



City of Cockburn
DRAINAGE MANAGEMENT STRATEGY 2018-2028



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Table of Content

1	Introduction.....	7
1.1	Background	7
1.2	Rationale for Preparing a Drainage Management Strategy	10
1.3	Vision for the City	10
1.4	Purpose of the Strategy.....	11
1.4.1	Strategy Approach.....	11
1.4.2	Drainage Management Philosophy	11
1.4.3	Key benefits of Strategy Implementation.....	13
1.4.4	Scope of the Document.....	13
1.4.5	Implementing the strategy	13
1.5	Advocacy	14
1.6	Liability	14
2	Vision, Values, Mission	14
2.1	Drainage Vision	14
2.2	Five-Year Goals	15
2.3	Ten-Year Goals	15
2.4	Council's Asset Management Vision	15
3	Other Strategic Documents	16
3.1	Long Term Financial Plan 2016/17 – 2025/26	16
3.2	Strategic Community Plan 2016 – 2026.....	16
4	DMS Objectives and Delivery.....	17
4.1	Managing the Provision of Service Delivery.....	17
4.2	New Underground Drainage Assets.....	17
4.3	Reliability Centered Maintenance.....	18
4.4	Periodic Maintenance.....	18
4.5	Renewal and Upgrade Works	18
4.6	Inspecting Drainage Assets.....	19
4.7	Prioritisation of the Drainage Improvement Program	19
4.8	Management of Storm Water Quality	19
4.9	Strategy and Actions	20

4.9.1	Maintenance Actions	20
4.9.2	Network Condition Actions	20
4.9.3	Flood Mitigation Actions	20
4.9.4	Design Standard Actions.....	21
4.9.5	Water Quality and Environmental Protection Actions.....	21
4.9.6	Drainage and Mosquitos	22
4.9.7	Reduction Targets	22
5	Summary of Community Consultation.....	23
6	Resourcing the Plan	24
6.1	Drainage Maintenance Program (10year).....	24
6.2	Drainage Reconstruction program (10 years)	25
6.3	Storm Water Drainage and Sumps Program (5 years)	26
6.4	Labor Resources	28
7	Measuring Achievement / Performance Measures	28
7.1	Cost Performance Measures.....	28
7.2	Condition Performance Measures.....	29
7.3	Maintenance Performance Measures	29
7.4	User Satisfaction Performance Measures.....	29
8	Reporting.....	29
9	References	30

Executive Summary

The drainage network within the City is a combination of pits, pipes, open channels, natural waterways and road reserves. Storm water is disposed of at source where possible through infiltration or carried and disposed of in lakes, wetland reserves and/or other catchments eventually ending up in the ocean.

The infrastructure assets included in the strategy are the drainage piped assets and pits throughout 18 catchment areas that are owned and operated by the City. Drainage systems are designed to be able to cope with the runoff from storms up to the and including the 1% Annual Exceedance Probability (AEP) rainfall event. The City's Guidelines and Standards for the Design, Construction and Handover of Subdivision within the Municipality outline standards that are traditionally used in the design of drainage systems for redevelopment and subdivision areas within the City.

There has already been substantial work towards fulfilling the requirements of the City's Asset Management Strategy adopted in 2012 and the City's Drainage Catchments Study Review completed in 2017. This included a Drainage Assets Management Plan detailing the necessary renewals and upgrade of drainage infrastructure. This previous work contributes significantly to fulfilling the objectives of a Drainage Management Strategy (DMS). These reports have identified that the environment in which local government operates is constantly changing and as assets continue to age, the City will need to demonstrate an accepted level of expertise and duty of care in relation to the management practices and maintenance relating to drainage assets.

The DMS is driven by the Asset Management Plan (AMP) goals and objectives as detailed in subsequent sections and relies on systematic assessments of asset performance.

The basic principles underlying the goals and objectives for storm water management include the following concepts:

- Ensure that new development does not increase the rate of storm water flow above that which the natural ground can safely accommodate.
- Reduce storm water flows as much as possible by the effective use of attenuating devices.
- Provide open space and preserve important ecosystems that integrate with planned urban network systems.
- Prevent pollution of waterways and water features by suspended solids and dissolved solids in storm water discharges.
- Maintain adequate ground cover at all places and at all times to negate the erosive forces of wind, water and all forms of traffic.

