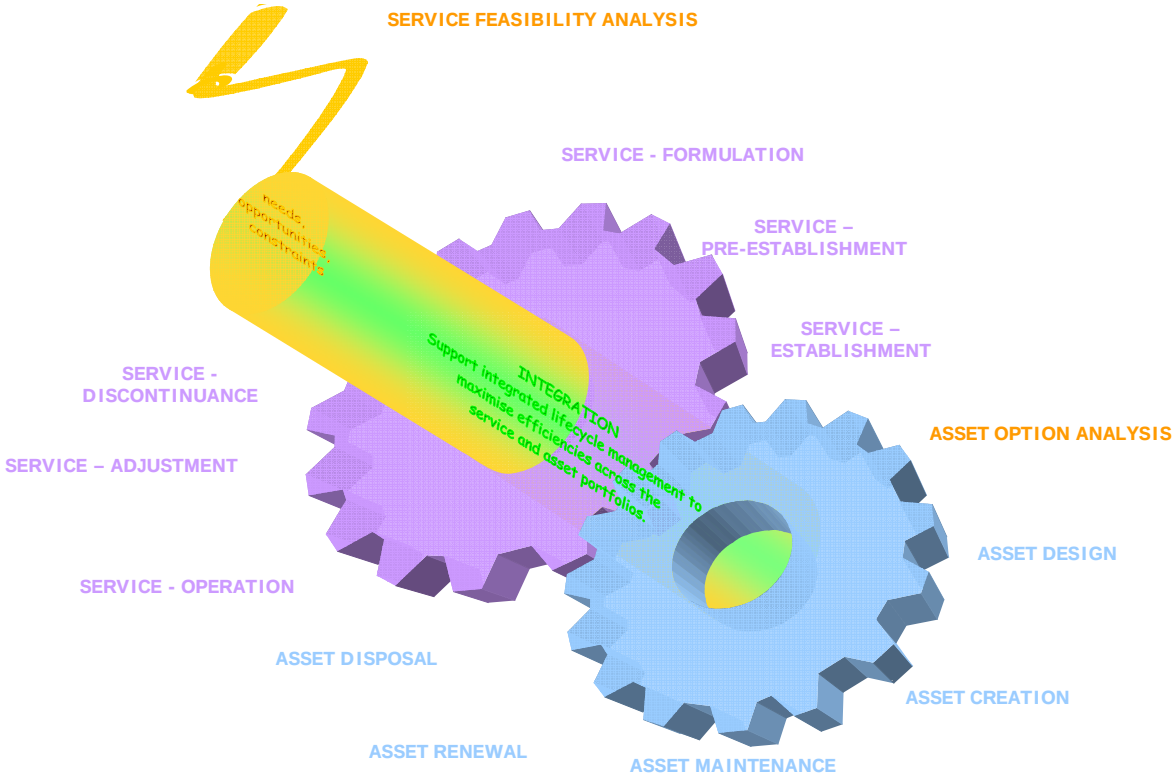

Figure 19 – Service Delivery Model

The service delivery model forms part of Council's Asset Management Policy. It demonstrates the integrated relationship between service and asset management and highlights the need for all phases of the service and asset lifecycle to be managed in a coordinated manner in order to meet community expectations. The model implies that assets should be managed in a manner that supports the delivery of service objectives.

When using this model to assess Council's approach to stormwater management, it became apparent that Council has focused its efforts on asset management. The interrelationship between community demand, service and asset management have been largely overlooked. Measurable service delivery objectives have not been clearly defined making it difficult to assess Council's current approach to the management of all phases of the service lifecycle. This chapter therefore focuses on describing and assessing Council's current drainage asset management practices and recommends that further work be undertaken to refine Council's approach to integrated water management.

7.2 Current Roles & Responsibilities

Current water management activities include the following:

- Flood mitigation (which tends to focus on upgrading the underground piped network)
- Environmental sustainability (which focuses on identifying opportunities to harvest and reuse runoff)
- Water Sensitive Urban Design (which focuses on the introduction of new drainage assets to slow the flow of stormwater runoff and protect the receiving waterways)

A number of teams are involved in water management on Council's behalf. Key stormwater management responsibilities of each team, listed below, are briefly discussed in this section.

Engineering & Infrastructure Directorate

- Project Delivery
- Construction Group
- Parks Services
- Works Services
- Asset Preservation
- Asset Strategy

City Development Directorate

- Urban Planning
- Place Management
- Sustainability

7.2.1 Project Delivery

The Project Delivery team is responsible for Council's *Drainage Upgrade Program (4017),* as well as a number of other capital works programs.

Discussions with members of the Project Delivery team suggest that only one senior resource is allocated to stormwater management. This Team Leader Engineering Services is responsible for investigating and solving drainage capacity issues. Since late 2009, a Drainage Engineer and a cadet have supported the Team Leader. Key drainage asset management tasks undertaken are listed below:

- Allocation of legal point of discharge for stormwater. This involves liaison with property owners when a suitable point of discharge is not available.
- Assessment of building permit applications when land owners wish to build over drainage easements.
- Provision of planning permit condition recommendations based on assessment of how all proposed developments may influence the condition and serviceability of existing drainage assets.
- Implementation of drainage special charge schemes under the Local Government Act.
- Implementation of the Drainage Upgrade Program (4017). Projects are identified, ranked and flagged as posing a tolerable or intolerable risk.

- Implementation of WSUD treatments as part of drainage upgrade projects. This includes investigating whether detention systems can be used in lieu of drainage upgrades.
- Review of on-site stormwater detention design methodologies and assessment of the strategic location of retarding systems in the municipality.
- Advocating for flood mapping of Council's system in partnership with Melbourne Water. This will enable future incorporation of a Knox administered Special Building Overlay layer into the City of Knox Municipal Strategic Statement.
- In conjunction with the Urban Landscape team, ensure master plans for public open spaces have appropriate drainage, overland flow paths and WSUD treatments.

Another (0.5 EFT) is allocated to development of the Knox WSUD & Stormwater Management Strategy. This resource also works on the following tasks:

- Collation and verification of WSUD asset data
- Review and development of WSUD design guidelines
- Assessment of lifecycle costs associated with WSUD treatments
- Definition and ongoing review of WSUD maintenance and renewal requirements
- Advocate for capital funding to renew, or upgrade, existing WSUD treatments
- Work with developers and Council staff to promote the use of WSUD features
- Administration of the newly created capital works program for WSUD renewal and new/ upgrades

As discussed in Chapter 2, a Technical Officer - Project Delivery is responsible for maintaining GIS Drainage Layer (11).

7.2.2 Construction Group

The Construction team has responsibility for renewal of all Council drainage pits and pipes. Since 2009, CCTV audits of underground pipes have been used to progressively identify and address pipe failures. Failed drainage pits and pipes identified by maintenance crews are also renewed. Replacement of pit lids with lighter weight Terra firma lids is also undertaken.

Given the absence of condition data, the Construction team has not been able to develop a prioritised program of drainage renewal works. Despite this, the current approach has ensured that known problems have been successfully addressed.

Current renewal record keeping practices have made it difficult for Council to retain up to date records of the age of Council pits and pipes. Without this information it is difficult for Council to have confidence in the economic life assumptions assigned to this asset class.

7.2.3 Parks Services

Since the introduction of WSUD features, the Park Services team has been increasingly involved in the maintenance of these assets. Rain gardens, wetlands, bio-retention trenches and tree pits are generally maintained and renewed by this team.

Parks Services is currently working with Project Delivery and Works Services to better define the maintenance and renewal requirements for WSUD assets. Discussions to date suggest that the Parks team is best suited to maintain the horticultural elements of these assets.

Overland flow paths and retarding basins are typically mowed by the Park Services team (or its contractors) where they serve a dual purpose, such as being part of the active or passive open space network. However, no other proactive inspection or maintenance of these sites is undertaken to ensure the assets function as effective components of the drainage network.

Melbourne Water is responsible for managing designated major overland flow paths.

7.2.4 Works Services

Works Services is responsible for the maintenance of Council's constructed drainage network. This includes maintenance of drainage pits and pipes, gross pollutant traps, table drains and litter baskets in accordance with the service level standards as defined in the Knox Road Management Plan. This team is also responsible for routine street sweeping. Underpasses (major culverts) that form part of the shared path network) are maintained by Works Services. During major storms signage is provided to restrict access to these underpasses.

Works Services is currently working with Project Delivery and Parks Services to define the team's responsibilities regarding the maintenance and renewal of WSUD treatments. Discussions to date suggest that the Works team is best suited to maintain the non-horticultural elements of these assets.

7.2.5 Facilities

The Facilities team are responsible for the installation of water tanks at various Council sites and maintain these assets on Council's behalf. This team implements the capital works program 4018 - Sustainability Initiatives and is responsible for the development and delivery of the capital works program 4021 – Sustainable Initiatives for Outdoor Structured facilities.

7.2.6 Asset Strategy

The Asset Strategy team is responsible for the development of Asset Management Plans and other supporting strategic documentation. Asset Strategy also has responsibility for maintaining Council's Asset Management Information System (Lifecycle), which includes Council's Asset Register and the Works Order System.

The Work Order System is used to manage the delivery of Council's reactive drainage maintenance activities and hazard inspection programs. Reactive maintenance performance is reported using this system. The Work Order System does not currently track the delivery of Council's routine drainage maintenance activities.

The asset register is used to store Council's centralised drainage asset data. Currently, the data is limited to drainage pits and pipes. Other drainage assets have not been captured within the centralised asset register.

The Asset Strategy team use data stored in the asset register to undertake formal valuations of all infrastructure assets. At the time of formal valuations, the team updates Council's centralised asset data to reflect changes resulting

from capital upgrade projects and new private developments. Drainage renewal works are not generally captured.

Asset Strategy also reports Council's financial sustainability to the Department of Planning and Community Development.

The Manager Assets convenes the Standards Committee that has responsibility for ensuring Council's construction standards are appropriate. The role of the Standards Committee is discussed later in this chapter.

7.2.7 Asset Preservation

The Asset Preservation team supports Project Delivery by assisting with the supervision and inspection of Council's capital works projects. The team is also responsible for Council's Asset Handover Process.

This team inspects all private development sites and ensures all assets, including drainage, have been constructed in accordance with Council's construction standards and permit conditions.

The Works Services team, responsible for maintenance of Council's drainage pits and pipes have noted that "missing pipes" is a common problem encountered. The maintenance crews (usually with support from the Construction Group) install new pipes (or property connection points) to address this issue. The problem has been known to result from developers not having installed the pipes in accordance with their design documentation. This problem may be avoided if Council required developers to provide CCTV footage of all pipes (and property connection points).

7.2.8 Place Management

The Place Management team (with support from specialist consultants) administers the redevelopment of activity centres throughout the municipality. Recent projects have included the upgrade of Dorset Square and other shopping precincts. Innovative designs are often implemented and most developments include the installation of WSUD treatments.

Capital funding support from others (including Melbourne Water) is often required to make the initial project construction costs feasible for Council. Such funding support is often contingent on the construction of WSUDs at the site. Until recently, decisions to accept funding support did not consider the lifecycle costs associated with the construction of new assets.

The point at which Place Management projects are handed over to Project Delivery for detailed design and construction is occasionally unclear. The Place Management team generally focuses on concept design but occasionally gets involved in more detailed specification of the assets to be constructed at specific sites.

7.2.9 Urban Planning

The Urban Planning department have responsibility as a statutory planning authority. This team ensure all private sector developments, including drainage works, are designed to a standard that meets Council requirements.

The Urban Planning department recently assisted the development and introduction of a web calculator that helps developers and residents to determine the size of rainwater tank appropriate for detaining runoff on private developments.

Despite the Planning team having engineering expertise, all development proposals that may have impacts on the drainage network are referred to Project Delivery for consideration and development of permit conditions. The Business Improvement Project conducted by the Engineering & Infrastructure Directorate in 2008, recommended streamlining the current approach. A detailed recommendation was proposed. Implementation of the proposed streamlined approach should be pursued to optimise the work practices of both the Planning and the Project Delivery teams.

7.2.10 Sustainability

The Sustainability team is charged with ensuring Council reduces its environmental footprint. The team has developed a capital works program for the installation of rainwater tanks and other measures to improve the sustainability of Council buildings. The Facilities team delivers the program. Minimal consideration is given to opportunities to incorporate flood mitigation works into stormwater harvesting projects.

There has been little consideration of the long-term costs associated with managing the functionality of new assets created as a result of these initiatives.

7.3 Service Delivery Model – Current & Proposed Responsibilities

The Service Delivery Model, illustrated in Figure 19, was first introduced to Council in 2008/09 during the development of the Knox Building Asset Management Plan and was later embedded in Council's Asset Management Policy.

It is fair to say that the model has not yet been used by staff to inform their service and asset management practices. Responsibilities for the management of each lifecycle phase have not been defined. It is therefore considered important that staff education be undertaken to ensure all decision makers have an understanding of the management responsibilities implied by the model.

Table 21 illustrates the Asset Strategy team's interpretation of how the organisation's current approach to the delivery of water management fits with the model. Current and proposed service and asset lifecycle management responsibilities have been nominated. Key integration functions required to support service and asset managers are outlined in Table 22.

A comprehensive review of Council's water management services is recommended. It is considered important that the service delivery model be used as a tool to inform the review. The responsibilities, documented in the tables below, should therefore be considered as a starting point for this review which is expected to include extensive consultation with all stakeholders and include definition of responsibilities at the team level.

Phase	Objectives	Responsible Departments	
		Current	Proposed
Horizon Scanning	Gain an understanding of Council's internal and external environment and use this knowledge to define Council's role regarding water management.	Corporate Planning & Performance Sustainability	Corporate Planning & Performance
Service Lifecycle Phase			
Service Feasibility Analysis	Assess the appropriateness of Council's current water management services. Determine the best approach for Council to meet current and future community needs. Service objectives must be defined so that analysis can be undertaken to compare a range of options including: ▪ Introduction of a new service ▪ Alteration of an existing service (or aspects of a service) ▪ Discontinuation of an existing service (or aspect of a service)	Engineering Services Sustainability	Engineering Services
Formulation	Broadly define all requirements to enable service delivery. Translate detailed service requirements into physical asset needs and measurable service standards and targets.		
Pre-establishment	Design the organisation structure, systems, standards, skill sets, and performance measures required for operation and monitoring of the service. Communicate service delivery objectives to all stakeholders.		
Establishment	Set up/ revise the operating structure, systems, standards, resources and performance measures required to enable operation and monitoring of the service.		
Operation	Operate and monitor delivery of the service to sustainably meet community needs.		
Adjustment	Determine whether the service is aligned with community expectations and the operating environment. Identify service and asset adjustments required to ensure service objectives are met. Adjust internal service agreements, organisation structure, systems, resources and performance measures to ensure service objectives can be monitored and met. Communicate adjustments to affected parties		

Phase	Objectives	Responsible Departments	
		Current	Proposed
Discontinuation	Ensure Council has a considered approach to the termination of services no longer required in a manner that minimises community disruption	Nil	Engineering Services
Asset Lifecycle Phase			
Asset Option Analysis	Enable Council to ensure the best asset solutions are provided to meet service needs within physical, financial, legislative and other constraints.	Sustainability Engineering Services Asset Strategy Place Management Operations	Engineering Services
Design	Prepare requisite documentation to ensure delivered assets will meet service needs, match expected service life and be able to be created, maintained and renewed in a sustainable manner.	Engineering Services Place Management	
Creation (including upgrades)	Ensure constructed drainage assets fit with service needs within physical and financial constraints	Engineering Services	
Maintenance	Preserve assets to ensure they meet service expectations, mitigate risks and achieve expected asset life	Operations	Operations
Renewal	Replace assets in a timely manner to ensure expected asset functionality is maintained over the life of the service.	Operations	
Disposal	Ensure assets that have no current (or foreseeable future use) are removed from Council's asset portfolio.	Nil	Engineering Services

Table 21 – Lifecycle Phases – Management Objectives & Responsible Departments

An attempt has been made to nominate departments which currently have some responsibility for each of the integration functions listed in the table below. It must be acknowledged, however, that many departments listed would not recognise these water management integration functions as part of their current role.

Integration Function	Description	Responsible Department	
		Current	Proposed
Access & Inclusion	Support consideration of access and inclusion initiatives within all water management services. Ensure assets are not constructed in a manner that adversely impacts accessibility. Ensure WSUD treatments support opportunities to develop sensory gardens within the municipality.	Community Wellbeing	Community Wellbeing
Communication	Support the development and implementation of internal and external communication strategies to support decision makers across all phases of the service and asset lifecycles.	Marketing	Marketing
Community Engagement	Support appropriate levels of community engagement at each stage of the service and asset lifecycles.	Community Wellbeing	Community Wellbeing
Data Management	Support the management of data created and required at each stage of the service and asset lifecycles. This includes: o identification of available data sources o data collection o data processing/ analysis o data review and update o data storage, transfer & retrieval etc	Fragmented across the organisation Asset Strategy (Lifecycle) Information Management (GIS)	Information Management Assets
Environmental Sustainability	Support consideration of environmentally sustainable initiatives at all phases of the service and asset lifecycles.	Sustainability	Sustainability
Financial Sustainability	Support assessment of lifecycle cost implications at all stages of the service and asset lifecycles. Ensure Council's long term financial plan incorporates future maintenance, operating , renewal and disposal costs	Finance Assets	Finance Assets

Integration Function	Description	Responsible Department	
		Current	Proposed
Governance	Ensure decision makers at all stages of the service and asset lifecycles, are aware of, and meet all legal and regulatory obligations. Ensure Council policies are developed, implemented, reviewed, updated and terminated as appropriate. Ensure third party agreements are developed, implemented, reviewed, updated and terminated as appropriate.	Nil	Governance
Human Resource Management	Ensure appropriate human resource strategies are developed, implemented, reviewed, updated and terminated as appropriate. Develop training programs to support service and asset management objectives.	People Performance	People Performance
Knowledge Management	Coordinate and support the development, retention and transfer of knowledge across the organisation via education programs and other knowledge sharing processes.	Nil	Corporate Planning & Performance
Service Integration	Ensure service reviews are undertaken in a consistent manner and make use of the service delivery model. Consider the whole of Council's service portfolio to take advantage of synergies. Ensure all services are aligned with each other and the internal and external operating environments. Coordinate (and if necessary, formalise) communication between disparate service teams Minimise duplication of effort by coordinating tasks common to all services (e.g. Horizon scanning, service feasibility analysis, development of service agreements etc.) Ensure strategic service objectives are aligned and monitor coordinated implementation of objectives	Nil	Corporate Planning & Performance
Physical Asset Integration	Optimise use of existing assets to deliver service objectives. Ensure asset design, creation; maintenance, renewal and disposal are aligned to service needs. Ensure asset related improvement recommendations documented in adopted Council strategies and plans are considered during business planning and implemented by decision makers	Nil	Corporate Planning & Performance Assets

Integration Function	Description	Responsible Department	
		Current	Proposed
Protocols, Standards & Process Development & Documentation	Support the development and implementation of processes, templates and standards to be used by service and asset managers	Fragmented across the organisation	Corporate Planning & Performance Asset Strategy
Performance Measurement & Reporting	Audit compliance with the following: o regulatory requirements o Council policies and procedures o mapped service processes (operating, monitoring, auditing & reporting) Audit achievement of: o service goals/ targets o asset goals/ targets o maintenance & renewal intervention levels Report results	Fragmented across the organisation	Corporate Planning & Performance Assets

Table 22 – Integration Functions – Objectives

The remainder of this Chapter summarises the findings of the Asset Strategy team's analysis of Council's current alignment with the service delivery model and suggests a number of improvement projects.

7.4 Horizon Scanning

Officers across the organisation scan the environment within the sector they operate and adjust their work practices accordingly. Horizon scanning information is formally reported by the Corporate Planning & Performance department to the management team, at a high level, as part of Council's annual planning process. When developing their annual business plans, all managers are expected to consider the implications of the information provided. The Sustainability team also scan the horizon for new innovations and initiatives to reduce Council's impact on the environment. This team have advocated for and introduced new initiatives in the area of water management.

As mentioned in Chapter 4, no formal demand analysis has been undertaken to help define the community's current and future water management needs. More comprehensive horizon scanning would provide decision makers with an understanding of how changes in the internal and external environment might affect Council's role regarding water management (of which stormwater management is a significant part).

7.5 Service Lifecycle Management

This section briefly describes each phase of the service lifecycle.

7.5.1 Service Feasibility

With the exception of the business improvement project (Drainage – Service and Asset Management (for New and Upgrade Drainage Works)) conducted by the Engineering & Infrastructure Directorate in 2008, there has not been a recent review of the appropriateness of Council's stormwater management services. Further work is required to define service objectives for all water management services. This will then enable assessment of the feasibility of current approaches to service delivery.

When current and future community expectations regarding water management have been investigated, water management service objectives can be defined. The feasibility of the following options can then be assessed:

- Introduction of a new service
- Alteration to an existing service (or aspects of a service)
- Discontinuation of an existing service (or aspect of a service)

A starting point for defining water management service objectives should incorporate review of this plan and other strategic documents relevant to the service:

- Stormwater Management Plan (2001) prepared by WBM Oceanics
- Knox Drainage Strategy (2001 – 2004) prepared by Egis and URS
- Knox WSUD & Stormwater Management Strategy (2010)
- Knox Sustainable Water Use Plan (2006)

It is recommended that the Manager Engineering Services be responsible for assessing the feasibility and relevance of all water management services currently provided by Council.

7.5.2 Service Formulation & Establishment Phases

Given that Council's current water management services have evolved over many years, the existing services have been formulated and established incrementally in response to changes in the operating environment. This has generally resulted in an absence of detailed service targets that are measureable and aligned with community needs. An objective review of the appropriateness of existing organisational structures, processes, standards and performance measures has not been undertaken.