- Ensure that the drainage assets are sustainable, appropriate, accessible and functional.
- Protect and enhance natural water systems and their hydrological regimes in urban developments.
- Integrate stormwater treatment into by incorporating multi-use corridors that maximise the visual and recreational amenity of developments;
- Protect water quality – minimise outputs of phosphorous, nitrogen and other pollutants.

In general, the DMS focuses on drainage asset improvement with the key benefits of the strategy implementation being:

- Lowering long-term costs of drainage asset preservation;
- Reducing the cost of maintenance; and
- Improving drainage network performance.

In this DMS, the issues of urban storm water and waterway management are documented, and provide Council with a comprehensive list of actions required to achieve appropriate storm water management throughout the City. To meet future demands, the City will align its strategy with recommendations made by the City's Asset Management Policy and Drainage AMP. The action plan identifies eight areas, which are related to improving the management of storm water flooding risks and actions to keep the drains functional.

The City's approach to the DMS is driven by the requirement to provide an acceptable, functioning drainage network. Maintenance, network condition, flood mitigation, design standard actions, water quality and environmental, sustainability actions, land use planning and development and education and awareness actions are the key recommendations and actions in the DMS.

The ultimate success of the DMS will be dependent on Council's ability to implement the strategy and progressively review effectiveness. The strategy will be monitored periodically to ensure the outcomes are being achieved. A full review of the DMS should take place every three to five years to document progress and set out proposals for the next five years. It is expected that the Drainage Management Plan will be reviewed every five years as a minimum.

In order to meet these requirements and to improve the overall stormwater management within areas under Council control, Council's DMS has been developed.

This Strategy has been specifically designed to:

1. Address the strategic issues outlined in the Drainage Catchments Study Review 2017.
2. Coordinate the operations of the various areas of Council to achieve an integrated approach to the management of urban storm water quantity and quality.
3. Ensure storm water management is adequately addressed in Council's Planning Scheme Review.
4. Integrate stormwater in the landscape by incorporating multi-use corridors that maximise the visual and recreational amenity of developments.
5. Link and integrate Council's Asset Management vision with setting priorities for funding used on drainage assets.
6. Address the growing community awareness of storm water and catchment management issues;
7. Forecasting future service delivery needs and the capacity of the drainage assets to meet those needs, on short, medium and long-term basis.
8. Communicate Council's approach to urban storm water management to key stakeholders to facilitate improved management of water quality throughout the City.

To meet these requirements, a projected operating expenditure of \$11.7M and capital expenditure of \$13.48M is required over the next 10 years.

1 Introduction

1.1 Background

Defining drainage

Stormwater is water that originates during rain events and runs off all urban surfaces such as roofs, pavements, car parks, roads, gardens and vegetated open spaces. Stormwater can be harvested and reused for many purposes. In urban areas, the best quality water is rainfall captured from roofs before it mixes with other storm water at ground level or in drains.

According to Australian Rainfall & Runoff 2016 guide to flood estimation, the main purpose of urban drainage systems is to collect and convey, to receiving waters, with minimum nuisance, danger or damage.

The drainage network within the City is a combination of pits, pipes, open channels, natural waterways and road reserves. Storm water is disposed of at source where possible through infiltration or carried and disposed of in lakes, wetland reserves or other catchments eventually discharging to the ocean.

Drainage in the City of Cockburn

The City, as a result of its period of development, was not established in a manner that has all roads or properties serviced by constructed drainage systems. Generally, communities have grown without many of the services considered normal in modern subdivision developments, including drainage.

This is particularly the case in the older areas of the City where infill projects are causing problems. Retrofitting and gaining good drainage practice is often difficult to achieve because of narrow road reserves, inaccessible easements or intensive development and revitalisation within the area.

Some areas have developed in a manner that resulted in the filling of minor waterways, occasionally without a replacement pipe system. This creates concerns around poor property access and drainage systems that have to service a large area and are often more susceptible to failure.

Stormwater System and Catchment

The City contains a significant number of stormwater systems end catchments (where stormwater is disposed of in drainage sumps) and four main arterial drainage catchments shown on the Figure 1.

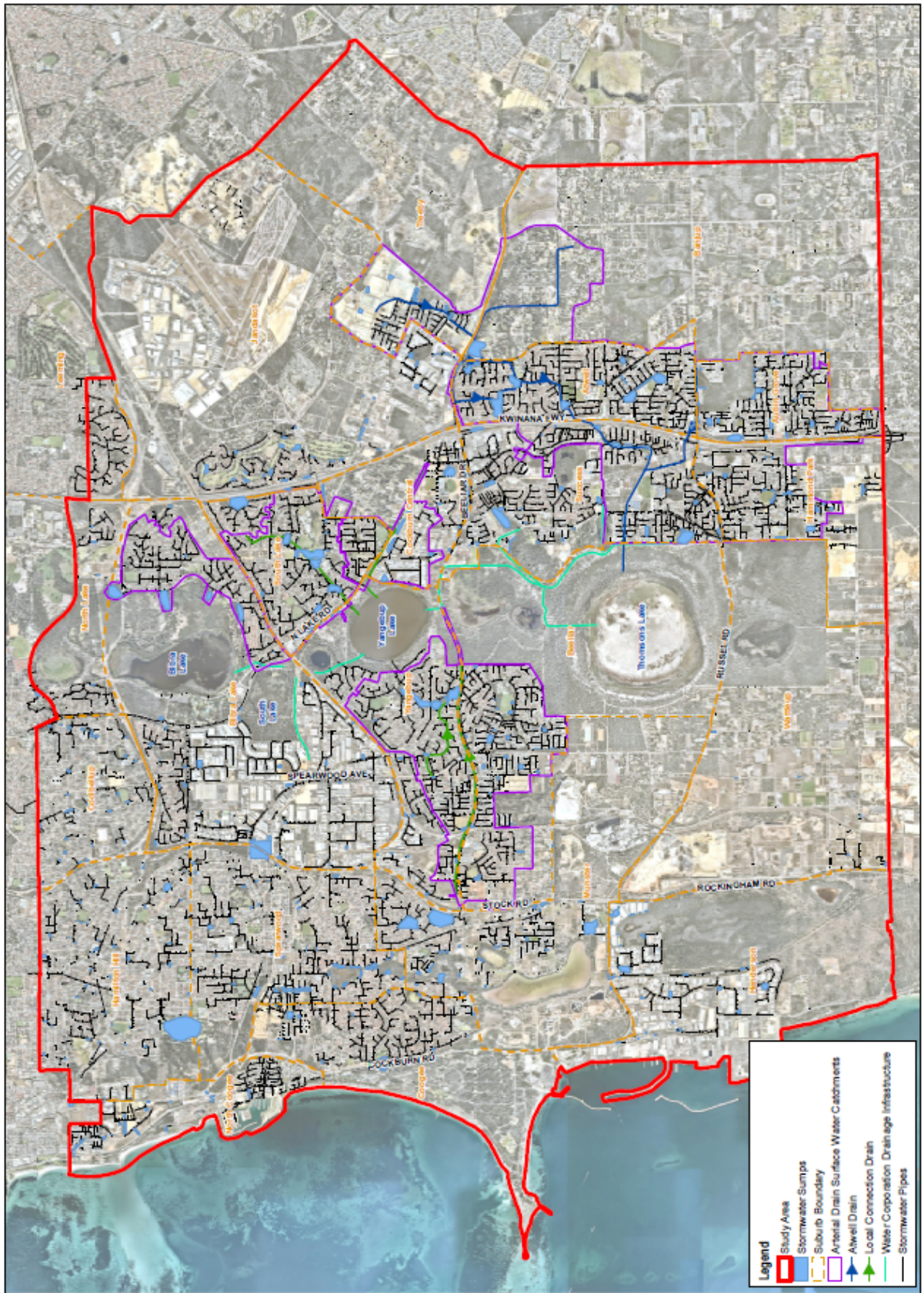


Figure 1 - Arterial Drain Surface Water

Drainage systems are usually designed as two separate elements.

The underground piped network transports stormwater flows for minor storm events (generally flows of up to the critical 20% AEP rainfall event). The piped network is designed to have sufficient capacity to contain flows and reduce the frequency and quantity of surface flows.

The major drainage system caters for flows in excess of the piped network, up to the critical 1% AEP rainfall event, and usually consists of floodways, road reserves or natural waterways. The major drainage system prevents storm water damage to properties and transports the storm water to the receiving waterways. Stormwater drainage systems ultimately discharge to lakes and the ocean, and come under the care and management of City of Cockburn and the Water Corporation.