In an ideal world, service formulation occurs before establishment and operation of the service commences and is adjusted periodically to reflect changes in the service objectives. Service formulation takes the results of service feasibility analysis and defines the service requirements in detail and in a manner that ensures the service will be responsive to community needs identified when scanning the horizon. Like service feasibility analysis, service formulation occurs over a short period of time and can be undertaken as a finite project. Essentially service formulation defines all the requirements to enable effective establishment and operation of the service (including appropriate asset provision and management). It defines the targets against which performance can be monitored to ensure community expectations are met. It is recommended that the Manager Engineering Services be charged with undertaking this work.

Given that Council has always provided the service of stormwater management in some form, it is considered important to review the appropriateness of the current level of formulation. If the standard of formulation is appropriate, then the organisational structures, processes, standards and performance measures currently in place will be found to be adequate to support and monitor the delivery of the desired service outcomes. If not, then appropriate adjustments should be made.

Service pre-establishment follows on from the service formulation phase and also occurs over a short period of time. Like service formulation, it can be undertaken as a finite project. This phase is often overlooked by the organisation. When Council adopts service adjustments there is a general expectation that the adjustments can be implemented almost overnight without consideration of the time and effort required to prepare the organisation for a significant service adjustment. When reformulating the revised water management service, due consideration must be given to this transition phase.

7.5.3 Service Operation & Adjustment Phases

Council's stormwater management services have been operating using pre-established (incrementally adjusted) structures, processes, standards and systems. In light of climate change, and the resultant changes in community expectations regarding water management, it is considered an appropriate time for Council to rethink, and adjust its approach to service delivery.

The service adjustment phase is not about the introduction of continuous improvement actions required to address issues identified while operating a service. It is a phase that occurs after the service has been operating for a number of years and is generally initiated by the Service Manager in response to changes in the internal or external environment.

The recent development and adoption of the Knox WSUD & Stormwater Management Strategy document is an example of Council's current approach to service adjustment. This review has been somewhat narrowly focused on WSUD assets. Changing community expectations regarding the value of water as a precious resource and other demand changes as outlined in Chapter 4, suggest a need for service adjustment that looks more broadly at the service of water management.

7.5.4 Service Discontinuation

Service discontinuation occurs when horizon scanning and service feasibility assessment reveals that a particular service, or aspect of a service, is no longer required to address a community need. Termination of a service is likely to be easier for a service that has been regularly reviewed, refined and improved so that it remains relevant to the community. Council has not discontinued any stormwater management services in recent times.

The proposed water management service review may result in discontinuation of certain aspects of current Council services.

7.6 Integration Functions

Integration of service and asset lifecycle managers is critical to the successful delivery of water management services for the Knox community. Integration of decision makers is considered necessary to ensure:

- all services are aligned with the internal and external operating environment
- all phases of the service and asset lifecycles are appropriately managed to deliver common service outcome objectives

Key integration functions, considered important for the management of Council's water management services and drainage assets are outlined in Table 22 above. These include:

- Access and inclusion
- Communication
- Community engagement
- Data management
- Environmental sustainability
- Financial sustainability
- Governance
- Knowledge management
- Performance measurement and reporting

It is expected that review and adjustment of Council's water management services will include clarification of each department's integration roles and responsibilities.

In future, integration improvements should be driven by both the Corporate Planning and Performance and the Assets departments. Staff education and refinement of work practices are likely to be required to ensure decision makers within each department acknowledge their role in improving the integration of Council's approach to delivering water management services.

7.7 Asset Lifecycle Management

Unlike service lifecycle management, discussed in the previous section, Council has a more robust understanding of asset management. Since the

development of the Knox Strategic Asset Management Plan 2003-2013, Council has made a concerted effort to improve all asset management practices, including those that relate to drainage assets. The table below illustrates the departments with proposed responsibility for each asset lifecycle phase.

Asset Lifecycle Phase					
Asset Option Analysis	**Design**	**Creation**	**Maintenance**	**Renewal**	**Disposal**
Engineering Services			Operations		Engineering Services

Table 23 – Proposed Asset Lifecycle Management Responsibilities - Departments

What seems to be missing, from Council's current approach, is the link between asset management and the delivery of service objectives to meet community demand. Service objectives are poorly defined and community expectations are not well understood. Other deficiencies relate to data management.

While asset management roles and responsibilities are clearly defined at the department level, some confusion is apparent at the team level. Table 24 below summarises the Asset Strategy team's understanding of current team level responsibilities regarding the management of particular drainage assets at various stages of the asset lifecycle. It is recommended that these responsibilities be reviewed and refined to ensure they support the objectives of the expected adjustment to Council's water management services.

Particular areas where clarification of roles and responsibilities is considered necessary include:

- Coordination of asset option analyses
- Proactive asset disposal
- Handover of concept designs to those responsible for detailed design and asset creation
- Maintenance and renewal of WSUDs, overland flow paths and drainage assets not associated with the road network
- Management of retention and detention systems (including retarding basins, dams)
- Management of wetlands
- Asset option analysis and design of rainwater tanks

Drainage Asset	**Current - Responsible Department**					
	Asset Lifecycle Phase					
	Asset Option Analysis	**Design**	**Creation**	**Maintenance**	**Renewal**	**Disposal**
Pits	Project Delivery	Place Management - Concept Design Only	Project Delivery - (Council Assets)	Works Services	Construction Group	No team has overall responsibility for asset disposal.
Pipes (including culverts)						

Drainage Asset	Current - Responsible Department					
	Asset Lifecycle Phase					
	Asset Option Analysis	**Design**	**Creation**	**Maintenance**	**Renewal**	**Disposal**
Outfall structures (including end walls and wing walls)		Project Delivery - Detail Design	Planning - (Developer Contributed Assets) Construction Group			(Disposal is undertaken by the Construction Group and Project Delivery team as part of upgrade projects.)

Drainage Asset	Current - Responsible Department					
	Asset Lifecycle Phase					
	Asset Option Analysis	**Design**	**Creation**	**Maintenance**	**Renewal**	**Disposal**
Retarding basins and, dams (including Council owned on-site detention systems)	Nil	Nil	Project Delivery - (Council Assets) Planning - (Developer Contributed Assets)	Nil	Nil	No team has overall responsibility for asset disposal. (Disposal is undertaken by the Construction Group and Project Delivery team as part of upgrade projects.)
Open drains (including table drains)	Project Delivery	Project Delivery	Project Delivery - (Council Assets) Planning - (Developer Contributed Assets)	Works Services - table drains only associated with the road network	Works Services - table drains only associated with the road network	
Rainwater tanks (constructed on Council property)	Sustainability Facilities	Facilities	Facilities	Facilities (funding introduced 2010/11)	Facilities	
WSUD Treatments						
Rain garden/basin	Project Delivery Place Management (Activity Centres only) All other Project Managers with responsibility for capital works projects that include incidental WSUDs)	Project Delivery Place Management (Activity Centres only) All other Project Managers with responsibility for capital works projects that include incidental WSUDs)	Project Delivery - (Council Assets) Planning - (Developer Contributed Assets)	Parks Services - (Horticultural components only) Works Services - (all other components)	Parks Services - (Horticultural components only) Works Services - (all other components)	No team has overall responsibility for asset disposal. Construction group as part of renewal projects
Bio-retention tree pits						
Swale/filtration trench						
Swale						
Infiltration system						

Drainage Asset	Current - Responsible Department					
	Asset Lifecycle Phase					
	Asset Option Analysis	**Design**	**Creation**	**Maintenance**	**Renewal**	**Disposal**
Wetland	Nil	Project Delivery	Project Delivery - (Council Assets) Planning - (Developer Contributed Assets)	Bushland Parks Services - (Horticultural components only)	Parks Services - (Horticultural components only)	
Permeable paving	Project Delivery Place Management (Activity Centres only)	Project Delivery Place Management (Activity Centres only)	Project Delivery - (Council Assets) Planning - (Developer Contributed	Works Services	Construction Group	
Gross Pollutant Traps	Project Delivery	Project Delivery	Construction Group	Works Services	Construction Group	
Sedimentation tank/basin	Nil	Nil	Project Delivery - (Council Assets)	Bushland	Nil	
Enviss system	Project Delivery	Project Delivery	Project Delivery - (Council Assets) Planning - (Developer Contributed Assets)	Works Services	Construction Group	

Table 24 – Current Asset Lifecycle Management Responsibilities - Teams

In this section, Council's current approach to the management of each asset lifecycle phase is briefly outlined with a view to identifying improvement opportunities.

7.7.1 Asset Option Analysis

Council's approach to water management is somewhat fragmented and has the potential to result in sub-optimal asset solutions. Teams focused on identifying asset solutions that will improve environmental sustainability and water quality, on occasions work independently from those seeking engineering solutions to known flooding issues. This fragmented approach results in lost opportunities to implement asset solutions in a coordinated manner that optimises opportunities to address flooding issues while improving water quality and capturing water for reuse.

Some critical components of the drainage network, such as overland flow paths, dams (and other types of retarding basins) have not been strategically managed or maintained.

Better aligned service objectives for all decision makers could lead to improvements in this area. It is recommended that a more coordinated approach to asset option analysis be implemented. With common measurable service level objectives, teams can continue to work within separate sections

of the organisation while working toward a common purpose. The Engineering Services department is considered best placed to take on overall responsibility for this phase.

Trial Products and Sites

Officers from across the organisation, trial various products and design solutions. These trials often occur without the knowledge, or input of the Standards Committee, or the Engineering Services team. As a result, opportunities to amend proposed designs and update Council standards are missed.

Trial sites, technologies and products, should continue to be encouraged as they are an effective means of finding innovative solutions to problems. It is recommended that all trials be brought to the attention of the Standards Committee so the results of trials be monitored and acted upon via this group.

If a trial is implemented, a formal scope should be developed prior, which would indicate how the trial would be conducted and measured, and the criterion for success, including the duration of the trial (maintenance costs, accessibility, purpose, etc).

The Works Services team recently trialled fabric litter baskets at some sites. These were expected to require a lower level of maintenance than conventional litter baskets. The trial demonstrated that they were subject to attack by rodents and the asset life was much shorter than that predicted by the manufacturer.

The Dorset Square upgrade is an example of a Place Management project that included the construction of WSUD treatments. The WSUD feature was funded by Melbourne Water and included a Melbourne Water designed and funded concrete structure that incorporated a number of tree pits. These were installed during 2008/09 and are already beginning to show signs of concrete cracking. It is recommended that the Standards Committee review the adopted design and construction standard and provide advice on how the design may be amended to avoid cracking problems in the future.

To avoid repetition of such issues in future, it is considered important that all project managers make use of lifecycle cost assessments to inform their decisions as there may be implications for the standard at which the assets will be constructed. Acceptance of capital funding support from others should include due consideration of the ongoing maintenance and renewal costs imposed on Council. Innovative designs introduced to Council projects should be vetted by the Standards Committee prior to the commencement of works.

7.7.2 Design

As noted previously, Project Delivery generally manages the design of new drainage assets. Consultants are often used to assist in solving issues in innovative ways. Council manages the design phase of the lifecycle via design standards and guidelines.

The Standards Committee has responsibility for administering and determining Council standards.

Standards Committee

Council's standard drainage design drawings are administered by the Assets Department. The Assets Department convenes the Standards Committee,

which is made up of representatives from Assets, Engineering Services, Operations, Planning, Sustainability and Strategic Economic Development.

Council's current design standards for drainage pits and pipes are documented in the 100 to 180 series of drawings. Council also has a small selection of WSUD standards (190 series) but these only cover small applications such as swales and filtration trenches.

WSUD treatments, installed by Council, have historically been considered unique and designed from first principles, using a range of design tools including:

- Specialist consultant advice
- CSIRO standards,
- eWater MUSIC program (model for urban stormwater improvement conceptualisation - developed by the University of Canberra)

During development of the WSUD & Stormwater Management Strategy, it became apparent that despite the existence of some standard drawings, Council's Planning Department is using a different set of WSUD standards to offer advice to private-sector developers. This suggests that the Standards Committee is not operating effectively. It seems that only officers working within the Engineering & Infrastructure Directorate consider the decisions of the Standards Committee to be binding on Council practices.

When considering new technologies or assets, it is considered important that the Standards Committee consider the ongoing maintenance and operation standards that will be required into the future. Staff skill requirements for the ongoing future asset maintenance and operation should also be considered.

Design Standards

Council's WSUD standards and guidelines are currently being reviewed as an adjunct to the development of the WSUD & Stormwater Management Strategy.

Given that maintenance crews have expressed concerns regarding blockage of pits and pipes due to tanbark and other loose material being washed away from landscaping treatments, it is considered important that Council's landscaping design standard be reviewed and adjusted as appropriate to limit impacts on the drainage network. Other Council drainage design standards are considered appropriate and do not require review.

Preparation of Design Solutions

Design solutions to known flooding issues are not developed until funding is approved, making it difficult for the projects to be delivered on time. It is recommended that a program for the ongoing development of design solutions for identified high risk flooding issues be implemented so that the solutions have been designed and costed before funding is sought. Design solutions should seek to incorporate WSUDs and water harvesting technologies, where appropriate. Once funding is available the projects can then be delivered in a timely manner.

7.7.3 Asset Creation

New drainage assets are created as a result of private land development projects and Council capital works projects as discussed below.

Since 2009, implementation of Council's Asset Management Policy and Discretionary Rate Funding Allocation Policy has meant that Council's capital works process ensures funds are allocated to enable future maintenance and renewal of created assets.

Private Sector Land Development Projects

Private developers have created the majority of Council's drainage assets. These assets are not recognised by Council until a certificate of practical completion has been issued to the developer.

When development sites include on-site detention systems, these assets remain private assets. They are not handed over to Council.

Implementation of Council's development approval process is the responsibility of the City Planning department. This department is responsible for providing town planning permit conditions while Project Delivery is responsible for updating Council's GIS drainage layer. The Asset Strategy team updates the asset register (every three years) in preparation for formal valuations. WSUD treatments created as a result of these projects have not been recorded systematically. It is expected that, via implementation of the recently adopted WSUD & Stormwater Management Strategy, this gap in Council's data management approach will be addressed.

***Capital Works Program - 4017* - Drainage Upgrades**

Capital works program, *4017 - Drainage Upgrades,* is the main program through which drainage assets are created or upgraded. The Project Delivery team is responsible for this program. In recent years, projects have included WSUD treatments.

Over the years, many flooding issues have been identified. Project Delivery's approach to implementation has involved the preparation of a business case submission and ongoing reprioritisation of a list of more than 300 locations where works are required. The process used to prioritise projects is presented in Table 25 below. This approach was adopted in 2008, following two major storm events during 2007. The criterion incorporates a triple bottom line evaluation, which considers an assessment of the social, environmental and economic impacts of the project. Projects with stormwater harvesting potential are given higher priority.

Opportunities for alignment with the drainage renewal program, managed by the Construction team, are not identified. Project managers responsible for the delivery of other Capital Works Programs that incorporate drainage assets do not typically consider opportunities to improve known flooding issues. Creation of a GIS Layer that highlights the priority and locations of all sites requiring new/upgrade drainage works would enable the renewal and upgrade programs to be more easily aligned.

Criteria	Rating	Score
1. Governance		
a) Project identified in Knox's Stormwater Strategy	Sliding Scale	30

Criteria	Rating	Score
• Flood Risk Index[#]	(derived from Strategy)	
• Hazard Index[##]	High	10
	Med	5
	Low	2
Or b) Risk to Council Based on Property Damage	**High** – Water inside Habitable area or essential part of a building. Property damage greater than $20,000	10
	Med – Water inside non habitable or non essential part of building. Property damage less than $20,000	5
	Low – water flowing or ponding in property but not entering building. Property damage less than $10,000	2
Risk to Council and community on personal safety	**Extreme** – D*V >0.70 m^2/s, Depth > 0.7m, V > 3m/s or Flow level higher than adjacent building floor level	30
	High - D*V >0.55 m^2/s, Depth > 0.5m, V > 2.3m/s or Flow level at adjacent building floor level	15
	Medium - D*V >0.35 m^2/s, Depth > 0.35m, V >1.5m/s or Flow level below adjacent building floor level	10
	Low - D*V <0.35 m^2/s, Depth < 0.35m, V <1.5m/s or Flow level 300mm below adjacent building floor level	5
2. Social / Community Engagement / Community Benefit		
How many properties have been affected by Risk to Personal Safety and Property Damage?	15 - or more properties	20
	6- 14 properties	10
	0 – 5 properties	5
3. Environmental Potential		
Opportunity to provide water quality improvements with drainage upgrade	**High** – Upgrade is within a High value catchment	10
	Medium –Upgrade is not within a High Value catchment – But pollutant reduction will meet Best Practice	5

Criteria	Rating	Score
	Low – Upgrade is not within a high value catchment but the pollutant reduction will meet 75% of Best Practice	2
Opportunity to provide stormwater harvesting with the drainage upgrade	**Great** – able to harvest greater than 50 % of 100 ARI volumes	10
	Good – Able to harvest greater than 25% of 100 ARI volumes	5
	Fair – Able to harvest less than 25% of ARI volumes	2
4. Economic / Financial Impact		
Are there integration opportunities with other Council Capital Works Projects?	Yes	5
	No	0
Are there external funding opportunities?	Yes	5
	No	0
What is the cost magnitude of proposed drainage works?	Less than $25,000	10
	$25,000 - $75,000	5
	Greater than $75,000	2
Maximum Possible Score		**100**

Table 25 – Ranking Criteria – Drainage Upgrades

The flood and hazard risk indices are defined in the 2005 Stormwater Strategy as described below.

Flood Risk Index is a measure of risk based on assessment of capacity of the major and minor systems and how many properties are affected.

Hazard Index is a measure of the magnitude of the hazard created by the municipal system being undersized

The risk Assessment (by the Operations Department) will only reach the threshold if an Operations Officer has assessed the issue (reported by a customer or identified by a Council Hazard Inspector) as posing an Extreme or High risk to public safety. Attachment 5 of the Knox Road Management Plan defines the process used by the Operations Centre to assess public safety risk.

The above criteria enable drainage issues to be ranked based on the impact of actual storm events. High scoring projects are considered to be high priority projects.

Given the low level of funding historically provided for drainage upgrades, the Project Delivery team further refines the prioritisation process. Using the thresholds illustrated in Table 26 below, the Project Delivery team identify the projects that pose an intolerable risk.

Criteria	Threshold for Intolerable Risk
1. Governance	
a) Project identified in Knox's Stormwater Strategy • Flood Risk Index	20

Criteria	Threshold for Intolerable Risk
• Hazard Index	10
Or b) Risk to Council Based on Property Damage	10
Safety Risk to Council and Community based on personal safety	15
2. Social / Community	
How many properties have been affected by Risk to Personal Safety and Property Damage?	20
3. Environmental Potential	
Opportunity to provide water quality improvements with drainage upgrade	10

Table 26 – Defining Intolerable Risks

Competing priorities and pressures on resources within the Project Delivery team, has meant that funding provided for upgrade works is rarely expended. It is therefore recommended that the resources, objectives and priorities within this team be reviewed to ensure that an effective upgrade program can be implemented when funded. Such a review should investigate what is deemed to be a reasonable timeframe to address intolerable risks, as this will ultimately determine the level of funding and resource implications.

The predictive model presented in Chapter 10 suggests 15 years as an appropriate timeframe to deliver $6.6 million of high priority upgrade works. If additional funding is secured, it is important that appropriate adjustments to work processes, resources and priorities be made to facilitate delivery.

Capital Works Program - 4017 - Drainage Upgrades- *WSUD Subprogram*

The WSUD & Stormwater Management Strategy did not include a detailed upgrade program. It is expected that the Interim WSUD Policy, due to be updated during 2010, will introduce a requirement that all capital works projects include (where practicable) the installation of WSUD assets at the locations recommended in the Knox Drainage Strategy. Implementation of this proposed policy position is likely to require a revision of staff responsibilities so that an officer is charged with monitoring implementation and reviewing capital works proposals with a view to introducing appropriate WSUD treatments wherever possible. (Refer Project 6.3 discussed previously.)

Other Capital Works Programs

A significant proportion of other capital works programs (new and upgrade categories) include the creation (or modification) of some drainage assets. Project Managers across the organisation therefore deliver projects that result in the creation of new drainage assets including pits, pipes, rainwater tanks, water harvesting infrastructure and various WSUD treatments.

Capital Works programs include:

- 4007 – Road and Bridge Construction
- 4015 – Place Management

- 4018 – Sustainability Initiatives

In addition to these capital works programs, assets created as incidental parts of major projects, such as the Eastern Recreation Precinct and Stamford Park may have a critical impact on the effectiveness of Council's drainage management practices. Despite this, asset data is often not collected in a centralised and coordinated manner. Council's GIS layer and asset register are only updated following ad hoc notification of the assets created.

Implementation of improvement projects 2.1 to 2.4 discussed in Chapter 2, can be expected to address this gap.

7.7.4 Maintenance

The Operations Centre manages all Council's drainage asset maintenance. Responsibilities are shared across the following teams:

- Works Services
- Parks Services
- Facilities
- Construction

Key aspects of drainage asset maintenance are described in this section.

- Hazard Inspections
- Reactive Maintenance
- Routine Maintenance

Hazard Inspections

Since 2005, Council has implemented a routine inspection regime for the road network in accordance with its Road Management Plan (RMP). The inspection frequencies for Council drainage assets (within the road reserve) are summarised in Table 27.

Asset Category	Road Hierarchy			
	Link	Collector	Industrial	Access
Drainage - Internal Inspection (Side Entry Pits Within Road Reserves	1 year cycle			
Drainage - External Inspection (Pit Lintel, Lid And Surrounds Within Road Reserves and along constructed shared paths	6 month cycle	1 year cycle	1 year cycle	2 year cycle
Table Drains (Excluding Drainage Pipes)	6 roads (Basin Olinda Road, Cathies Lane, Quarry Road, Doongalla Road, Old Coach Road, Sheffield Road) – 1 year cycle Other unsealed roads 3 month cycle or in accordance with Council's routine grading program.			

Table 27 – Routine Hazard Inspection Frequencies

Proactive routine hazard inspections are intended to identify and quantify defects that represent a trigger point at which reactive drainage maintenance works will occur. The table below summarises the relevant hazard classifications listed in the Knox RMP.

Hazards Code	Description
D-063 – Obstructed Culvert / Pipe	Pipe obstructions that prevent stormwater flow
D-064 – Obstructed Drainage Pit	Debris obstructing pit inlets
D-065 – Damaged Pit Lintel	Pit throat (inlet) is reduced to the extent that it obstructs stormwater flow into the pit Lintel is heaved to the extent that it obstructs stormwater flow into the pit Lintel with reinforcement exposed
D-066 – Damaged Pit Lid Structure	Pit lids damaged to the extent that they are hazardous to road users/ pedestrians Grates damaged to the extent that they are hazardous to road users/ pedestrians Pit surround damaged to the extent that they are hazardous to road users/ pedestrians Vertical displacement >15 mm only if the pit is within a designated pedestrian walkway Cracks > 5 mm likely to cause the pit lid and/or surround to collapse Broken or missing pit covers Broken frames that no longer support the lid Missing/ damaged/ deteriorated step irons and/or mesh panels
D-016 – Non-Functional Household Connections	Household drainage connections that are non-functional

Table 28 – Drainage Hazard Codes

An inspection program for pipes in the road reserve has not been developed. Introduction of a program to inspect pipes that traverse the roadway would enable early identification of failed pipes. Early repair of these pipes is considered important because moisture escaping from a collapsed pipe can undermine the integrity of the road pavement leading to potholes and potential pavement collapse. Similarly an inspection program for overland flow paths and easement drains has not been implemented.

The cost and feasibility of undertaking these inspections should be evaluated. Priorities for inspecting drainage assets must make use of the hierarchy proposed in Chapter 2 of this plan.

Reactive Maintenance

In addition to the regular hazard inspections, the community and Council maintenance crews also identify potential drainage issues. Council officers may identify defects exceeding intervention levels when they are carrying out other activities within the municipality. Defects identified this way are recorded in Council's Work Order System (Lifecycle) as ad hoc inspections. Customer requests for asset repairs are received by the Customer Service team and assessed by maintenance crews to determine whether they exceed the intervention levels documented in Council's RMP.

Target timeframes for Council's response to drainage maintenance issues are defined in the RMP for each reactive maintenance activity listed in Table 29

below. It should be noted that some of these service levels are being reviewed as part of a series of general amendments to Council's RMP (2010).

Reactive Maintenance Activity	Initial Response Time (working days)	Rectification Time (working days)	Current Service Level
D-REA-063 Clear Blocked Drainage Pipes & Culverts	2	120	Temporary and/or permanent treatment to remove obstruction that impedes outlet pipe flow. This activity may include replacement of single lengths of pipe of up to 300mm diameter.
D-REA-064 Clear Blocked Drainage Pits	2	120	Clean any debris from pit inlet and pit if obstruction impedes pipe flow to the invert level of the outlet pipe - for all drainage pits within road reserves and shared path underpasses.
D-REA-065 Drainage Pit Lintel Repair	2	120	Provide temporary and/or permanent pit lintel repair when: a) the pit throat (inlet) is reduced to the extent that it obstructs stormwater flow into the pit b) reinforcement is exposed c) the lintel is heaved to the extent that could be hazardous to pedestrians or vehicles
D-REA-066 Drainage Pit Lid/ Structure Repair (excluding lintels)	3	120	Provide temporary and/or permanent repair when: a) Pit covers are broken or missing b) Cracking present and likely to result in pit instability or structural collapse c) Vertical displacements >15mm within designated pedestrian walkways only d) Pit lid
D-REA-016 Household Drainage Connection Repair	3	64	Treatment to repair and/or replace non-functional or missing household drainage connections (i.e. drainage pipe from the property boundary to the kerb line) within Council road reserves or easements.
D-REA-077 Clear Blocked Easement Drain	5	96	Temporary and/or permanent treatment to remove obstruction that impedes pipe flow. This activity may include replacement of single lengths of pipe of up to 300mm diameter.
TD-REA-070 Table Drains Maintenance (incl. open channels)	5	120	Inspect and install temporary protection measures if necessary to reduce the risk to public safety

Table 29 – Reactive Maintenance Activities

The Works Services team is responsible for delivery of all the above listed reactive maintenance activities. All rectification works are expected to be completed as soon as practicable within the target timeframes of 64 and 120 days depending on the maintenance activity.

The initial response timeframes are only applicable when a request is received from a customer. It is the time available to assess the issue raised and to determine what, if any, work is required. The initial response assessment is intended to enable staff time to assess requests received and prioritise reactive maintenance works based on public safety risk.

In accordance with the RMP, temporary works to mitigate public safety risk must be undertaken for all issues assessed as posing an extreme or high risk. Temporary works must be undertaken as soon as practicable, and within 1 or 5 days, respectively for extreme and high risk issues.

Routine Maintenance

The Works Services team provides a number of routine maintenance activities as listed in Table 30. The routine maintenance service levels and frequencies are detailed in the RMP.

Routine Maintenance Activity		Current Service Level
D-ROU-064	Clear Blocked Drainage Pits	Remove accumulated debris from drainage pits including pipe and pit inlets if accumulation obstructs the outlet pipe opening for: a) Side Entry Pits only – 1 year cycle
D-ROU-067	Litter Basket Maintenance	Clear all contents of Council owned litter baskets – 3 month cycle
D-ROU-068	Gross Pollutant Trap Maintenance	Clear all litter/debris from Council owned Gross Pollutant Traps – 6 month cycle
TD-ROU-070	Table / Spoon Drain Maintenance	Reset rock beaching, reshape and clear major obstructions impeding stormwater flow path of drain – 1 year cycle

Table 30 – Routine Maintenance Activities

Routine street sweeping forms part of Council's approach to proactively limit the amount of debris able to be washed into the underground drainage system. The Works Services team is responsible for delivering this service.

Routine mowing of Council owned retarding basins tends to fall under the maintenance of reserves, rather than being an activity that is classified as a form of drainage maintenance. The Parks Services team is responsible for all mowing. As mentioned in Chapter 3, a more proactive approach to the management of Council's retarding basins is recommended (refer Project 3.1).

As noted previously, Council does not have a reliable means of measuring the delivery of routine drainage maintenance. Upgrades to the Asset Management System (Lifecycle), or an alternative centralised maintenance management system, are recommended to enable performance to be monitored.

In 2009/10 there were no specific maintenance programs for the following:

- Rainwater tanks (introduced in the 2010/11 budget)
- Retarding basins
- Regrading of open drains (other than those within the road reserves)
- WSUD treatments (introduced in the 2010/11 budget)

Historically, most WSUDs were not maintained because the Operations Centre had not been informed of their existence and maintenance requirements, nor had funding been allocated.

As mentioned previously, as a result of Council's WSUD & Stormwater Management Strategy, Parks Services are currently in discussions with Project Delivery and Works Services regarding the maintenance of WSUD

treatments. Historically, these treatments have not been maintained, with the exception of litter removal. WSUD maintenance activities currently being developed are likely to state that Parks Services have responsibility for vegetation maintenance within the WSUD treatments, whilst Works Services will be responsible for maintaining the drainage functionality of these assets. This demarcation of responsibilities may have practical difficulties as no team has overall responsibility for these assets.

7.7.5 Renewal

Renewal works are funded under capital works program *1003 - Drainage Renewal* administered by the Construction team. Project Delivery administers a subprogram for the renewal of WSUDs.

During the development of the WSUD & Stormwater Management Strategy, five (5) locations were identified as having non-functional WSUDs that require renewal.

- Boronia Park – behind basketball centre (Park Cres, Boronia)
- Lords Crt, Lot 7 Rathgar Rd, Lysterfield
- Rowville Community Centre
- Clayden Rise – subdivision of 47-53 Palmerston Rd, Lysterfield
- Railway Avenue, Boronia (Peregrine Estate)

Funding has been provided to renew these assets for the first time in 2010/11. No long term renewal funding requirements have been established as yet.

To date, the development of the drainage (pit & pipe) renewal program has been largely reactive. Renewal ranking criteria have been developed to help prioritise works, however these are rarely used and business case submissions are typically high level in nature. In recent years, CCTV data has been used to identify works. It is important that investment in CCTV audits continues. This will enable condition data to form the basis for defining Council's drainage renewal priorities. As noted previously, the prioritisation and delivery of future CCTV audits should be more systematic and make use of a transparent prioritisation methodology that incorporates the proposed hierarchy as explained in Chapter 2. The condition data should be captured in Council's asset register and used to update the predictive model presented in Chapter 10 .

The initial focus of the CCTV audits should be on pipes where failure is expected to pose the highest public safety risk. Pipes (under road pavements) within the following two hierarchy classifications should therefore have priority and be considered in the first instance:

- Road Reserve - Major Drains
- Habitable Land – Major Drains

As mentioned earlier, inconsistent renewal record keeping by the Construction team has meant that it is difficult to estimate the age of Council's pit and pipe network. It is therefore difficult to assess the effectiveness of recent expenditure on drainage renewal.

Some renewal works incorporate addressing minor capacity issues (for example upgrading 225mm diameter pipes to 300mm diameter).

Opportunity exists to improve record keeping and the alignment of Council's drainage renewal and upgrade programs, and to ensure works are correctly allocated for financial and asset management purposes.

7.7.6 Disposal

Drainage asset disposals are quite rare. Disposals are not reported separately in Council's financial reports. They generally occur as a result of a renewal or upgrade project. Given the nature of development within the municipality, it is unlikely that drainage assets will be disposed without replacement.

A number of gross pollutant traps (GPTs), have been disposed of (or rather abandoned) in recent years. These have proven difficult to maintain, or are no longer considered to be required for water quality management.

7.8 Improvement Projects

PROJECT 7.1. Staff Education – Service Delivery Model

It is recommended that the Asset Strategy team (with support from the Manager Corporate Planning and Performance) embark on a staff education campaign to explain the purpose of the service delivery model described in the AM Policy. The aim should be to use this conceptual model as a basis for developing a common understanding of the key tasks required to effectively manage the delivery of each phase of the service and asset lifecycle. The importance of key integration functions should also be explained. The education program should focus on the service of water management and consider all drainage assets that are required to support service delivery.

PROJECT 7.2. Review Water Management Services

A comprehensive review of Council's water management services is recommended. The review should make use of the service delivery model to assess the feasibility and relevance of the existing approach. The Manager Engineering Services (with support form the Manager Sustainability and other stakeholders) is considered to be best placed to conduct this review.

This proposed review should seek to improve integration of decision makers and address the gaps identified in this plan (for each stage of the service and asset lifecycle). This project is expected to include refinement of current roles and responsibilities to support better integration and enable delivery of all water management services to the community. The review should consider creation of a dedicated water management team to drive service delivery improvements.

PROJECT 7.3. Review Routine Maintenance Programs

If required, based on the outcome of PROJECT 3.1 and PROJECT 8.5, it is recommended that Council's current approach to the maintenance of overland flow paths and retarding basins be reviewed. If necessary, new routine maintenance programs may be introduced to ensure these assets function appropriately during major storm events.

PROJECT 7.4. Encourage Developers to provide CCTV footage

'Missing pipes' is a common problem encountered by maintenance crews in older areas of the municipality. These sections of pipe that were not constructed by developers are generally only found when a resident contacts Council because the nature strip becomes wet and boggy after a rain event.

This issue can be avoided in the future if developers were required to provide Council with CCTV footage to demonstrate that all underground assets have been constructed.

It is recommended that the Asset Preservation team work with the Urban Planning department to investigate the feasibility of introducing a requirement for developers to provide CCTV footage of underground assets that are handed over to Council.

PROJECT 7.5. Create GIS Drainage Layer – Future Capital Renewal Program

It is recommended that the Construction team (with support from Project Delivery) manage a GIS Layer that highlights Council's future drainage renewal program. This layer should indicate the priority of works and the expected completion date. It is important that the team responsible for the proposed GIS layer ensure that the results of all capital works that have an impact on Council drainage assets are captured and accurately recorded. This will require support from Project Delivery.

The new layer should be used as a basis for updating Council's asset register and GIS drainage layer as works are completed.

It is expected that the Asset Strategy and Information Management teams will support Project Delivery with the initial creation of the layer and the link to Council's asset register. Ongoing maintenance would be the responsibility of the Construction team. (Refer also PROJECT 2.4iii)

PROJECT 7.6. Review Implementation of amended planning approval practices

It is recommended that the Manager Engineering Services, in consultation with the Executive Engineer - Business Improvements, review the implementation of recommendations contained in the Business Improvement Project, *Drainage – Service and Asset Management (For New and Upgrade Drainage Works)* report.

In particular, this project should review the implementation of the Assessment of Subdivisions/Town Planning Requests process as detailed in Section 5, Attachment 7 & 8 of the above mentioned document. The intention of implementing the revised process, and recommended forms, was to relieve administrative pressures placed on the Project Delivery - Team Leader Engineering Services and enable this officer to focus on more complex drainage issues and the strategic direction of Council's approach to water management.

The proposed review should assess, and if necessary, modify the current forms and demarcation of responsibilities for City Planning and the Engineering Services staff.

This project should be undertaken in conjunction with PROJECT 7.2 described above.

PROJECT 7.7. Review Standards Committee Terms of Reference

It is recommended that the Standard Committee's Terms of Reference be amended to include a requirement that all trial designs and products be overviewed by this Group. Changes to the Terms of Reference should be communicated to all staff.

When considering new technologies or assets, it is considered important that the Standards Committee also consider ongoing maintenance and operation standards.

PROJECT 7.8. Develop Solution to Dorset Square WSUD cracking

To ensure ongoing improvement in Council's WSUD design standards, it is recommended that the Standards Committee seek to develop a solution to the cracking of the WSUD feature recently constructed at Dorset Square.

The Committee should ensure feedback is provided to Melbourne Water regarding the design and advocate for maintenance funding support.

If necessary the design and construction standards should be amended and an appropriate maintenance regime instigated.

PROJECT 7.9. Review & Amend Landscaping Design Standards

Review Council's current landscaping design and construction standards and amend, as appropriate, to limit the use of tanbark, and other loose materials, that have been found to enter and block Council drains.

PROJECT 7.10. Manage the Construction of WSUDs in Road Reserves

If during the implementation of the WSUD and Stormwater Management Strategy, Council begins to construct (and/or allow others to construct) WSUD treatments within the road reserve, it is considered important that these assets are managed in a manner consistent with the obligations imposed on Council, as a responsible road authority, under the Road Management Act (2004). The design, construction and ongoing maintenance (including inspections) of these assets will need to be carefully managed. Inspection and maintenance service levels will need to be defined by Engineering Services and documented as a revision to Council's Road Management Plan. It is recommended that this project be led by the Manager Engineering Services.

PROJECT 7.11. Review Drainage Inspection Practices- Update Road Management Plan

Drainage maintenance and inspection practices should be reviewed and adjusted (if necessary) to include consideration of the drainage hierarchy.

It must be noted that the Knox Road Management Plan, sets out Council's service levels for hazard inspections and drainage maintenance. The proposed hierarchy includes two classifications that have been developed to classify all road related drainage within the municipality:

- Road Reserve - Major Drain
- Road Reserve - Minor Drain

It is therefore important that any changes to Council's approach to inspection and maintenance of these road related assets are considered for inclusion at the next amendment of Council's Road Management Plan.

The review of inspection and maintenance practices should define Council's approach to managing drainage assets affected by tree roots. A proactive pipe cleaning program already exists.

Chapter 8 Asset Performance

CHAPTER SUMMARY

- Since 2005, there has been a decline in the number of customer requests for drainage maintenance
- The number of customer requests is closely aligned with storm activity
- Most customer requests require Council to undertake the following drainage maintenance activities
    - Clear Blocked Drainage Pipes and Culverts
    - Drainage Pit Lid/ Structure Repair
- Drainage issues assessed as posing an extreme or high public safety risk have been declining over the past five years.
- Council has generally achieved 90% compliance with the reactive drainage maintenance service levels defined in the Knox Road Management Plan. Some drainage pit lintel repairs have not been completed on time generally because of difficulties with availability of skilled concreting contractors and staff.
- Unlike reactive maintenance, delivery of routine activities is not managed within the centralised asset management system (Lifecycle). Compliance with the routine maintenance service levels as set out in the Knox Road Management Plan is therefore difficult to measure.
- Council has generally found it difficult to comply with the drainage hazard inspection program as set out in the Knox Road Management Plan.
- Council has not systematically recorded the maintenance of drainage assets that are not covered by the Knox Road Management Plan. Specific maintenance service level standards have not been defined.
- In recent years, the EPA has not issued any notices on Council in relation to poor drainage management practices.
- Since 1994, only 4% of all over excess insurance claims made against Council have been attributed to a drainage issue.
- The capacity of the drainage network to remain functional during major storm events is a direct measure of performance.
- On average, 46 requests are received each day for a period of 5 days after a storm event.
- On 3 and 20 December 2007, the City of Knox experienced two major storms in succession. Both were measured by the Bureau of Meteorology to be approximately 50 year events. During these events, Council's Operations Centre had to deal with ten times the normal level of enquiries to address flooding issues.
- Areas developed prior to 1975, when provision of overland flow paths was not regulated, were found to have a higher volume of reported flooding events during major storms.

8.1 Introduction

This chapter provides a summary of the current performance of Council's drainage pit and pipe network. Recent flooding history is presented together with maintenance records collected since January 2005. Recent EPA compliance and insurance claim statistics are also reviewed.

8.2 Reactive Maintenance History – Pits & Pipes

8.2.1 Issues Addressed

Table 31 below indicates an overall decline in the number of drainage issues identified since 2005. The majority of issues are identified via Council's internal processes demonstrating an increasingly proactive approach to maintenance. The number of customer requests raised has varied during the period and is closely aligned with storm activity. Particularly intense rainfall periods were observed during 2005 and 2007 and are discussed in more detail in section 8.7 of this plan.

Issue Identified by	No. Issues Identified				
	2005	2006	2007	2008	2009
Customer Request (including After Hours Call-outs)	1178	1185	1611	987	1096
Routine Hazard Inspection	1913	2578	2002	2064	1649
AdHoc Hazard Inspection	1315	907	397	406	529
Condition Audit#	4	53	1	2	1
Total	**4410**	**4726**	**4011**	**3459**	**3275**

Table 31 – Maintenance Data – Source of Request

Data source: Work Order System (LifeCycle) January 2005 to December 2009

Contractors engaged to undertake a pit/ pipe inventory and/ or condition audit were required to report extreme and high public safety risks observed on site.

The types of maintenance issues identified over the past 5 years are summarised in Table 32.

Reactive Maintenance Activity		No. Issues Identified					
		2005	2006	2007	2008	2009	Total
D-REA-064	Clear Blocked Drainage Pits	1805	2185	1583	644	1069	7286
D–REA-063	Clear Blocked Drainage Pipes & Culverts	1112	927	1009	597	408	4053
D–REA-077	Clear Blocked Easement Drains	10	52	199	108	146	515
D-REA-016	Household Drainage Connection Repair	11	15	75	81	148	330
TD-REA-070	Table Drain Maintenance	21	29	23	21	14	108

Reactive Maintenance Activity		No. Issues Identified					
		2005	2006	2007	2008	2009	Total
D-REA-065	Drainage Pit Lintel Repair	190	162	174	194	195	915
D-REA-066	Drainage Pit Lid/ Structure Repair (excluding lintels)	1272	1355	948	1814	1295	6684
	Total	**4410**	**4726**	**4011**	**3459**	**3275**	**19881**

Table 32 – Reactive Maintenance – Total Issues Identified

Data source: Work Order System (LifeCycle) January 2005 to December 2009

As shown in the table below, the exclusion of requests identified during significant storms, illustrates some trends in the distribution of maintenance issues addressed.

Reactive Maintenance Activity		No. Issues Identified					
		2005	2006	2007	2008	2009	Total
D-REA-064*	Clear Blocked Drainage Pits	1693	2185	1564	644	1054	7140
D–REA-063*	Clear Blocked Drainage Pipes & Culverts	1101	927	518	597	350	3493
D–REA-077*	Clear Blocked Easement Drains	9	52	95	108	123	387
D-REA-016*	Household Drainage Connection Repair	0	15	68	81	135	299
TD-REA-070*	Table Drain Maintenance	21	30	20	21	14	106
D-REA-065*	Drainage Pit Lintel Repair	189	162	168	194	195	908
D-REA-066*	Drainage Pit Lid/ Structure Repair (excluding lintels)	1268	1355	886	1814	1287	6610
	Total	**4281**	**4726**	**3319**	**3459**	**3158**	**18943**

Table 33 – Reactive Maintenance –Issues Identified (excluding major storm periods)

* The reported number of issues addressed for these activities excludes requests received during the following four major storm events: 2nd to 4th Feb 05; 3rd to 7th Dec 07; 20th to 28th Dec 07; 22nd to 27th Nov 09 (refer section 8.7 of this plan)

A decline in demand for the following activities is evident:

- D-REA-063 Clear Blocked Drainage Pipes
- D-REA-066 Drainage Pit Lid/ Structure Repair (excluding lintels)

This decline may be attributed to the routine hazard inspection program, which has enabled officers to identify defects, clean pipes and repair pits on a more regular frequency.

The increase in requests identified under the following activities may suggest an increasing demand.

- D–REA-077 Clear Blocked Easement Drains
- D-REA-016 Household Drainage Connection Repair

However, it is also possible that improved record keeping by the Works Services team, in recent years, has meant that defects that were often inappropriately recorded under the D–REA-063 Clear Blocked Drainage Pipes & Culverts activity are now allocated to the correct activity.