Drainage Standards

Drainage systems are designed to be able to cope with the runoff from storms up to a predetermined designed rainstorm. This design rainstorm is discussed in terms of the frequency with which it occurs, intensity of the expected storm and storm duration.

The Council's Guidelines and Standards for the Design, Construction and Handover of Subdivision within the Municipality, which outlines standards is used in the design of drainage systems for redevelopment and subdivision areas within the City.

The work to be executed under the guideline consists of the design of storm water drainage systems for urban and rural areas and is in accordance with the major/minor system concept set out in the Australian Rainfall & Runoff Guidelines. That is, the major system shall provide safe, well-defined overland flow paths for rare and extreme storm runoff events while the minor system shall be capable of carrying and controlling flows from frequent runoff events.

Current Position

The City controls approximately 19,000 pits, 455km of pipes, 445 drainage sumps and a series of open drains across the Local Government Area. As part of the Drainage Catchment Study completed by Cardno (2017) the suburbs of Hamilton Hill and Coolbellup were identified as having the most critically undersized sumps. While infrastructure was not undersized, Success and Hammond Park, where also found to have nuisance flows causing unusable public open space.

For further details regarding the current state and extent of the City's drainage infrastructure, refer to the City's latest AMP.

1.2 Rationale for Preparing a Drainage Management Strategy

Historically, stormwater has been managed so that it is conveyed as quickly as possible to local gullies and waterways to reduce local flooding. It is now being recognized and accepted that this approach is contributing to both the increased likelihood of local flooding as well as the degradation of water quality and the health of waterways.

In order to meet these requirements and to improve the overall storm water management within areas under Council control, Council's DMS has been developed. This Strategy has been specifically designed to:

1. Address the strategic issues outlined in the Drainage Catchments Study Review 2017.
2. Coordinate the operations of the various areas of Council to achieve an integrated approach to the management of urban storm water quantity and quality.
3. Ensure storm water management is adequately addressed in Council's Planning Scheme Review.
4. Integrate stormwater in the landscape by incorporating multi-use corridors that maximise the visual and recreational amenity of developments.
5. Link and integrate Council's Asset Management vision and resources for setting priorities for funding used on drainage assets.
6. Address the growing community awareness of storm water and catchment management issues;
7. Forecasting future service delivery needs and the capacity of the drainage assets to meet those needs, on short, medium and long-term basis.
8. Communicate Council's approach to urban storm water management to key stakeholders to facilitate improved management of water quality throughout the City.

1.3 Vision for the City

The large road network with associated drainage systems, wetlands, reserves and open space is one of the City's most important and valuable assets. Drainage management, which is based on ecologically sustainable development principles and linked to the City's Structure Plan and the transport optimisation objectives are vital in maintaining the high quality of the City's infrastructure and attain our vision of:

"To build on the solid foundations that our history has provided to ensure that the Cockburn of the future will be the most attractive place to live, work, visit and invest in, within the Perth Metropolitan area".

The DMS ensures drainage infrastructure is provided and maintained in a manner that achieves:

- Technical service levels based on the Council's Guidelines and Standards for the Design, Construction and Handover of Subdivision within the Municipality and a good work practice of the Water Sensitive Urban Design (WSUD);
- What our Stakeholders require of us; and
- A cost effective solution through an optimal balance of development, construction and maintenance.

1.4 Purpose of the Strategy

1.4.1 Strategy Approach

The DMS is an assessment of the adequacy of existing systems and the number of drainage issues experienced in the City, meeting the needs of the drainage assets that are sustainable, appropriate, accessible and responsive to the community and Council expectations.

The DMS is driven by what it takes to provide an '*acceptable, functioning drainage network*' and has been developed as follows:

- Defines the desired key service levels. These services form the basis of the DMS and funding objectives. This document refers to both the current state of assets and services and Council's vision for future services and assets;
- Identifies the standard of new drainage assets and their functional features;
- Identifies upgrade requirements for existing assets;
- Identifies minimum maintenance requirements for existing assets so service levels are met;
- Identifies the monitoring and reviewing process for the continuous improvement of the quality of information, strategies and associated procedure and plans; and
- Identifies Key Performance Indicators (KPI's) that will be used to monitor the strategy. These KPIs essentially provide the base-line for future decision-making.