8.2.2 Customer Requests

The table below illustrates that the majority of concerns identified by customers require Council to undertake the following activities

- D-REA-063 Clear Blocked Drainage Pipes and Culverts
- D-REA-066 Drainage Pit Lid/ Structure Repair

Reactive Maintenance Activity		No. Issues Identified by Customers					
		2005	2006	2007	2008	2009	Total
D-REA-064	Clear Blocked Drainage Pits	226	159	82	61	199	**727**
D–REA-063	Clear Blocked Drainage Pipes & Culverts	552	532	784	366	297	**2531**
D–REA-077	Clear Blocked Easement Drains	8	35	186	87	114	**430**
D-REA-016	Household Drainage Connection Repair	11	9	53	57	106	**236**
TD-REA-070	Table Drain Maintenance	8	16	19	15	10	**68**
D-REA-065	Drainage Pit Lintel Repair	19	43	47	27	33	**169**
D-REA-066	Drainage Pit Lid/ Structure Repair (excluding lintels)	365	391	440	374	336	**1906**
	Total	**1189**	**1185**	**1611**	**987**	**1095**	**6067**

Table 34 – Reactive Maintenance – Issues Identified by Customers

Data source: Work Order System (LifeCycle) January 2005 to December 2009

8.2.3 Public Safety Risk Results

All defects identified are assigned a public safety risk rating which determines the timing of risk mitigation works. The distribution of risks reported is presented in Table 35 below.

Identified Risk	No. Issues Identified (%)				
	2005	2006	2007	2008	2009
Extreme	194 (4.4%)	122 (2.6%)	39 (1.0%)	59 (1.7%)	59 (1.8%)
High	565 (12.8%)	580 (12.3%)	500 (12.5%)	424 (12.3%)	387 (11.8%)
Medium	2937 (66.6%)	3356 (71. %)	1795 (44.8%)	563 (16.3%)	861 (26.3%)
Low	382 (8.7%)	236 (5.0%)	946 (23.6%)	1974 (57.1%)	1589 (48.5%)
No Hazard	332 (7.5%)	432 (9.1%)	731 (18.2%)	439 (12.7%)	379 (11.6%)
Total	**4410**	**4726**	**4011**	**3459**	**3275**

Table 35 – Maintenance Data – Identified Risk Levels

Data source: Work Order System (LifeCycle) January 2005 to December 2009

The majority of issues were found to pose a medium or low public safety risk. Figure 20 below, shows that the number of drainage issues assessed as posing an extreme or high public safety risk has been declining over the past five years.

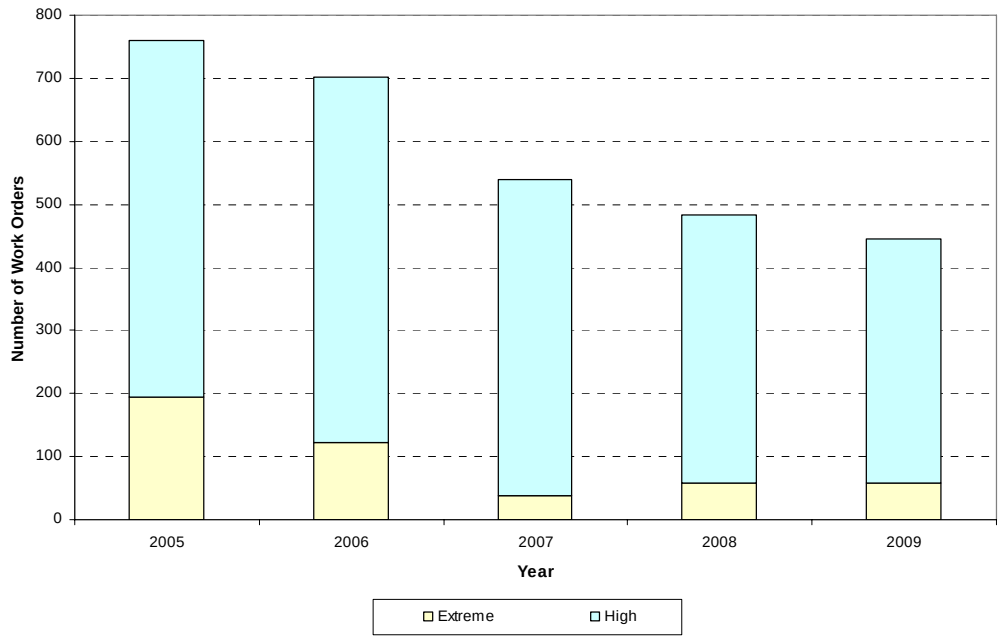

Figure 20 – Extreme & high public safety risk issues – Trend 2005-2009

Figure 201 below, shows that the distribution of public safety risks attributed to drainage issues reported by customers.

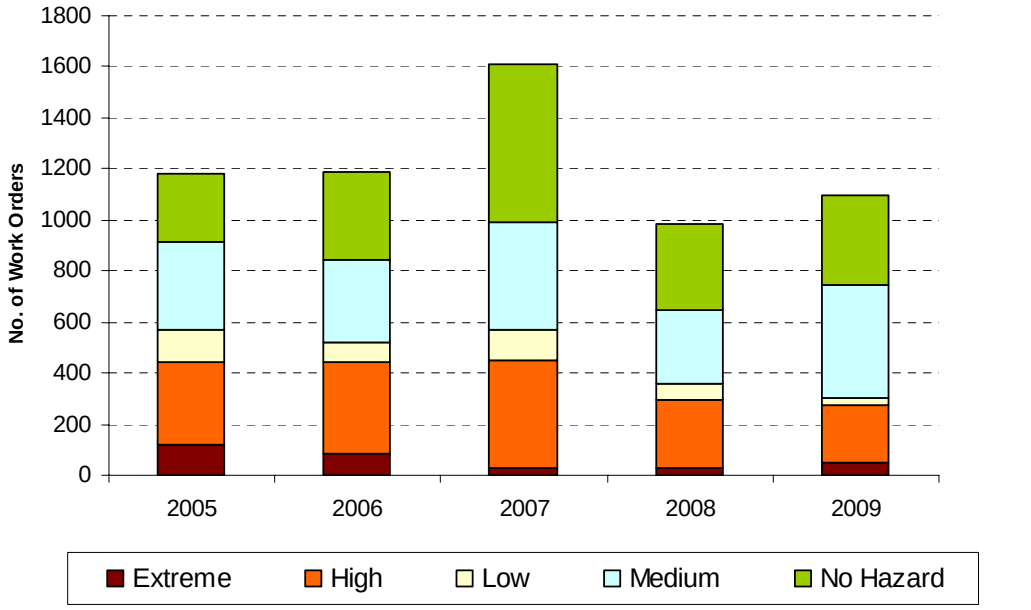

Figure 21 – Public safety risk attributed to customer requests – Trend 2005-2009

Issues attributed a risk of "No Hazard" are either below Council intervention levels or are considered to be duplicate requests. That is, the issue raised by the customer has already been reported to Council. During storm events, Council receives many duplicate requests as multiple customers contact Council to report the same issue.

During the period 2007 to 2009, 1308 (35.4 %) of requests received were assessed as posing no public safety risk and were assigned a risk rating of "No Hazard".

Of the 1308 "No Hazard" requests, 309 (23.6%) were recorded as Duplicate Requests. That is, requests that had been raised previously. Other "No Hazard" requests were either assessed as not exceeding Council's maintenance intervention levels or related to assets for which Council is not the responsible authority.

Routine Maintenance Service Levels

The Knox Work Order System does not have the functionality required to monitor delivery of Council's routine drainage maintenance activities listed below:

- D-ROU-064 Clear Blocked Drainage Pits
- D-ROU-067 Litter Basket Maintenance
- D-ROU-068 Gross Pollutant Trap Maintenance
- TD-ROU-070 Table Drains Maintenance (incl. open channels)

These activities are managed by various Operations Centre supervisors using a range of spreadsheets and other methods. The lack of a centralised recording system for routine maintenance service delivery makes it difficult to know whether documented service levels are achieved.

8.3 Maintenance History – Other Drainage Assets

Council has not systematically recorded the maintenance of drainage assets that are not covered by the Road Management Plan and specific maintenance service level standards have not been defined.

8.4 Road Management Plan (RMP) Compliance

In order for Council to invoke a policy defence under the Road Management Act (2004), compliance with the service levels documented in the RMP is sought. Compliance performance for the period January to December 2009 is summarised below.

Routine Hazard Inspection Compliance

Compliance has been calculated using the following formula:

$$\frac{\text{No. assets } \textbf{inspected when due} \text{ during the period 01 Jan '07 to 31 Dec '09}}{\text{No. assets } \textbf{due to be inspected} \text{ during the period 01 Jan '07 to 31 Dec '09}}$$

Achievement of 100% compliance with the inspection frequencies set out in the RMP is unrealistic – this requirement has since been modified to a target of 90% compliance in the 2010 amendments to the RMP. This is considered to be an achievable target and consistent with neighbouring Councils. Considerable effort has been made over the past six months by the Operations Centre leadership team to ensure performance improvement is made a priority. The results of this work should be visible in a future review of performance, as well as in monthly directorate reporting.

Hazard Inspection	Road Hierarchy			
	Link	Collector	Industrial	Access
Drainage - Internal Inspection (Side Entry Pits Within Road Reserves	33.0 %			
Drainage - External Inspection (Pit Lintel, Lid And Surrounds Within Road Reserves	47.0 %	55.0 %	87.0 %	53.0 %

Table 36 – RMP Compliance - Routine Hazard Inspections (2009)

Reactive Maintenance Compliance – Initial Assessment

During 2009, more than 90% of drainage issues raised by customers, against each of the maintenance activities, listed in the following table, were assessed on time.

Activity		Number of Customer Requests	% Assessed on Time
D-REA-064	Clear Blocked Drainage Pits	199	94.5
D–REA-063	Clear Blocked Drainage Pipes & Culverts	297	91.3
D-REA-065	Drainage Pit Lintel Repair	33	90.9
D-REA-066	Drainage Pit Lid/ Structure Repair (excluding lintels)	335	96.4
D-REA-016	Household Drainage Connection Repair	106	97.2

Table 37 – RMP Compliance – Initial Assessment Timeframes (2009)

Reactive Maintenance Compliance – Temporary Works

Generally the time taken to address temporary works has been within target times set in the Road Management Plan. That is, 1 working day for extreme risk issues and 5 working days for high risk issues. 11.8% of the time, temporary works to address blocked drainage pits were not undertaken within target timeframes. These delays generally occurred during significant storm events.

Activity		Number of Requests Assessed as Extreme or High in 2009	% Completed on Time
D-REA-064	Clear Blocked Drainage Pits	17	88.2
D–REA-063	Clear Blocked Drainage Pipes & Culverts	45	100
D-REA-065	Drainage Pit Lintel Repair	16	100
D-REA-066	Drainage Pit Lid/ Structure Repair (excluding lintels)	365	97.5
D-REA-016	Household Drainage Connection Repair	2	100

Table 38 – RMP Compliance – Temporary Works Timeframes (2009)

Reactive Maintenance Compliance – Rectification Works

Table 39 below illustrates delays to rectify damaged drainage pit lintels. This has generally occurred because it is difficult to find concreting contractors that are willing to undertake such small scale jobs in a timely manner. In-house staff with the requisite concreting skills are also often difficult to recruit and retain.

Activity		Number of Requests Due in 2009	% Completed on Time
D-REA-064	Clear Blocked Drainage Pits	727	100
D–REA-063	Clear Blocked Drainage Pipes & Culverts	238	97.5
D-REA-065	Drainage Pit Lintel Repair	139	82.7
D-REA-066	Drainage Pit Lid/ Structure Repair (excluding lintels)	1130	99.5
D-REA-016	Household Drainage Connection Repair	105	91.4

Table 39 – RMP Compliance – Rectification Works Timeframes (2009)

Routine Maintenance Compliance

Unlike reactive maintenance, delivery of routine activities is not managed within the centralised asset management system (Lifecycle). Compliance with the routine maintenance service levels set out in the Knox Road Management Plan is therefore difficult to measure. Delivery of these activities is managed

by a number of Council Officers using a range of spreadsheets and other techniques. To enable compliance to be measured in future years, it is recommended that the capabilities of the Lifecycle system be expanded to accommodate routine drainage maintenance management.

8.5 EPA Compliance

In recent years, the EPA has not issued any notices on Council in relation to poor drainage management practices.

8.6 Insurance Claims History

Insurance claims are managed by Council's Safety, Risk and Wellbeing team. Claims are separated into two categories:

- Over Excess Claims – over $10,000
- Under Excess Claims – under $10,000

An analysis was undertaken of all over excess (greater than $10,000) claims, between 1994 and 2009. These claims are managed by Civic Mutual Plus (CMP). In this period, a total of 164 claims were made against Council, the breakdown for which is shown in Figure 22.

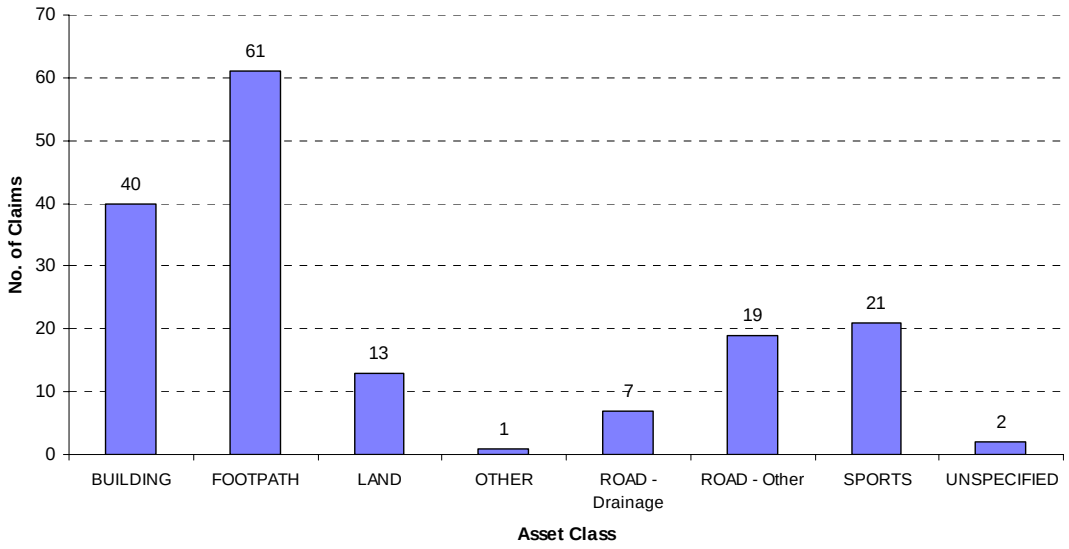

Figure 22 – Over Excess Claims by Asset Class 1994–2009

Data source: Civic Mutual Plus

Since 1994, 4% of all over excess claims made against Council have been attributed to a drainage issue. This is a relatively minor amount considering the number (and associated value) of claims relating to other asset classes such as roads, footpaths and buildings. However, unlike these other asset classes, it is rare for claims relating to Council's drainage network to reach the $10,000 threshold required to initiate this course of action.

On the other hand, under excess claims are managed by Echelon (a subsidiary of Jardine, Lloyd and Thompson), which process and manage claims on behalf of Council. As can be seen in Figure 20 below, flooding claims (which relate to Council's drainage network) are minimal. The exception is in the year 2007/08 when 19 claims were received. This can possibly be attributed to two major storms occurring in December of that year

where flooding affected a number of properties. The increasing likelihood of major storm events resulting from climate change may mean that Council is exposed to increasing claims regarding property damage or loss. It is interesting to note, however, that of all the claims received, the vast majority are denied or do not proceed.

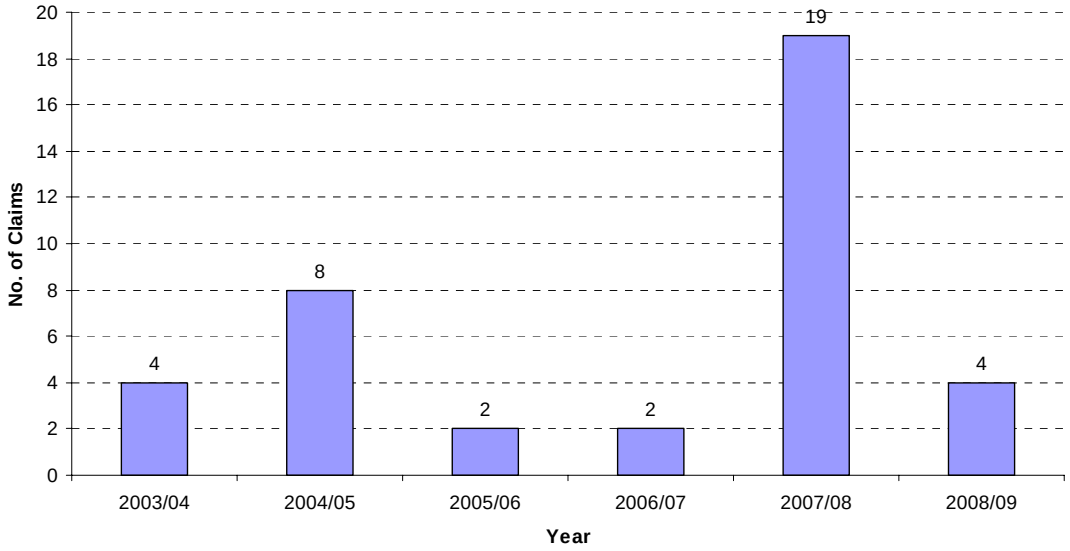

Figure 23 – Under excess claims per year 2004–2009 (drainage/flooding related)

Data source: Echelon (Jardine Lloyd & Thompson)

It is apparent from this analysis that only a small number of claims are made relating to Council's drainage network, and of these, most are dealt with as under excess claims. Very few claims are ultimately successful. This highlights that Council is rarely deemed at fault for flooding issues and infers that Council's drainage network generally performs as required and as designed.

8.7 Flooding History

The capacity of the drainage network to remain functional during major storm events is a direct measure of performance. Flooding problems typically occur at low points in roads, where the depth of flow exceeds the storage capacity of the road, or other available overland flow paths.

According to rainfall data captured by the Bureau of Meteorology between September 2004 and December 2009, there were 26 days during which more than 20mm of rainfall was recorded in the City of Knox. As expected, these high rainfall days coincided with days when customer requests for drainage maintenance also peaked. The table below indicates the five largest storm events recorded during the past five years. The number of requests and the amount of rainfall recorded is also presented for each event.

On average, 46 requests are received each day for a period of 5 days after a storm event. This peak in demand places a massive impost on the resources of the Operations Centre which normally receive only 5 drainage maintenance requests each day.

Storm Event	Rainfall (mm)	No. Customer Requests
3/11/2004 to 9/11/2004	107.0	130
2/02/2005 to 4/02/2005	148.0	129
3/12/2007 to 7/12/2007	38.8	325
20/12/2007 to 28/12/2007	107.8	367
22/11/2009 to 27/11/2009	84.6	117

Table 40 – Flood Events – Customer Requests Recorded

Rainfall data was obtained from the Bureau of Meteorology Climate Data for the Melbourne Observation Station - Scoresby Research Institute 086104

Some 36% of customer requests received during a storm event are reported as duplicate requests because multiple customers contact Council to report concerns. The map below illustrates the relationship between locations where multiple requests have been recorded and the land that is known to be subject to inundation.

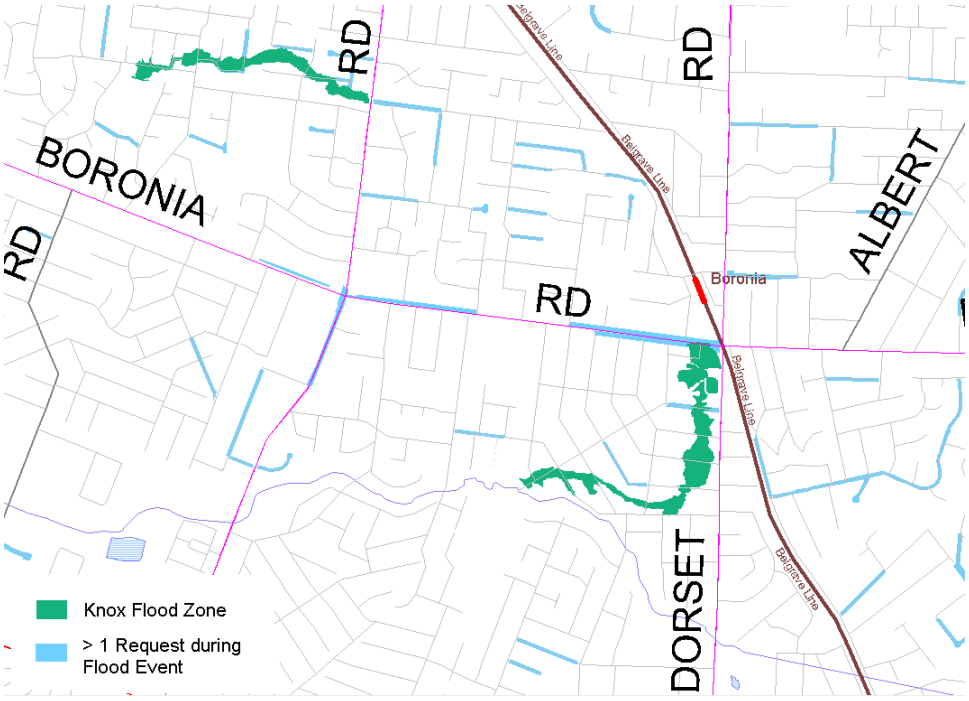

Figure 24 – Multiple Requests during Major Storm Events – Knox Identified Flood Zones (proposed SBO2 layer)

On 3 and 20 December 2007, the City of Knox experienced two major storms in succession. Both were measured by the Bureau of Meteorology to be approximately 50 year events. During these events, Council's Operations Centre had to deal with ten times the normal level of enquiries to address flooding issues. Investigations that followed these storms indicated that most issues were a result of inadequate overland flow paths.

The figure below illustrates the locations across the municipality where maintenance requests have been raised in multiple storm events.

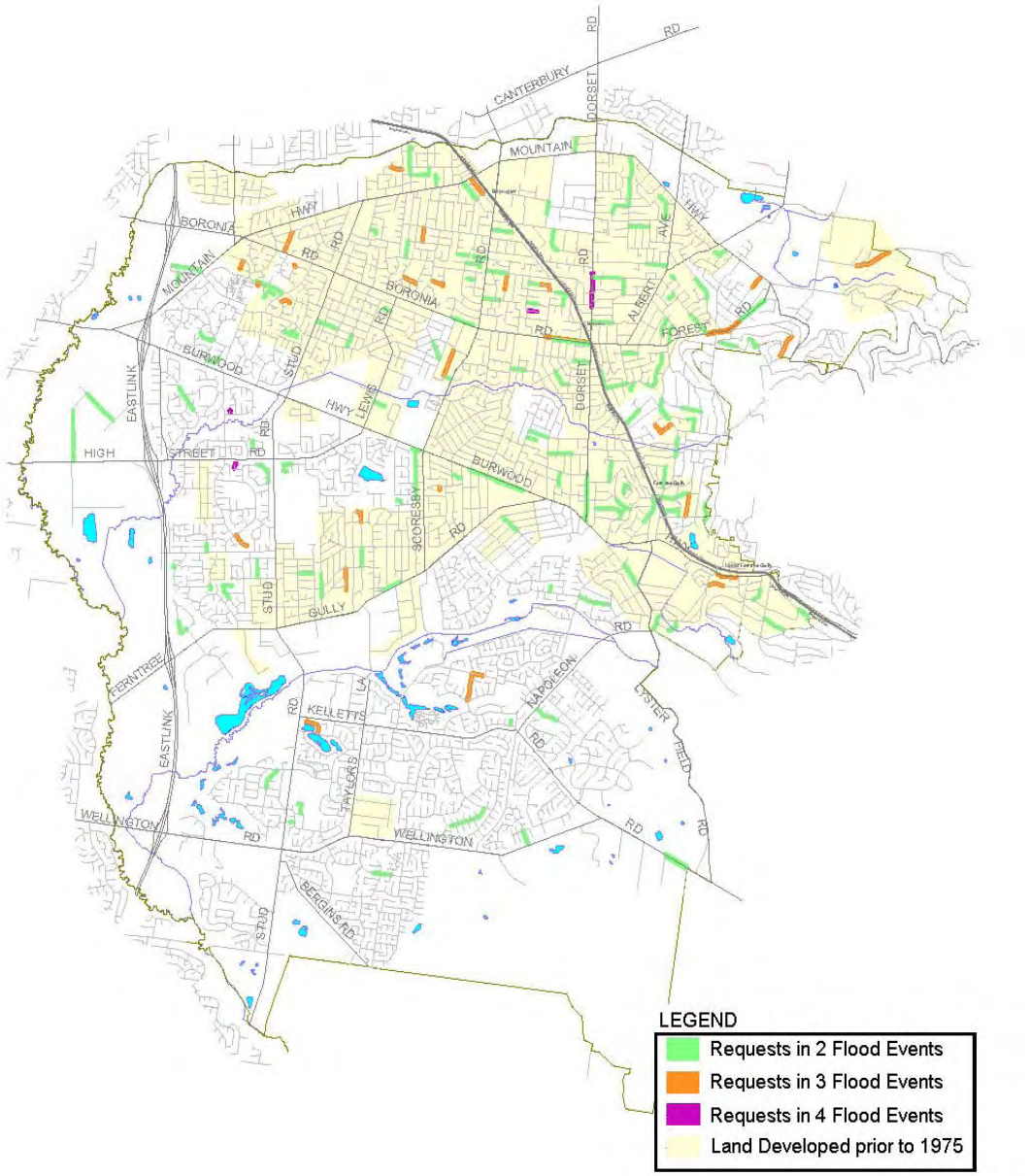

Figure 25 – Flooding History (Request during Multiple Major Storm Events)

As expected, areas developed prior to 1975, when provision of overland flow paths was not regulated, were found to have a higher volume of reported flooding events during major storms. Other problem locations tend to be in streets where there is intense development and insufficient drainage.

The Drainage Infrastructure Status Report, (prepared by Engineering Services) was presented to Council following the two major storms in December 2007. It suggested that the Blind Creek channel, located near Lewis Road, Wantirna, was considered to be an example of a good overland flow system. Flood events in the area have not resulted in property damage or significant clean up works. The overflow system that runs through Silverton Drive, Ferntree Gully, on the other hand, was considered an example of a poor overflow system. Property along Silverton Drive was adversely affected during the December 2007 storms. This overflow system is just one example

of the legacy of past development standards which did not allow for the provision of adequate overland flow paths.

Given that Council's road network is expected to contribute to the protection of properties during major storm events, it is considered important that road reconstruction and resurfacing works ensure, where possible, that the profile of the renewed roadway is adjusted in line with the road hierarchy and made to cater for 1 in 100 year storm events. Opportunities to reduce impervious surface areas should also be considered.

It must be noted that, the effectiveness of all overland flow paths can be significantly affected by the condition of boundary fences and the introduction of minor landscaping works, or other obstructions that can occur without Council knowledge or control. It is therefore considered important that all overland flow paths be identified and regularly inspected for obstructions.

Future flood mapping exercises should focus on problem areas in order to inform the introduction of a new Knox Special Building Overlay. This planning control would impose floor level restrictions on future development in these areas. Flood mapping results could also be used to inform Council's drainage upgrade program and identify areas where Council could better enforce existing controls that are currently in place to limit construction within drainage easements and designated flood ways.

8.8 Improvement Recommendations

PROJECT 8.1. Upgrade Lifecycle (or Alternative Asset Management system) to record Routine Maintenance

Council has recently developed a module (within the Asset Management System - Lifecycle) to support the management of routine maintenance for Council's buildings. It is recommended that this functionality be further developed to facilitate the management of all routine drainage maintenance activities undertaken by the Operations Centre staff.

In the event that an alternative maintenance management system is introduced, the ability to record and monitor delivery of routine drainage maintenance activities should be a functional requirement of the system.

PROJECT 8.2. Define Maintenance Service Standards – WSUDs & Non-Road Related Assets

The Engineering Services department (as designer or asset creator) should develop and document maintenance service level standards for all non-road related drainage assets including, but not limited to, the following:

- Porous pavers
- Enviss pits
- Bio retention tree pits
- Retarding basins and dams
- Overland flow paths

Responsibilities for delivery of these maintenance service standards should also be assigned.

PROJECT 8.3. Local Flood Mapping

In order for Council to get a good understanding of the flooding risks within the municipality it is important to invest in a robust flood mapping project. This

would involve the following key steps and is likely to be a lengthy and expensive process:

- identification of all overland flow paths
- survey of the terrain in the vicinity of the flow paths
- hydraulic modelling of multiple storm events

Flood mapping will enable Council to predict the flood area, the flood level, the expected velocity of floodwaters and rate at which the waters can be expected to rise in major storm events. Generally a 100 year ARI storm is used for this type of analysis. Armed with this information, Council will be able to better target its proactive flood management practices to minimise community impacts.

Flood mapping results, would provide Council with a sound basis for introducing a planning scheme amendment that enables Council to impose planning and building permit conditions within the designated flood prone areas to ensure floor levels, of habitable buildings, are constructed above the predicted flood levels.

This project should seek to complete the GIS Layer 167 – Knox 1% overland flow path which demonstrates the results of Melbourne Water's flood mapping for three Knox catchments.

Given that outsourcing flood mapping is an expensive exercise (as discussed in Chapter 4.7.1) it is recommended that development of flood mapping skills be encouraged among Council staff.

Outsourcing the development of flood mapping is only recommended if Council is prepared to revise the current planning controls to incorporate a Knox specific special building overlay.

The initial flood mapping should focus on catchments that cover areas:

- known to have experienced recent flooding issues during major storm events, and
- predicted to have increased dwelling density as a result of new development (and redevelopment) projects

PROJECT 8.4. Develop a Flood Management Procedure

It is recommended that the Operations Centre leadership team formalise current processes and procedures regarding flood management. This project should make use of the flooding history data that has been collected to date (and summarised in this Chapter). Historic data regarding the duration of the impact of major events can be used to define expected resource needs and recovery times.

The procedure could form part of the forthcoming Operations Centre manual and should set out key actions to be undertaken before, after and during a major storm event. Responsibilities for all actions should be assigned.

Items to be considered include:

- Techniques to minimise (and manage) duplicate requests
- Identification of high risk issue locations and appropriate management strategies
  - Proactive measures to be utilised at known flooding locations (e.g. provision of sandbags)

- Approach to managing flooding of culverts / underpasses used as shared paths (e.g. Installing temporary signage)

PROJECT 8.5. Introduce Proactive Overland Flow Path Management

It is recommended that the Asset Preservation team, in consultation with Engineering Services and Governance, develop a process or procedure to identify and direct landowners to remove fencing or structures from overland flow paths and drainage easements. This project should include investigation of the location of all overland flow paths for which Council is the responsible authority. This project can link with the work currently being undertaken by the Corporate Property Taskforce.

PROJECT 8.6. Revise Road Reconstruction & Resurfacing Design Practices

Adjust Council's design practices for road reconstruction and resurfacing projects to ensure that these projects give due consideration to the capacity of the roadway to cater for 1 in 100 year storm events. Opportunities to reduce road widths, and therefore the impervious surface areas, should also be considered. It is recommended that the Engineering Services Department take responsibility for delivering this improvement.

Chapter 9 Drainage Pit & Pipe Condition

CHAPTER SUMMARY

- Council needs to understand the condition of its drainage assets in order to maintain them effectively
- Council has collected pit and pipe condition data via a number of audits undertaken during the period 2004 – 2009
- Easement drains make up 50% of the total length of the piped network
- Only pits and pipes within the road reserve have been audited.
- Only 2.4% of pipes and 23% of pits in the road reserve have been audited.
- The pipe condition audits were funded by the Construction team and focused on locations where the team expected to find failed pipes.
- Pipe audits were conducted using a CCTV camera in accordance with the Water Services Association of Australia Conduit Inspection Reporting Code (WSA 05 - 2008). The condition rating system considered the structural and service condition of each pipe.
    - structural condition – is based on assessment of defects that affect the pipe structure (cracking, displaced joints, defective lining etc.)
    - service condition – is based on defects that affect the flow of water through the pipe (obstructions, roots, deposits on walls etc)
- 55% of audited pipes were found to have a structural mean condition of Poor or Failed. The service mean condition of 90% of these audited pipes was found to be Excellent.
- Although many pipes were found to be structurally unsound, their serviceability was not compromised.
- Pit audits considered the internal condition (walls, floor, step irons, pipe bandaging) and external condition of the pits (cover, lintel, throat) separately.
- The internal condition of audited pits was much better than the external condition
- 69% of pits had an internal condition rated as Excellent and only 10% were assessed as Poor or Failed.
- Only 28% of pits had an external condition rated as Excellent and 32% were assessed as Poor or Failed.
- The following improvement projects are recommended:
    - Continued investment in condition audits.
    - Seek relationships with research bodies to remain abreast of advancements regarding pipe deterioration modelling.

9.1 Introduction

Failure of the drainage network occurs when the drainage assets do not perform as intended. For an asset, such as an underground pipe, failure may result from structural problems (e.g. where a pipe joint gives way) or service problems (e.g. where debris reduces capacity) diminishing the ability of the system to remove stormwater runoff.

This Chapter summarises the recent pit and pipe condition audit findings. Council needs to understand the condition of its assets in order to properly maintain them. Unless Council continues to fund ongoing condition monitoring, poorly performing drainage assets may not be detected until they have had an adverse impact on the community.

9.2 Audit

Between 2004 and 2009 Council collected drainage pit and pipe data via a number of projects as summarised in the table below.

It is intended that future audits follow the format of this most recent audit to ensure consistency for benchmarking purposes. Over the long term, the data collected will improve Council's ability to predict deterioration of the network and act to maximise the useful life of these assets.

Audit Type	Year	Auditor	Description	No Pits / Pipe Length	Limitations of Audit
Pit Inventory	2006	Directions Management & Consulting	This audit sought to confirm the location of a selection of pits within the road reserves. The location of existing pits was confirmed with GPS accuracy, and the locations of pits on the ground that were not recorded in GIS layer 11 were also obtained.	19,834	Focus on GPS data and key attributes Condition data was not collected
Pit Inventory	2009			5,295	
Pit Condition	2004	Geospatial Data Services	This audit sought to record internal and external characteristics of a selection of pits in road reserves.	1,613	Limited primarily to link and collector roads. Condition rating only – no defects recorded.
Pit Condition	2005/ 2006	Geospatial Data Services		963	Limited primarily to gatic pits on link and collector roads. Condition rating only – no defects recorded. Some internal pit data not obtained.
Pit Condition	2009	Directions Management & Consulting		5,522	Limited to remainder of link and collector roads.

Audit Type	Year	Auditor	Description	No Pits / Pipe Length	Limitations of Audit
Pit Condition	2009	Geospatial Data Services		590	Limited to remainder of link and collector roads and selected zones.
Pipe Condition (CCTV)	2008/09	Rangedale Drainage Services	This audit sought to record the internal condition of pipes in areas selected by the Construction team	26.7km (98% concrete pipe, 2% PVC)	Only selected pipes in suburbs Boronia, Ferntree Gully, Wantirna & Wantirna South were audited. Focus of the audit was on areas where pipe failure was expected to be found

Table 41 – Audit Summary

Condition audits were undertaken in order to:

- Determine the current status of the network
- Inform future maintenance and renewal priorities
- Enable assessment of past treatments
- Facilitate the development of methods to improve performance.

The limited data set (only 2.4 % of pipes and 23% of pits located in Council road reserves) is inadequate to draw reliable conclusions regarding asset condition.

Assessing the condition of underground pipes is very expensive, ($4,000/km) and like most Councils, the City of Knox has not been able to afford the use of closed circuit television (CCTV) to assess all pipes. During 2009-10 Council engaged Rangedale Drainage Services to conduct a CCTV audit of approximately 27km of Council pipes located within local road reserves. Only pipes in the following suburbs were audited:

- Boronia
- Ferntree Gully
- Wantirna
- Wantirna South

The audit was funded by the Construction team. The audits focused primarily on suspected problem areas and results were used to identify renewal works. The audit was conducted in accordance with the Water Service of Australia Conduit Inspection Reporting Code of Australia WSA 05-2008 Second Edition Version 2.2 May 2008.

The extent of the pipe condition audit is summarised in the table below.

Pipe Description	Length Audited (km)	Suburb/ Catchment	% of Network Audited	% Audits Abandoned
Pipes Located in Road Reserves				
Pipes (150–300 mm dia.)	9.58	Boronia	0.85%	13.7%
Pipes (375–525 mm dia.)	9.62	Ferntree Gully	0.85%	8.7%
Pipes (600–675 mm dia.)	4.64	Wantirna	0.41%	20.2%
Pipes (>750 mm dia.)	2.89	Wantirna South	0.25%	4.1%
Easement Drains				
Pipes	0	N/A	0	N/A

Table 42 – Pipe Condition Audit Scope

Although easement drains make up approximately 50% of the total length of the piped drainage network, no easement drains were audited. Survey of easement drains is difficult as it requires coordination of access to private property.

Given the high cost of data collection, it is important that reliable predictive models be developed to predict deterioration of pipe condition in terms of serviceability and structure. Through active engagement with the Regional Drainage Interest Group, universities and other research groups, Council should aim to remain abreast of research into predictive deterministic deterioration modelling of underground drainage pipes.

9.3 Drainage Pit Audit

A summary of known drainage pits is presented in Table 2. The condition of approximately 23% of all Council drainage pits has been audited. The audit methodology is described in Attachment 4.

Type	Quantity	% Condition Audited
Drainage Pits (within Road Reserves)		
Side Entry Pits	20,080	33.3%
Junction Pits	4,092	4.5%
Grated Pits	492	0.4%
Other		
Total Drainage Pits (within Road Reserves)	22,709	38.3%
Drainage Pits (within Property Easements)		
Total Drainage Pits (within Property Easements) Pit type is unknown (assumed to be junction pits)	11,594	0%

Table 43 – Drainage Pits - Quantity

During the audit only 6% of pits audited could not be opened. Some of these lids were gatic and therefore unable to be opened without specialist equipment. Others had been damaged covers or had been sealed over. Future specifications for internal pit condition audits should ensure contractors are only engaged if they are equipped with appropriate equipment to open all pit lids.

9.4 Drainage Pipe Audit – CCTV

The pipe audits were conducted using a CCTV camera in accordance with the Water Services Association of Australia Conduit Inspection Reporting Code (WSA 05 - 2008) second edition, May 2008. The code also includes “a simplified grading process suitable for the initial screening of appearance, intended as no more than a tool to identify which conduits are sufficiently deteriorated to justify more professional assessment.” This grading system was designed for gravity sewers, but is generally accepted as appropriate for the assessment of stormwater drainage pipes.

Both the structural and the service condition were assessed for all pipes audited. The audit methodology is described in more detail in Attachment 4.

A poor structural condition rating indicates that the pipe is damaged or deteriorated. Defects indicating the structural condition include:

- Cracking
- Fracturing
- Breaking
- Deformation
- Collapse
- Surface Damage
- Soil visibility
- Appearance of voids
- Porosity
- Dropped inverts
- Displaced joints
- Ingress of soil
- Defective lining
- Joint intrusion

The structure and service condition of a pipe are largely independent of one another. A pipe with a poor service condition may be in excellent structural condition and simply require cleaning. Defects indicating the service condition include:

- Surface Damage
- Deposits on the wall and in the invert
- Obstructions
- Roots
- Exfiltration (i.e. flow of water out of the pipe)
- Infiltration(i.e. flow of water into the pipe)
- Defective connections
- Vermin

9.5 Condition Results - Pipes

9.5.1 Structure Condition

For any continuous length of pipe between two pits, the structural peak condition refers to the condition of the worst metre of the audited pipe in terms of defects. The graph below shows that while the vast majority of pipes were in excellent condition, a significant proportion recorded defects that meant the worst metre of pipe was often assessed as failed.

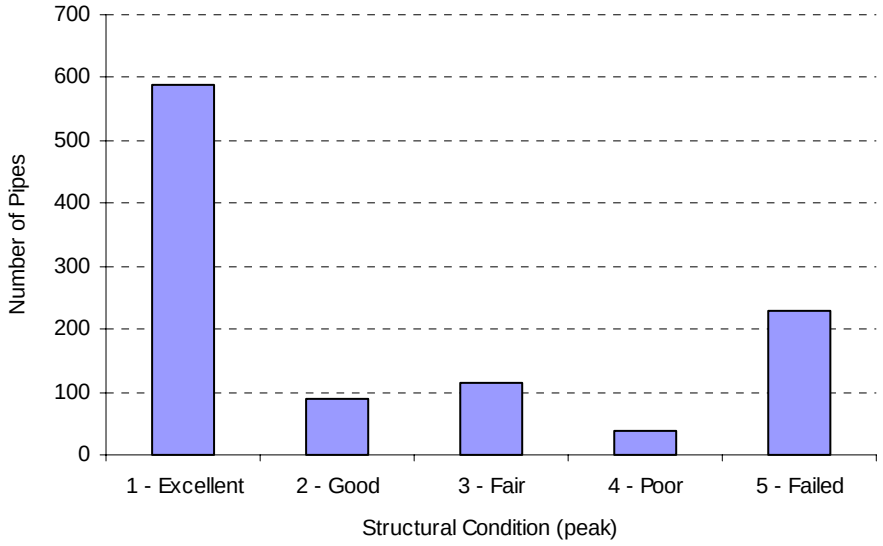

Figure 26 – Pipe Condition – Structural (Peak)

The mean structural condition refers to the average structural condition over each continuous length of pipe between two pits. This measure of the structural condition is therefore considered appropriate for defining pipe renewal needs.

The graph below shows that the majority of the 26.7km of pipes audited were in poor or failed condition. This is to be expected given that the sample of pipes audited was selected by the Construction team to help identify pipes due for renewal. The sample data was therefore collected from areas that had a recent flooding history. Additional condition auditing is required across the municipality to determine whether the condition distribution illustrated below is actually representative of the entire drainage pipe network.

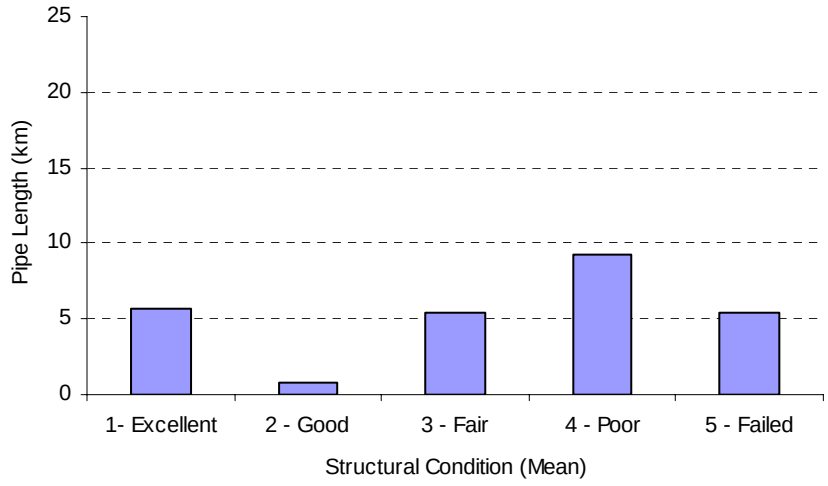

Figure 27 – Pipe Condition – Structural (Mean)

9.5.2 Service Condition

The service condition data is best used to identify segments of pipe which require cleaning to remove obstructions. This data is more useful for determining maintenance works.