1.4.2 Drainage Management Philosophy

The stormwater system can be managed simply as a support system for an urban area or it can be managed in a way that will enhance efforts to achieve a broad range of goals and objectives. The basic principles underlying the goals and objectives for storm water management include the following precepts:

- *Urbanisation has the potential to increase both the volume and rate of stormwater runoff.* Ensure development does not increase the rate of storm water flow above that which the natural ground can safely accommodate at any point in the sub-catchments. All storm water control works are constructed in a safe and aesthetic manner in keeping with the overall development theme for the area;
- *Planning and integrated water cycle management.* Better urban water management can be achieved through capacity building and assessing new development and redevelopment areas to ensure the principles and practices of integrated water cycle management are incorporated into the design and development.
- *Stormwater requires space and stormwater management is a time-related space allocation problem.* Stormwater runoff should not be concentrated to an extent that would result in any damage to the environment during storms. Reduce stormwater flows as much as possible by the effective use of attenuating devices;
- Wetlands are natural storage areas forming a natural easement along a watercourse used for the collection, storage and transmission of storm water runoff. This function cannot be subordinated to any other use without applying control measures. Within these constraints, wetlands have the potential to help improve water and air quality, provide open space, preserve important ecosystems, and accommodate properly planned urban network systems;
- *Water pollution control is essential to fully realise the potential benefits to be derived from watercourses and floodplains.* Prevent pollution of waterways and water features by preventing toxic waste and pollution discharging to storm water systems;
- *Water quality management.* Maintain surface and ground water quality at pre-development levels (winter concentrations) and, if possible, improve the quality of water leaving the development area to maintain and restore ecological systems in the sub-catchment in which the development is located;
- *Contain soil erosion by constructing protective works.* Maintain adequate ground cover at all places and at all times to negate the erosive forces of wind, water and all forms of traffic. Avoid situations where natural or artificial slopes may become saturated and unstable, both during and after the construction process; and
- The drainage system as a part of the minor storm water system needs a management plan to ensure that the drainage assets are sustainable, appropriate, accessible and functional. Ensure the drainage system is design in accordance with City drainage standards.

1.4.3 Key benefits of Strategy Implementation

Through the implementation of the DMS, Cockburn City Council seeks to achieve the following benefits:

- Lowering its long-term costs of drainage asset preservation;
- Reducing the backlog of maintenance progressively over time through improved decisions, enhanced technology and increased funding that is optimally targeted;
- Improving drainage network performance, lowering disruptions and inconveniences to ratepayers and lowering risks of accidents and damage resulting from drainage failures;
- Making more effective use of available resources through optimised decision-making and asset management, and
- Taking a clear position on integrating WSUD as our new committed approach to water management for the City, this can provide aesthetic value to the people who live in industrialised urban areas; and reduce stormwater flows which can lead to decreased flood risks.

1.4.4 Scope of the Document

The DMS is an assessment of the adequacy of existing systems and the number of drainage issues experienced in the City while planning to meet the needs of the drainage assets that are sustainable, appropriate, accessible and responsive to the community and Council perspective.

This DMS defines the key recommendation and actions that are to be carried out on the existing and new drainage systems within the City. The following is a list of some of the key actions identified:

- Maintenance;
- Network condition assessment;
- Flood mitigation;
- Design standard;
- Water quality and environmental;
- Sustainability;
- Land use planning and development
- Education and awareness actions.
- To insure that the City is not liable for third party damage.

1.4.5 Implementing the strategy

The DMS provides the basis for the development of the forward works plan and expenditure targets. Also, it will lead to a dynamic adaptation of future design standards to ensure that new assets in the drainage portfolio are built in such a manner that they lend themselves to cost-effective maintenance practices.

The actions and priorities identified in the strategy will provide the City with clear direction in the management of City's drainage systems for the next 10 years.

1.5 Advocacy

To ensure a provision of safety, it is important to inform rate payers of flood prone areas within the City, drainage issues that Council faces and what actions they can take to alleviate the risk and/or consequence of potential flooding events.

1.6 Liability

To ensure the City is not liable for third party damage:

- City engineers have an obligation to approve and clear subdivisions drainage infrastructure only if they meet approved design and/or Council policy.
- The City must ensure that it maintains its drainage network in accordance with its professional obligations and duties.