For any continuous length of pipe between two pits, the service peak condition refers to the condition of the worst metre of the audited pipe in terms of defects. Of the pipes audited, it appears that there was generally no issue with the service functionality of the pipes.

It must be noted however, that given only 2.4% of the piped network was audited. It would be unreasonable to assume that the condition rating shown below is representative of the entire network.

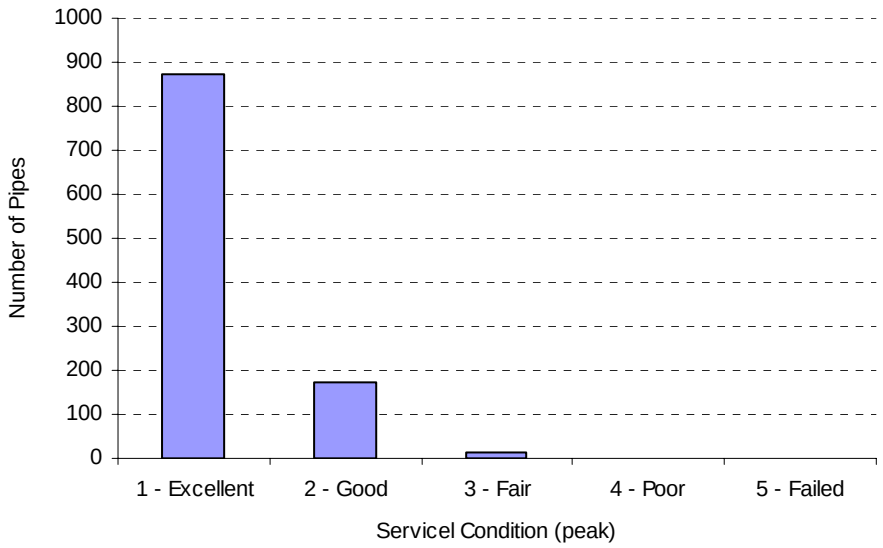

Figure 28 – Pipe Condition – Service (Peak)

The service mean condition refers to the serviceability over the continuous length of pipe between two pits. This is an indicator of the average serviceability of the pipe and is therefore appropriate for defining, or assessing the efficacy of, pipe cleaning programs.

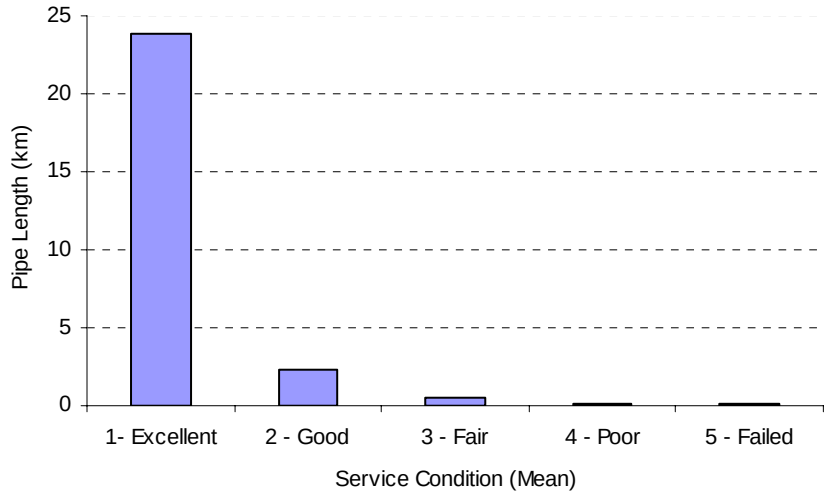

Figure 29 – Pipe Condition – Service (Mean)

Most common defects identified by the audit are summarised in the table below.

Defect	Structure / Service Condition	Number of Defects
Surface Damage	Structure/ Service	1990
Deposits	Service	1028
Roots	Service	821
Cracking	Structure	774
Deformation	Structure	539
Infiltration	Service	368
Soil visible thru defect	Structure	226
Breaking	Structure	205
Fracturing	Structure	200
Point Repair	Structure	151
Inspection Abandoned	-	145
Obstruction	Service	82
Defective Connection	Service	42
Defective Repair	Structure	18
Exfiltration	Service	11

Table 44 – Summary of Observed Defects - Pipes

Pipes found to be in poor or failed condition tended to display the following defects:

- Defective Connections
- Obstructions
- Deposits
- Root Issues
- Cracking

9.6 Condition Audit Results - Pits

Results of the pit condition audits are summarised in the following graphs. Given that the audit only included pits within the road reserve, the majority of pits audited were side entry pits.

The internal and external conditions of the pits were assessed separately. The internal condition was determined based on the average condition of the following pit components:

- Pit Walls
- Pit Floor
- Pipe Bandaging
- Step Irons

The external condition was determined based on the average condition of the following pit components:

- Cover
- Throat/ Kerb and Channel Tray
- Lintel
- Surrounds

The internal condition of the majority of pits was found to be excellent. The external condition was more variable, with 11% of pits audited assessed as failed and 21% considered to be in poor condition.

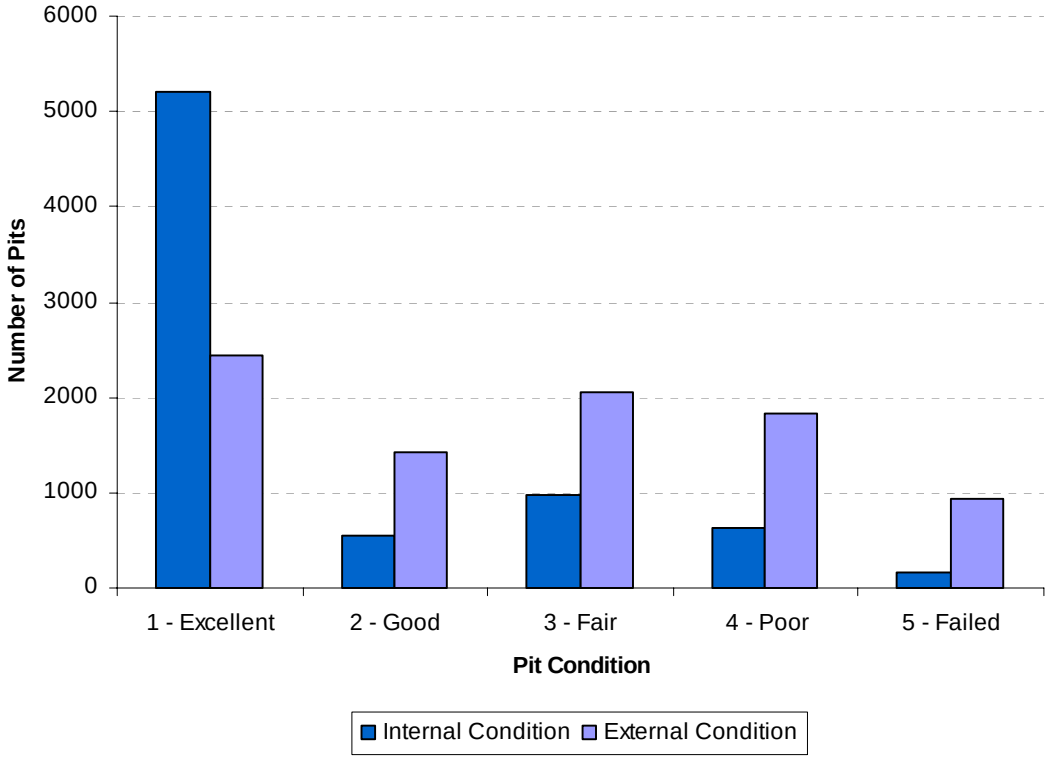

Figure 30 – Pit Condition (Internal & External)

There is no evidence of a relationship between the internal and external condition of pits. Examples of pits with an external condition of 5 (failed) and an average internal condition of 2 (good) were identified in the audit.

9.6.1 Defects Identified - Pits

Most common defects identified during the 2009 pit condition audit are summarised in the table below. These suggest that most issues relate to the deterioration of the concrete structure.

Defect Description	No. of Defects
Spalling	8347
Cracking	7525
Exposed Reinforcement	1460
Broken Component	1085
Corrosion	313
Heaved Lintel	131
Loose	39
Missing Component	17
Collapsed Component	8

Table 45 – Summary of Observed Defects - Pits

The condition audit was based purely on observed visual defects, therefore is unable to make any assessment of the hydraulic performance of pits. While the internal structural condition of pits may be excellent, it is possible that benching of pit bases is poor, which causes turbulence in the flow. The defect data unfortunately does not provide any insight into the hydraulic performance of pits.

The defect data suggests that the external components of a pit have a shorter expected life than the internal components. The most defective components tended to be pit covers, throats, and surrounds which are subject to vehicle damage.

Pit Component	Internal / External	No. of Defects found on Component
Cover	External	6340
Throat/Kerb &Channel Tray		4078
Surround		3031
Lintel		1832
Pit Walls	Internal	2680
Pit Floor		968
Pipe Bandaging		80
Step Irons		47

Table 46 – Summary of Pit Components – Affected by Defects

9.7 Assessment of Pit and Pipe Deterioration Rates

It is considered important that Council actively seek relationships with research groups working on the assessment of pit and pipe deterioration rates. The City of Greater Dandenong, in collaboration with Swinburne University of Technology, has investigated use of an ordinal regression model for predictions of serviceability deterioration of stormwater pipes. The model predicts serviceability condition for individual pipes, given the attributes of the pipes including factors such as age, construction material, proximity to trees, soil type. This type of collaboration can be expected to enable Council to more accurately predict drainage renewal funding requirements.

In this section, the impact of the following factors on pit and pipe condition is assessed:

- Age
- Pipe diameter
- Proximity to trees

Age

As expected, the condition of the pits declines with age. Over a period of 30 years pit conditions decline one level on the condition rating scale.

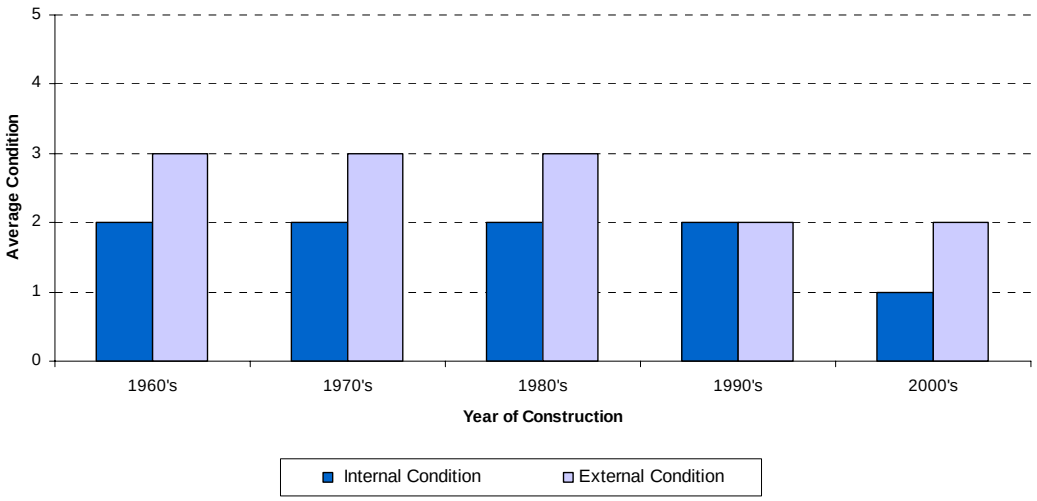

Figure 31 – Relationship between Pit Condition & Year of Construction

Similarly, the condition of the pipes declines with age. Over a period of 30 years pipe conditions also decline one level on the condition rating scale.

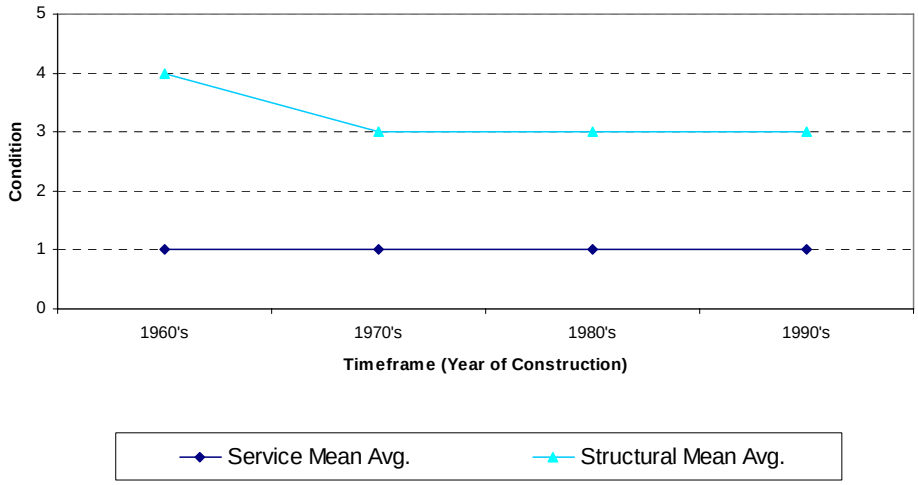

Figure 32 – Relationship between Pipe Condition & Year of Construction

Pipe Diameter

No relationship between pipe condition and pipe diameter was observed.

Proximity to Trees

42.4% of all Council drainage pipes are estimated to be located within five (5) metres of a tree. 57.9% of the audited pipes were located within five (5) metres of a tree.

In contrast to our expectations, the limited pipe condition data collected to date, suggests that tree proximity has minimal impact on the condition of the piped drainage network. This is illustrated in Table 14. It must be noted however that less than 2.4% of all Council pipes were audited and this may

not be a representative sample. Additional audits are required to confirm these results.

Distance from a Tree	Length of Pipes Audited	Average Structural Condition		Average Service Condition	
		Peak	Mean	Peak	Mean
Less than 5 m	14.98km	2- Good	3 - Fair	1 – Excellent	1- Excellent
More than 5 m	10.89km	2 - Good	3 - Fair	1 – Excellent	1- Excellent

Table 47 – Impact of Trees on Pipe Condition

9.8 Improvement Recommendations

Project 9.1 Analysis of CCTV Audits

In order to expand on Council's understanding of pipe condition and provide the basis for more proactive maintenance and renewal of the pipe network, it is recommended that the Construction team, with support from Asset Strategy, analyse the results of all CCTV audits. As more CCTV audits are undertaken, the resulting data should be analysed and used to inform the tree replacement program. Until further condition audits are obtained, trees should, wherever possible, be planted more than five (5) metres from drainage pipe lines and be of appropriate species in line with Council's Streetscape Policy. It is therefore important that the Construction team communicate the analysis findings to Parks Services and other internal stakeholders.

Project 9.2 Remain abreast of research into pipe deterioration modelling

Make use of forums such as the Regional Drainage Interest Group to remain abreast of research into underground pipe deterioration modelling.

Investigate potential relationships with universities and other research bodies to develop and/or make use of modelling techniques that enable prediction of underground asset condition without the need to rely solely on CCTV audits. A starting point for this investigation should consider work done by the City of Greater Dandenong and Swinburne University of Technology.

Chapter 10 Financial Sustainability

CHAPTER SUMMARY

- Financially sustainable asset management requires a balance between providing new assets, upgrades, renewal, maintenance and operations (i.e. a balanced allocation of capital and operating funds).
- A predictive financial model was developed to demonstrate the impact of different funding decisions on drainage performance over 20 years.
- The model has assumed that drainage pit and pipe condition determined during the most recent condition audits is representative of the entire network. This may not be appropriate given that only 23% of pits and 2.4% of all pipes were audited, and that no easement drains were audited.
- Two alternative funding scenarios (Medium and High) were modelled to compare with the Status Quo scenario.
- The Status Quo funding scenario assumes this Drainage Asset Management Plan is not adopted and funding continues in accordance with the Long Term Financial Strategy (LTFS) and existing budgets.
- Adoption of the recommended funding scenario (Medium) would implement high priority drainage upgrades, provide a sustainable level of renewal funding and focus Council investment and resources on the introduction of operational improvements. Key aspects of this scenario include:
    - New/upgrade – address the capacity issues identified in the Knox Drainage Strategy and undertake annual projects to address extreme and high risk capacity issues identified by maintenance crews.
    - Renewal – fund to enable Council to address all condition 5 (failed) drainage pits and pipes over the 20 year period. Results indicate that the required funding is similar to what is already allocated for drainage renewal works in the LTFS.
    - Maintenance – more proactive maintenance activities and allowance for network growth in maintenance budgets.
    - Operating improvements – all improvement projects identified throughout this report would be implemented over a 10 year period.
- Sound asset management and sustainability are not solely reliant on the provision of capital funds. Continual improvements in data management to support service and asset management work practices are required to ensure assets deliver the required level of service in the most cost effective manner.
- A number of alternative funding sources have been identified to enable delivery of this plan.
- Development of a prioritised renewal program is recommended for:
    - Drainage pipes
    - Internal and external drainage pit components

10.1 Introduction

In pursuit of good governance, Council must ensure the drainage network is managed in a way that preserves functionality and caters for changing demand. Funding allocations at each stage of the service and asset lifecycle impact the standard to which Council's drainage assets perform.

Provision of a sustainable drainage network requires a balanced allocation of capital and operating funds.

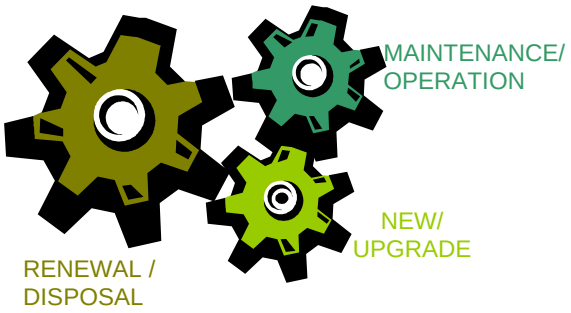

Figure 33 – Lifecycle Cost Components

Capital funding is required to ensure:

- **New drainage assets** are created to accommodate increases in demand and improve environmental sustainability outcomes
- **Asset upgrades** are adequate to address capacity issues and improve environmental sustainability outcomes
- **Renewal** occurs at a rate that matches the expected rate of asset deterioration
- **Disposal** of assets that are no longer required

Operating funds are required to ensure:

- **Maintenance** (including inspections, reactive and routine maintenance activities) is delivered in a manner that preserves the functionality of all existing drainage assets
- **Operational** activities are adjusted to enable improvements in Council's approach to all aspects of water management.

This Chapter assesses the long term financial sustainability of continuing Council's current capital and operating investment in drainage pits and pipes. It describes a predictive model developed to enable comparison of retaining status quo funding allocations against a range of alternatives.

Adoption of a more sustainable funding scenario is recommended with a focus on providing adequate funds to implement improvement projects presented throughout this plan and summarised in Attachment 8. Operational improvements include:

- Service review and adjustment
- Condition auditing to improve asset knowledge
- Data management
- Staff and community education
- Performance monitoring and reporting

10.2 Predictive Model

A model has been developed to assess the financial sustainability of Council's current investment in drainage pit and pipe asset management against a range of alternative scenarios. It uses available asset condition data as a starting point, and predicts drainage pit and pipe condition over a twenty year period.

The model has been set up to enable future assessment in a repeatable and consistent manner, providing opportunity to improve predictive analysis as Council's understanding of asset deterioration rates improve, and more condition data becomes available.

The assessment incorporates Council's long term financial plan projections and assumptions about asset condition, rates of deterioration, inflation, network growth. Accuracy and reliability of the model predictions is limited by a lack of condition data.

The model has assumed that drainage pit and pipe condition determined during the most recent condition audits (refer Chapter 9) is representative of the entire network. This may not be appropriate given that only 23% of pits and 2.4% of all pipes were audited, and that no easement drains were surveyed.

A detailed description of model assumptions and limitations can be found in Attachment 6. Detailed model results are presented in Attachment 7.

Funding for long term financial sustainability of WSUD treatments has been addressed separately in the WSUD & Stormwater Management Strategy.

10.3 Scenarios Modelled

A multitude of funding scenarios can be modelled. The table below summarises the range of service delivery standards examined using the predictive model. By assessing the current funding scenario (Status Quo) against Medium and High service standards, Council has attempted a balanced assessment of future drainage pit and pipe management options.

Service Delivery Standard			
	Scenario 1 **Status Quo**	**Scenario 2** **Medium**	**Scenario 3** **High**
New / Upgrade	Address approximately 1/3 of all extreme and high public safety risk issues expected to be identified by the Works Services team and referred to Project Delivery for asset upgrade. (i.e. 3 issues per year)	Address all extreme and high public safety risk issues expected to be identified by the Works Services team and referred to Project Delivery for asset upgrade. (i.e. 10 issues per year) Complete all works identified in the Knox Drainage Strategy: High Priority issues – Year 1 to15 Medium Priority issues – Year 16 to 40 Low Priority Issues – Year 41 to 50	Address all extreme and high public safety risk issues identified by the Works Services team and referred to Project Delivery for asset upgrade (i.e. 10 issues per year) Complete all works identified in the Knox Drainage Strategy: High Priority issues – Year 1 to 10 Medium Priority issues – Year 11 to 15 years Low Priority Issues –Year 16 to 30
Renewal	Fund in accordance with Long Term Financial Plan (adjusted for inflation)	Fund Average Annual Asset Consumption consistent with an 80 year adopted economic life Renew backlog of condition 5 pits and pipes within 20 years	Fund Average Annual Asset Consumption consistent with an 80 year adopted economic life Renew backlog of condition 4 & 5 pits and pipes within 20 years
Maintenance	Fund in accordance with Long Term Financial Plan (adjusted for inflation)	Fund in accordance with Long Term Financial Plan (adjusted for inflation and network growth)	Fund in accordance with Long Term Financial Plan (adjusted for inflation and network growth)
Operation	No change	Allowance for funding of improvement projects (flagged as 'consultant' in Attachment 8) over 10 years. Internal projects to be incorporated into existing operational capacity	Allowance for funding of *all* improvement projects (flagged as 'internal' and 'consultant' in Attachment 8) over 5 years.

Table 48 – Summary of Model Funding Scenarios

In the future, Council's financial capacity and delivery priorities may change to reflect dynamic community aspirations. The scenarios modelled can then be adjusted accordingly.

10.4 Predictive Model Results

Table 49 below, summarises the predicted funding requirements for the next five years. Complete breakdowns for each funding scenario over the 20 year planning horizon can be found in Attachment 7.

Predicted Funding Requirements ($ '000)					
	2011/12	**2012/13**	**2013/14**	**2014/15**	**2015/16**
Scenario 1 - Status Quo					
Upgrade	$342	$352	$362	$373	$384
Renewal	$2,039	$2,039	$2,674	$2,755	$2,837
Maintenance	$1,535	$1,587	$1,636	$1,686	$1,737
Operating*	$0	$0	$0	$0	$0
Total	**$3,916**	**$3,978**	**$4,672**	**$4,814**	**$4,958**
Scenario 2 – Medium					
Upgrade	$342	$1,575	$1,622	$1,671	$1,721
Renewal	$2,618	$2,693	$2,770	$2,850	$2,931
Maintenance	$1,600	$1,654	$1,706	$1,759	$1,812
Operating*	$251	$259	$266	$274	$283
Total	**$4,811**	**$6,181**	**$6,364**	**$6,554**	**$6,747**
Scenario 3 - High					
Upgrade	$342	$1,816	$1,871	$1,927	$1,985
Renewal	$5,884	$6,059	$6,239	$6,425	$6,617
Maintenance	$1,600	$1,654	$1,706	$1,759	$1,812
Operating*	$698	$719	$741	$763	$786
Total	**$8,524**	**$10,248**	**$10,557**	**$10,874**	**$11,200**

Table 49 – Predicted Lifecycle Costs – Drainage Pits & Pipes

Note: *Operating funding refers to estimated additional costs to implement improvement projects (listed Attachment 8). It does not include existing operational funding (i.e. salaries, overheads, etc).

Financial information, presented in this chapter, is based on the best available information. Future updates of the model, including improved condition data, will supersede existing data and be used to inform the Long Term Financial Strategy and future decision making.

The graph presented in Figure 34 below, compares the predicted funding requirements for each scenario over the 20 year planning period.

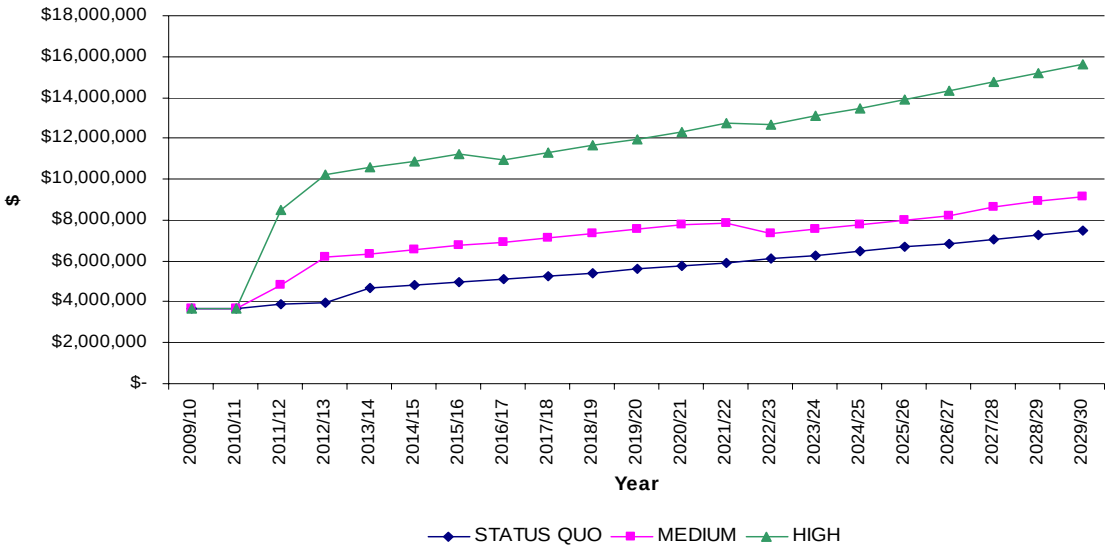

Figure 34 – Funding Scenario Comparison

The graphs presented in the following sections summarise the distribution of pit and pipe conditions predicted for each of the scenarios modelled. Based on the condition audit, and as per Council's convention, condition ratings are described as follows:

- Condition 1 – Excellent
- Condition 2 – Good
- Condition 3 – Fair
- Condition 4 – Poor
- Condition 5 – Failed

When reading these graphs, it is important to understand the reliability of the data on which it is based. Only a small sample of pit (23%) and pipe (2.4%) condition data was collected. The condition distribution of the audited samples was assumed to be representative of the whole network. It is therefore possible that the current condition of the pit and pipe network presented in the graphs below is inaccurate and that the pits and pipes are starting off in better (or worse) condition than that determined by extrapolation of the condition audit data. Renewal funding predictions discussed here are therefore somewhat unreliable. As more condition data is collected, reliability of the model can be expected to improve.

10.5 Scenario 1 - Status Quo

The Status Quo funding scenario assumes that no additional funding is allocated to support the delivery of the Drainage Asset Management Plan. It therefore makes use of existing budgets and projections in accordance with Council's LTFS. The breakdown of this funding scenario is demonstrated in the figure below.

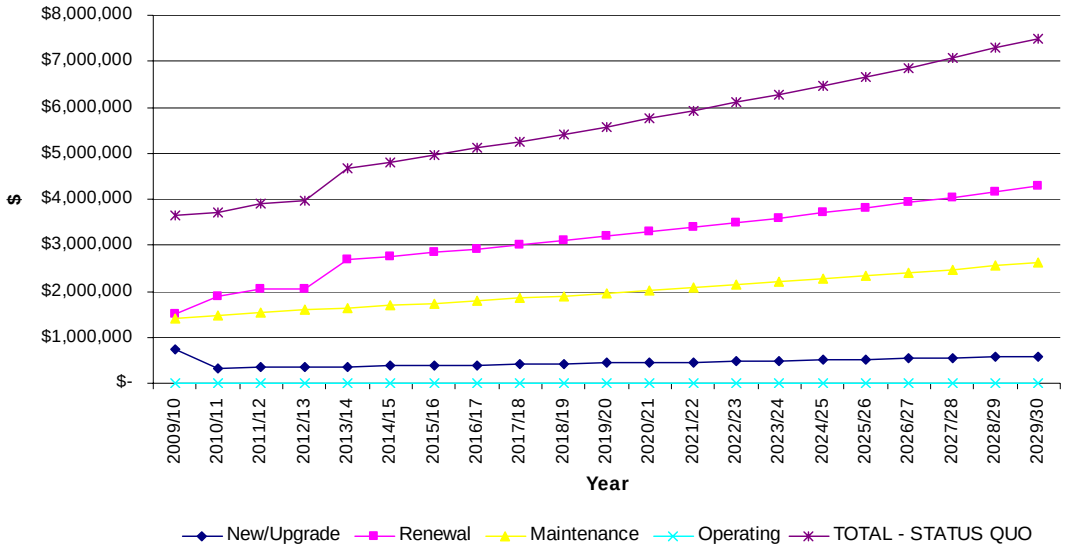

Figure 35 –Status Quo Scenario – Predicted Expenditure

New/Upgrade

Each year, the Works Services team identify a number of drainage issues that are assessed as posing an extreme or high public safety risk. A number of these issues cannot be rectified by maintenance crews because the available drainage network does not have sufficient capacity to capture the flood waters. Addressing these issues generally requires upgrading the existing pits and pipes. These upgrades are managed by the Project Delivery team.

Based on historical data provided in the Business Improvement Project 2008 – Drainage – Service & Asset Management (for New & Upgrade Drainage Works), the Works Services team tend to refer ten (10) extreme or high risk drainage issues to the Project Delivery team each year.

Under the Status Quo scenario, an average of three (3) extreme or high risk issues referred to Project Delivery is assumed to be able to be addressed. No other drainage upgrades identified in the Knox Drainage Strategy would be able to be implemented. The list of known flooding locations where upgrades are required is therefore unlikely to decline.

Renewal

Continued renewal funding at current levels can be expected to slowly address the deterioration of Council's drainage assets. A backlog of pits and pipes in poor (4) and failed (5) condition can be expected to continue. However, given the limited condition data available, the size of the backlog is difficult to quantify. The following graphs depict the predicted condition of the drainage pipe and pit network if Status Quo renewal funding levels are maintained. A gradual improvement over a 20 year period is evident.

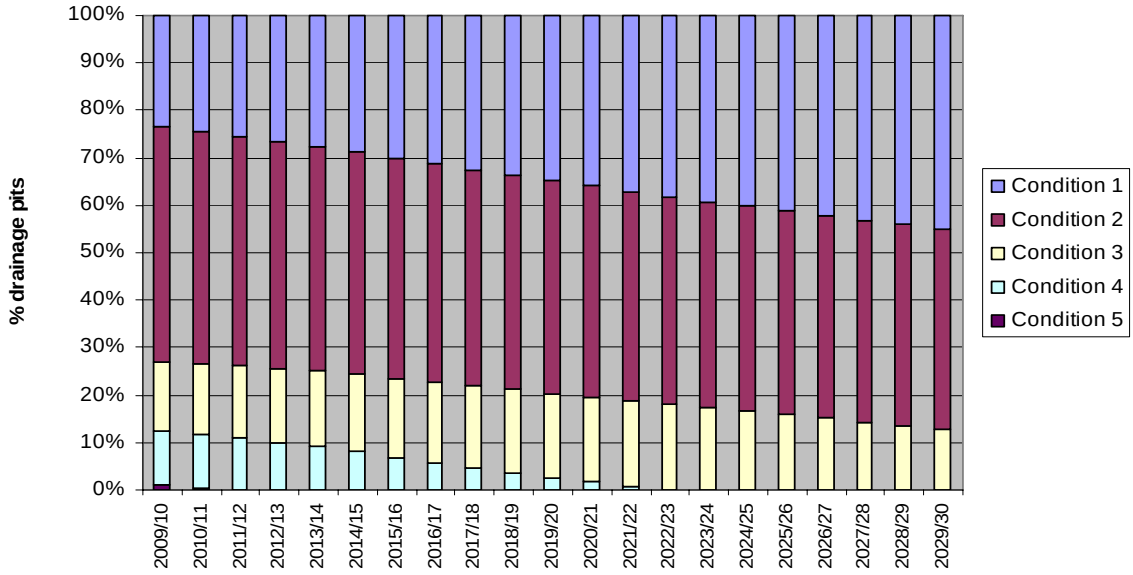

Figure 36 – Predicted Condition – Pits – Status Quo Scenario

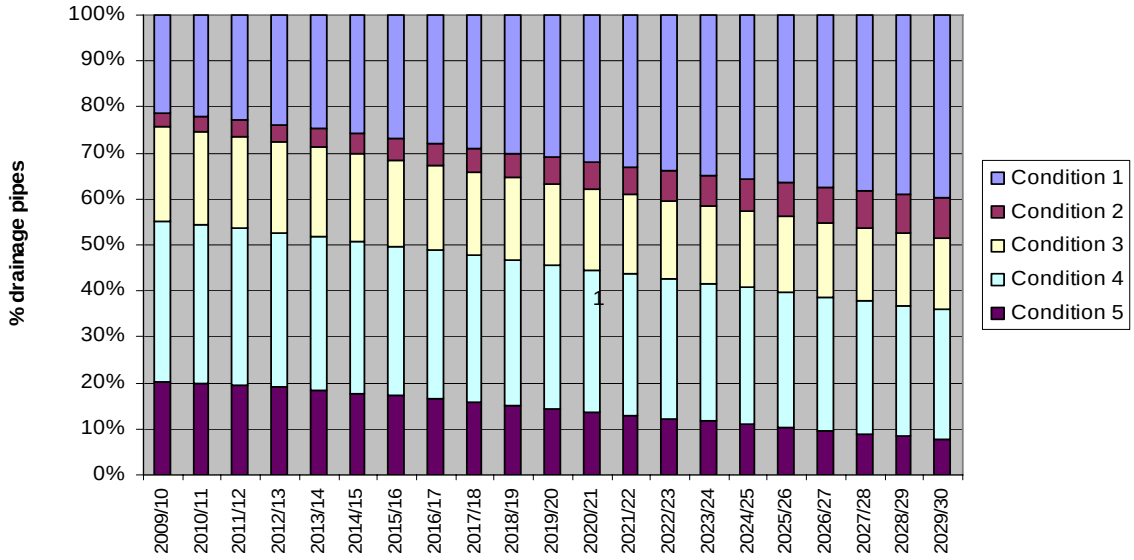

Figure 37 – Predicted Condition – Pipes – Status Quo Scenario

Maintenance

No improvement in satisfaction levels can be expected as maintenance activities will remain unchanged.

Operations

Under this scenario, it is expected that Council would not be able to address key operational, procedural and data process issues which limit the sound management of drainage data and programs. Few, if any, of the improvement projects identified throughout this report (and summarised in Attachment 8) would be implemented. Only projects that can be absorbed into current operating budgets can be expected to proceed.

10.6 Scenario 2 – Medium

In order to allow time for Council adoption of this plan to occur and time to set up the processes, resources and systems required for implementation, this scenario assumes that funding levels will continue in accordance with the status quo scenario until 2011/12 (and 2012/13 in the case of upgrade works).

Adoption of the medium scenario would implement high priority drainage upgrades, provide a sustainable level of renewal funding and focus Council investment and resources on the introduction of operational improvements. The breakdown of this funding scenario is demonstrated in the figure below.

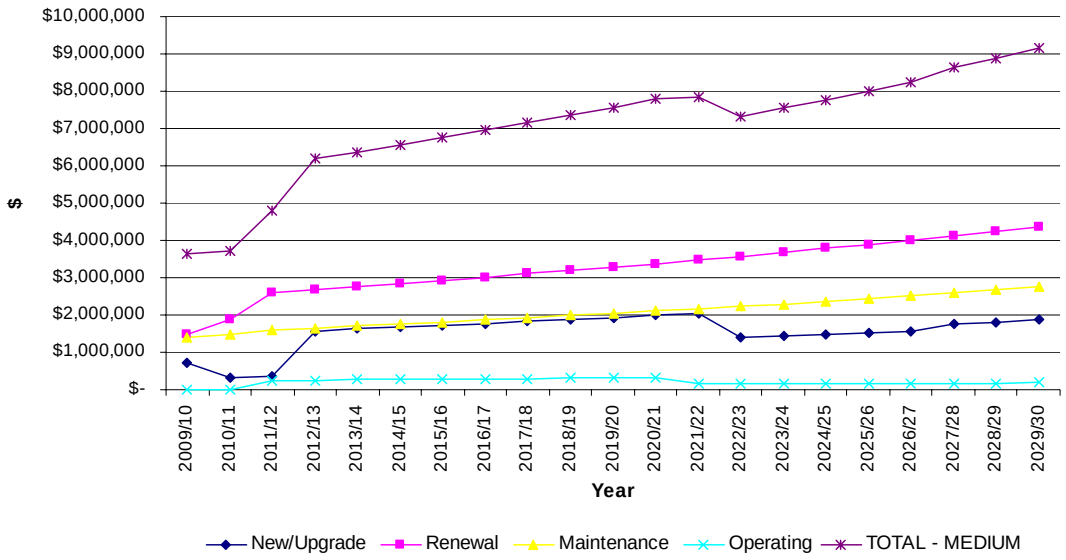

Figure 38 –Medium Scenario – Predicted Expenditure

New/Upgrade

The Medium scenario allows sufficient funds for approximately ten (10) upgrade projects to be undertaken annually to address extreme and high risk issues referred to Project Delivery from the Works Services team.

Additional upgrade funding provided under this scenario is consistent with the recommendations described in the Business Improvement Project 2008 – Drainage – Service & Asset Management (for New & Upgrade Drainage Works). This level of upgrade funding will allow the Project Delivery team to progressively address the capacity issues identified in the Knox Drainage Strategy. This scenario therefore assumes High and Medium priority drainage upgrade works can begin to be addressed, with High priority works expected to be the focus for the first 15 years. Recognising that Council has historically found it difficult to deliver the drainage upgrade program, it is recommended that increasing funding for upgrades be delayed until 2012/13. This delay is expected to enable Council to adequately plan, design and resource the desired level of upgrade works.

Renewal

Renewal funding can be expected to enable Council to address all condition 5 (failed) drainage pits and pipes over a 20 year period. Due to the small sample of condition data available, and the possibility that the drainage network is in better condition than the assessment based on extrapolation

suggests, it is likely that funding at these levels will also address some condition 4 (poor) assets. With the exception of external pit components, it is considered reasonable to only renew pits and pipes that have been rated as condition 5 (failed) until better condition data is available. The following graphs depict the predicted condition of the drainage pipe and pit network if medium renewal funding levels are adopted.

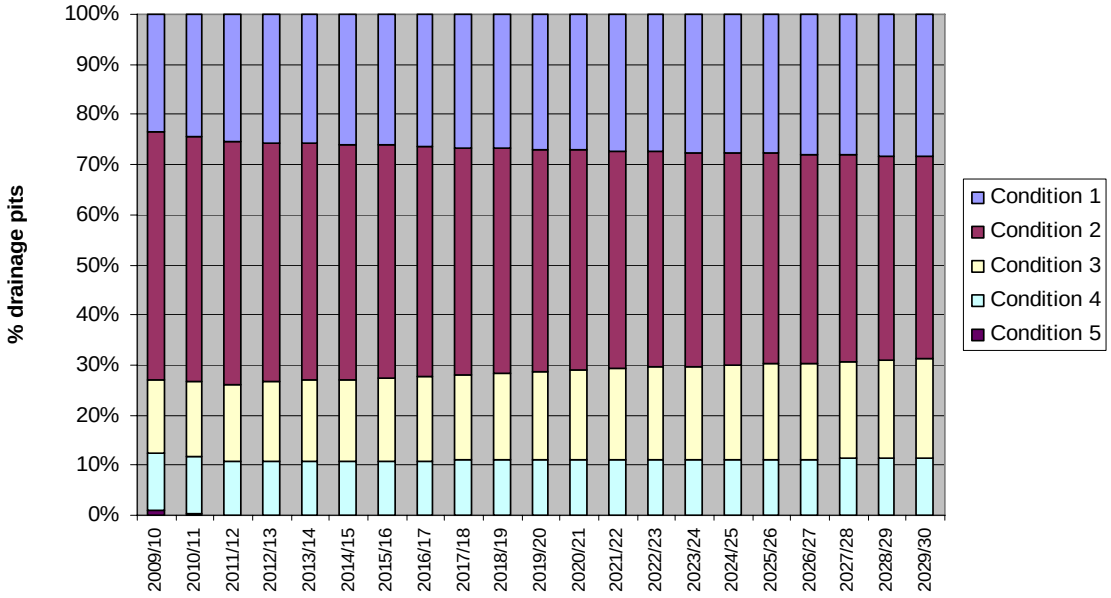

Figure 39 – Predicted Condition – Pits – Medium Scenario

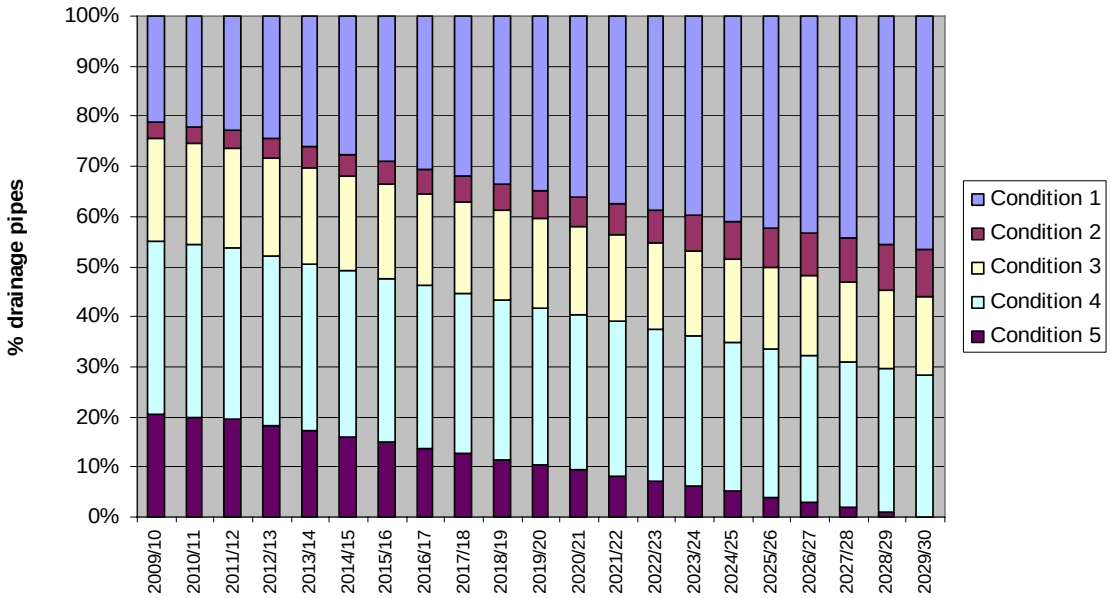

Figure 40 – Predicted Condition – Pipes – Medium Scenario

Maintenance

Improvement in satisfaction levels can be expected as maintenance activities will become more proactive and better informed by updated drainage data. Lifecycle costing allowances under this scenario will ensure growth in the network is reflected in maintenance budgets.

Operations

Under this scenario, it is expected that Council would be able to address service planning, procedural and data management issues. All improvement projects identified throughout this report (and summarised in Attachment 8) would be implemented over a 10 year period. It is assumed that the vast majority of these projects (marked 'internal') will be incorporated within respective directorate business plans and existing operational capabilities, while additional funding has only been allowed for those projects marked as requiring consultant or external support.

Implementation of the improvement projects will ensure future water management service provision will be underpinned by improving service and asset management practices. Data quality will also improve. Implementation of the improvement projects is expected to focus on high priority projects in the first instance.

10.7 Scenario 3 - High

Like the Medium scenario, adoption of the High scenario will focus investment on operational improvements, a sustainable level of renewal funding and high priority upgrade opportunities. This funding scenario aims to address these outcomes in a shorter timeframe. A higher service level for renewal would also be possible. Additional operating funds are sought to fast track the implementation of improvements projects in order to ensure all future investment in drainage is spent effectively.

To allow time for Council adoption of this plan, and time to set up the processes, resources and systems required for implementation, this scenario assumes that funding levels will continue in accordance with the Status Quo scenario until 2011/12 (and 2012/13 in the case of upgrade works). The breakdown of this funding scenario is demonstrated in the figure below.

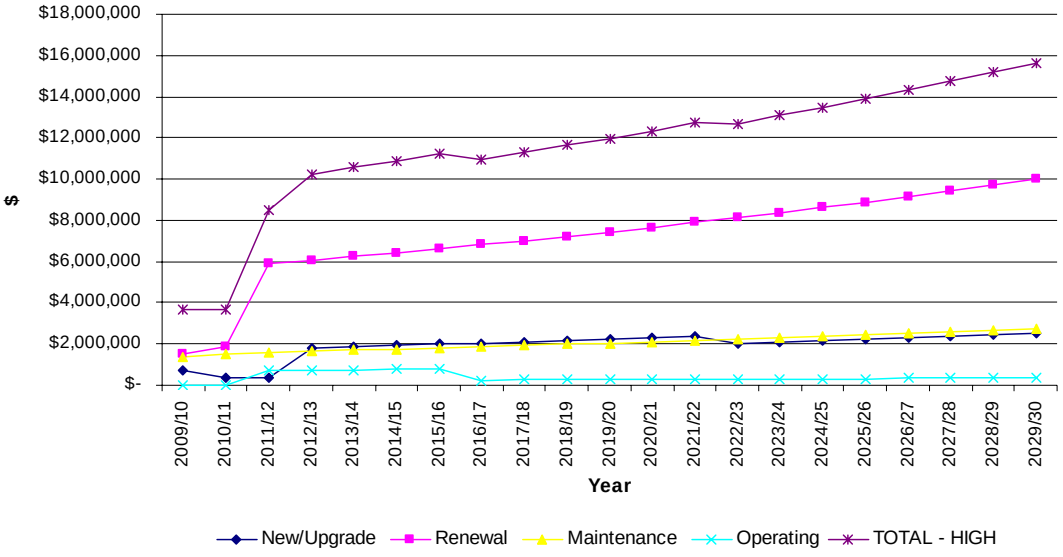

Figure 41 –High Scenario – Predicted Expenditure

New/Upgrade

Like the Medium scenario, the High scenario provides sufficient funds to implement approximately ten (10) upgrade projects annually to address extreme and high risk issues referred to Project Delivery from the Works Services team.

Additional upgrade funding provided under this scenario is consistent with the recommendations described in the Business Improvement Project 2008 – Drainage – Service & Asset Management (for New & Upgrade Drainage Works). This scenario therefore also allows for the progressive addressing of High and Medium priority drainage works identified in the Knox Drainage Strategy, with High priority works to be the focus for the first 10 years. In order to enable Council to adequately plan and resource this level of upgrade works, this scenario assumes additional funding for upgrade works will become available in 2012/13, with Status Quo funding being maintained until that time.

Renewal

Funding at the levels predicted for the high scenario can be expected to address all condition 4 (poor) and 5 (failed) pit and pipe assets. Given the small sample of condition data, and the possibility that the drainage network is in better condition than the assessment based on extrapolation predicts, it is possible that funding at these levels may be excessive, higher than community expectations or result in unnecessary renewal works. The following graphs depict the predicted condition of the drainage pipe and pit network if high renewal funding levels are adopted.

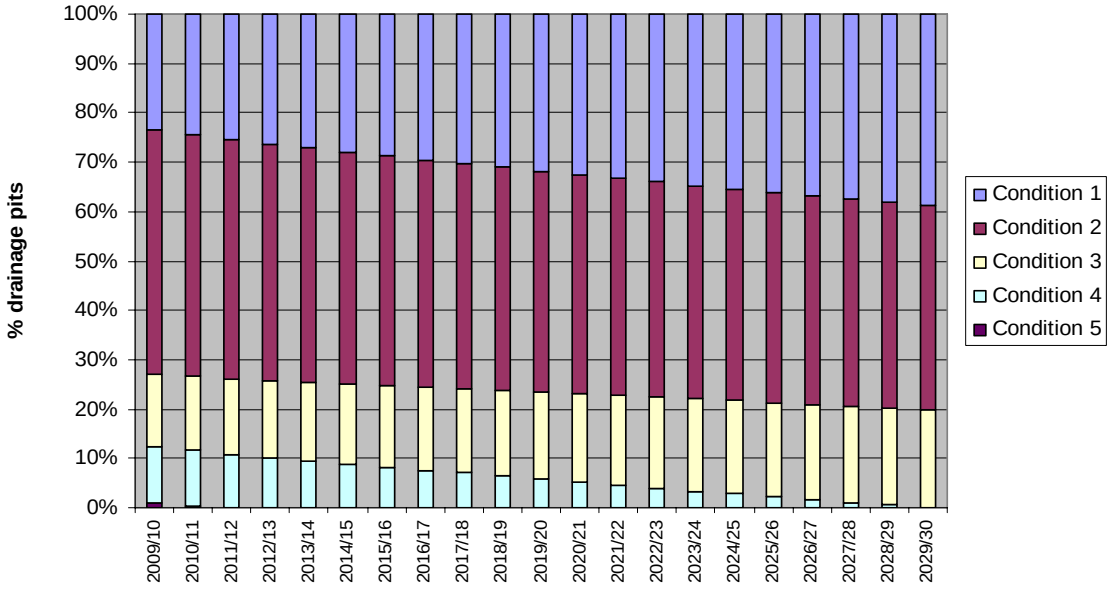

Figure 42 – Predicted Condition – Pits – High Scenario

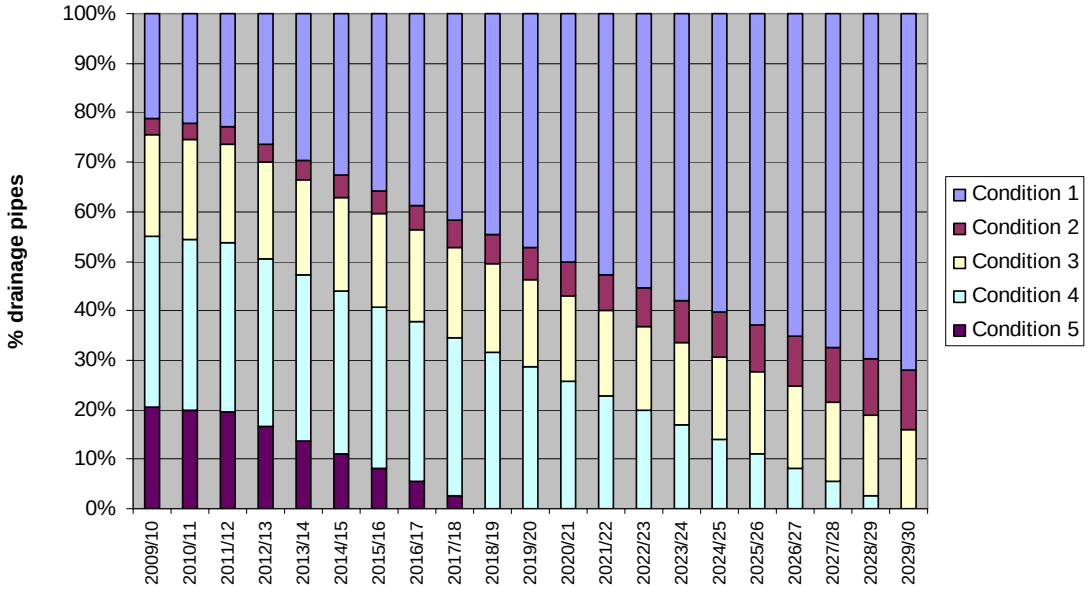

Figure 43 – Predicted Condition – Pipes – High Scenario

Maintenance

As per the Medium scenario, improvement in satisfaction levels can be expected as maintenance activities will become more proactive and better informed by updated drainage data. Lifecycle costing allowances under this scenario will also ensure growth in the network is reflected in maintenance budgets.

Operations

Under this scenario, it is expected that Council would be able to address service planning, procedural and data management issues. All improvement projects identified throughout this report (and summarised in Attachment 8) would be fast tracked and implemented over a 5 year period. It is therefore assumed that all projects would be funded to provide for external support rather than being incorporated within existing operational structures. This scenario will ensure that future water management and supporting drainage asset management will be underpinned by sound practices and data.

10.8 Recommended Funding Levels

To achieve the desired improved service and asset management outcomes, a sustained commitment to the provision of adequate funding for drainage asset renewal, maintenance, upgrade and operational improvements is required. The funding targets necessary to deliver sound asset management for the next five years, based on delivery of the Medium scenario (described above and summarised in Table 50 below) will present Council with that opportunity.

This table also compares the current funding levels as set out in the Long Term Financial Strategy (LTFS) and the Status Quo scenario to the recommended levels (Medium scenario) and identifies the annual funding shortfall in both the capital and operating budgets.

Proposed Funding – MEDIUM Scenario ($ '000)					
	2011/12	**2012/13**	**2013/14**	**2014/15**	**2015/16**
Capital Works – New/Upgrade					
Pit & Pipe Upgrades	$342	$1,575	$1,622	$1,671	$1,721
LTFS/Status Quo	$342	$352	$362	$373	$384
Funding Shortfall	**$0**	**$1,223**	**$1,260**	**$1,298**	**$1,337**
Capital Works – Renewal					
Pit & Pipe Renewal (incl. Disposal)	$2,618	$2,693	$2,770	$2,850	$2,931
LTFS/Status Quo	$2,039	$2,039	$2,674	$2,755	$2,837
Funding Shortfall	**$579**	**$654**	**$96**	**$95**	**$94**
Operating Budget – Maintenance					
Pits & Pipes Maintenance	$1,600	$1,654	$1,706	$1,759	$1,812
LTFS/Status Quo	$1,535	$1,587	$1,636	$1,686	$1,737
Funding Shortfall	**$65**	**$67**	**$70**	**$73**	**$75**
Operating Budget – Operational Improvements					
Operational Improvements (all drainage)	$251	$259	$266	$274	$283
LTFS/Status Quo	$0	$0	$0	$0	$0
Funding Shortfall	**$251**	**$259**	**$266**	**$274**	**$283**

Table 50 – Funding Requirements 2011/12 to 2015/16 – Medium Scenario

It must be noted that sound asset management and sustainability are not solely reliant on the provision of funds. A thorough review of Council's approach to water management (as recommended in Chapter 7) is considered critical. Continual improvements in data management to support service and asset management work practices is also required to ensure assets deliver the required level of service in the most cost effective manner.

10.9 Funding Sources

A number of possible funding sources have been identified to enable delivery of this plan:

- General Rates
- State and Federal Government funding support

- Private / Public sector partnership opportunities
- Developer Contributions
- Reviewing current expenditure on capital funding for new/upgrade works for other asset classes and/or operational programs that do not support the delivery of this plan

Alternatively, the use of Special Rates and Charges can provide a mechanism for Council to 'fast track' works to alleviate stormwater problems. However, these schemes are not recommended for the majority of required drainage works as they usually require lengthy consultation and considerable administration, and ultimately are not often supported.

In accordance with Council's Asset Management Policy, it is expected that Council will proactively seek grants and partnership opportunities to supplement investment in lifecycle asset management.

When accepting funds from others, decisions should be based on information that justifies initial expenditure and demonstrates the long term benefits, costs and ongoing sustainability of the investment. Melbourne Water has displayed an ongoing interest in pursuing partnerships with local councils.

The introduction of developer contributions, collected in accordance with a Development Contribution Plan, should also be considered.

The October 2007 Council Engineering & Infrastructure Report – External Funding Options for Drainage Infrastructure, assessed the implications of the following:

- Formal Development Contribution Plan (DCP)
- Pseudo Development Contribution Plan (DCP)
- On-site Detention Systems (OSD)

Lifecycle costs associated with the three alternatives were assessed.

The report suggested that under the Planning and Environment Act 1987, formal DCP funds can be used for the following project types:

- New infrastructure
- Upgrading of existing assets
- Extension to an existing facility
- Asset replacement at the end of its useful life

When implementing a DCP, there are a number of legal requirements with which Council must comply. This places an administrative burden on Council resources. Manningham and Darebin City Councils have implemented a Formal DCP.

Under the Planning and Environment Act 1987, Council can seek to collect a developer contribution via a permit condition whereby the developer has the option of installing an on-site detention system, upgrading existing infrastructure or paying a levy. These conditions can only be used for town planning applications and can be overturned by the Victorian Civil & Administrative Tribunal (VCAT). The report considered these levies to be a pseudo DCP.

OSD systems were considered to be the preferred option to minimise capital expenditure required to upgrade the existing network. The private sector funds the installation of OSDs, maintenance and renewal remains the private sector's or owner's responsibility. It was noted that future resources however,

may be required to ensure OSDs installed by developers are effectively maintained. It is considered important that this position be reviewed (as outlined in improvement PROJECT 4.4) in relation to its ongoing feasibility for achieving the desired service outcomes.

10.10 Funding Prioritisation

It is considered important that all Council expenditure be prioritised using transparent methodologies.

10.10.1 Operating Budget

Addressing the operating budget shortfall is considered to be critical to ensure the implementation of the identified improvement projects listed in Attachment 8 occurs. As discussed in the following chapter, each recommended project has been assigned a risk rating, an estimated delivery cost, and recommended Project Leader.

To ensure delivery, each Project Leader should work toward implementing the assigned projects. The scope of each project and cost estimates, presented in the attachment, should therefore be reviewed and updated each year by each nominated Project Leader as part of Council's annual budget and business planning preparations.

10.10.2 Capital Budget - New / Upgrade Ranking Criteria

It is expected that Council's Drainage (New / Upgrade) program will continue to utilise current prioritisation methods and processes. As outlined in PROJECT 2.6, it is however recommended that the existing prioritised list of new/upgrade drainage works be re-ranked to incorporate the drainage hierarchy described in Chapter 2. Each project must given a score based on its location and criticality. The following scoring system is proposed where a score of 20 reflects the highest priority.

- Road Reserve – Major Drain 20 points
- Habitable Land – Major Drain 15 points
- Undeveloped Land – Major Drain 10 points
- Road Reserve – Minor Drain 8 points
- Habitable Land – Minor Drain 6 points
- Undeveloped Land – Minor Drain 4 points

10.10.3 Capital Budget - Renewal Ranking Criteria

Drainage pipe and pit renewal works can be divided into the following sub-programs:

- Pipe renewal (based on condition audits)
- External pit renewal
- Internal pit renewal

An improvement project is recommended to ensure the Construction team develop and utilise appropriate ranking criteria for each of the above programs.

In the absence of complete condition data across the network, it is recommended that Council pipe renewals continue to be driven by the results of CCTV audits. It is important however, that the auditing program be transparent and based on ranking criteria (that incorporates the drainage hierarchy) established as a result of implementing the recommendation as presented in Chapter 2 (PROJECT 2.5 Condition Audits – Prioritised Rolling

Programs). It is expected that only pipes found to be in condition 5 (structural) will be replaced and audit information will be used to improve the quality of the predictive model presented in this chapter.

10.11 Improvement Recommendations

10.1 Develop Prioritised Renewal Program

The Construction team (with support from the Asset Strategy team) should develop renewal ranking criteria for each of the following:

- Pipe renewal (based on condition audits)
- External pit renewal
- Internal pit renewal

The ranking criteria should be used to develop a prioritised list of works that will form the basis of a GIS layer that illustrates proposed renewal works (refer PROJECT 2.4ii)

Factors to be incorporated into the criteria include:

- Drainage Hierarchy (refer PROJECT 2.6)
- Consequence of inundation (property damage, personal trauma, injury, loss)
- Frequency of inundation
- Asset condition (as recorded in Council's asset register or assessed via CCTV)
- Opportunities to upgrade the capacity of the network
- Proximity to trees.

Chapter 11 Recommended Improvement Projects

CHAPTER SUMMARY

- It is recommended that Council adopt the Medium funding scenario modelled in the previous Chapter. This will include the implementation of all recommended improvement projects over the next ten years.
- Attachment 8 summarises the improvement projects recommended throughout this plan.
- For each project, the following aspects have been nominated:
  - Related projects
  - Responsible directorate
  - Recommended project leader (Department)
  - Expected project outcomes
  - Preliminary cost and resource estimates
  - Council teams and other authorities likely to be consulted during project implementation
- To support prioritised implementation, the criticality of each project has been assessed by the Asset Strategy team. All projects have been assigned an Extreme, High, Medium or Low risk using Council's Integrated Risk Management Framework.
- The nominated Project Leader will be expected to administer a business case application to seek additional funding to deliver on improvement projects that are expected to require consultant support.
- In the event there are multiple stakeholders required to successfully deliver the improvement project it will be incumbent on the nominated Project Leader to define the scope, estimate the hours required to complete the works and communicate this information to all stakeholders to ensure they too allocate appropriate time and resources to work collaboratively on the improvement project.
- Review of this Plan is expected to occur at 5 year intervals and focus on updating asset performance, the predictive model and the applicability of outstanding improvement projects.

11.1 Introduction

Implementation of the improvement projects presented throughout this plan is intended to enable Council to move toward best practice water management. Drainage assets will be managed in a manner that effectively supports service objectives which are aligned with community expectations.

The predictive financial model, presented in Chapter 10, includes an allowance for progressive implementation of all the improvement projects. If the recommended Medium funding scenario is adopted, it is expected that via changes in work practices and priorities, together with specialist consultant support, all recommended improvement projects can be delivered over the next ten years.

11.2 Improvement Projects

Attachment 8 summarises the improvement recommendations. It highlights the following:

- Risk Assessment
- Related Projects
- Responsible Directorate
- Recommended Project Leader (Department Manager)
- Expected Project Outcomes
- Preliminary cost and resource estimates
- Council teams and other authorities to be consulted during project implementation

Given that a number of the recommended improvement projects are interdependent, it is expected that nominated Project Leaders will seek to combine the delivery of related projects.

To prioritise implementation, the criticality of each project was assessed by the Asset Strategy team. Council's Integrated Risk Management Framework was used to define the risk associated with not undertaking each project. All projects have been assigned an Extreme, High, Medium or Low risk. It is expected that High risk projects will be undertaken as soon as practicable.

Each project has also been classified as either *internal* or *consultant* to reflect the Asset Strategy team's assessment of whether the project is expected to require consultant support. It is expected that those projects flagged as *internal* can be delivered by current resources via a change in Council practices. Those projects flagged as *consultant* are expected to require input from consultants with relevant expertise.

Each Project Leader is charged with responsibility for incorporating delivery of the project into their annual business plan. Further work is therefore required by each Project Leader to define the scope of nominated projects and review the estimated project delivery costs.

Business Planning

As stated above, all improvement projects have been classified as either "internal" (can be completed by Council staff) or "consultant" (where specialist support is required). It is envisaged that the relevant Project Leader will use the risk rating to prioritise the inclusion of the improvement projects into their annual business plan. In the event that multiple stakeholders are expected to

be required to contribute to the successful delivery of an improvement project it will be incumbent on the Project Leader to define the scope, estimate the hours required to complete the works and communicate this information to all stakeholders to ensure they too allocate appropriate time and resources to work collaboratively on the improvement project. This is particularly important for those projects classified as internal because these projects will often require an ongoing change in current work practices.

Business Case Submissions

For those initiatives flagged as “consultant” it will be necessary for the nominated Project Leader to administer a business case application to seek additional funding for the delivery of the improvement project. Consideration for funding of new initiatives occurs on a biannual basis either during the development of the budget or at mid year reviews.

Each nominated Project Leader will need to define the scope of work and estimate the hours required to complete each project. It is important that relevant stakeholders be identified during the preparation of the business cases so that the extent of consultation and expected project costs can be appropriately defined. Upon receiving required funding, each Project Leader will be expected to consult with the identified stakeholders to quarantine the required resources and time required to undertake the improvement project.

11.3 DAMP Review & Updates

Review of this Plan should occur at 5 year intervals and focus on updating asset performance, the predictive model and the applicability of outstanding improvement projects.

The predictive model presented, in Chapter 10 should be updated every three years to reflect improvements in Council’s asset knowledge. Updates of the financial model should incorporate:

- Future condition audit results
- Changes to the improvement project priorities and expected costs
- Asset changes resulting from renewal works
- Asset changes resulting from capital upgrades
- New developments

Implementation of the improvement projects set out in Attachment 8 should be monitored on an annual basis and used to inform business planning activities and budget priorities in subsequent years.