2 Vision, Values, Mission

2.1 Drainage Vision

The City's goal in managing infrastructure assets is to meet the required level of service in the most cost effective manner for present and future residents. The key elements are:

- Sustainable: continue to implement the long term AMP to deliver sustainable asset management and the long term financial plan to deliver a sustainable financial future.
- Appropriate: provide fit for-purpose drainage infrastructure that has the capacity and adequacy to manage the flow requirements, based on defined levels of service as contained and monitored in our Drainage AMP.
- Accessible: provide drainage infrastructure that can be accessed by all residents as per Council's service standards.

- Responsive: provide fit-for-purpose drainage infrastructure that is maintained and repaired based on established standards and response times.

Council's five year and ten year goals are the fundamental basis of determining the action plans and funding needs for the Drainage AMP.

2.2 Five Year Goals

To attain this vision in the following five years, the City will:

- Develop an on-going proactive program to keep the drains clear;
- Continue with its proactive pit cleansing program, once annually;
- Review all overland flow paths and develop a targeted program to keep these paths clear of obstructions;
- Develop a plan to upgrade the drainage system to the City's drainage standards;
- Implement the best practice WSUD to the new road and subdivision projects; and
- Retrofit the existing sumps, pipe and pit systems to swales, rain gardens and ephemeral wetland.

2.3 Ten Year Goals

In the next ten years, the City will:

- Review the underground drainage network and develop a targeted program to upgrade under-capacity pipes and storm water disposal assets;
- Have all new developments meet 100% on-site treatment for storm water management under the Council's Guidelines and Standards for the Design, Construction and handover of the subdivision within the Municipality; and
- Reduce impermeable surface areas where appropriate

2.4 Council's Asset Management Vision

The vision statement for Council's Asset Management Policy (City of Cockburn, 2018), is as follows:

"To ensure that Council's infrastructure and other assets are provided and maintained in a manner that achieves the community and technical service levels that we aspire to and our stakeholders require of us, in a cost effective manner through an optimal balance of creation, preservation, enhancement and disposal."

The Asset Management Strategy and its companion Implementation Action Plan set out the goals of meeting the required level of service in the most cost-effective way through the creation, acquisition, maintenance, operation, rehabilitation and disposal of assets to provide for the community in the present and future.

The City acknowledges that the fundamental aspect of this vision is to provide an acceptable level of service that will enable a good quality of life. This is the basis of the DMS.

3 Other Strategic Documents

3.1 Long Term Financial Plan 2016/17 – 2025/26

The City of Cockburn's Long Term Financial Plan (LTFP) details what is proposed over the next ten years as a means of ensuring the City's financial sustainability. The LTFP is aligned to other core planning documents including the Strategic Community Plan 2016–2026 (SCP) and the Corporate Business Plan (CBP). Information contained in other strategic plans including the Asset Management Plan (AMP) informs the LTFP which in turn is the basis for preparation of the City's Annual Budgets.

Details of costs relating to drainage are provided in Section 12.1 Asset management

https://www.cockburn.wa.gov.au/getattachment/ccbc6936-b942-43a0-928c-2d7fe0363941/ECM_4709469_v1_Long-Term-Financial-Plan-2016-2026-pdf.aspx

3.2 Strategic Community Plan 2016–2026

The Strategic Community Plan 2016-2026 (SCP) is a long term Community Plan that sets the direction for the future. It will link with a number of other strategic documents, to identify and balance community needs, while shaping our environment to cope with continued growth. Drainage is listed in the SCP under City Growth City's Strategic Objectives.

3.2 Corporate Business Plan 2016/2107–2019/20

The Corporate Business Plan 2016/17 – 2019/20 maps the City's key priorities, projects, services and actions over the next four years. It provides the detail for the first years of the Strategic Community Plan 2016 – 2026 as well as detailing business as usual service delivery.

This plan is developed on a four yearly cycle and reviewed annually to prioritise or re-prioritise projects and services. Drainage is listed under City Growth, Community, Lifestyle and Security, and Leading and Listening themes.

4 DMS Objectives and Delivery

4.1 Managing the Provision of Service Delivery

The DMS together with the Council's AMP is based on providing assets that are adequate for defined service levels. The provision of service is based on three levels.

1. Initial design and construction of new assets
 - a. Define the key features of a new drainage asset;
 - b. Define the level of functional adequacy, level of capacity and condition as a minimum.
2. Maintenance of built assets
 - a. Ongoing routine maintenance - once the drainage asset is constructed, set the minimum level of maintenance we will provide to keep the asset safe and serviceable;
 - b. Periodic maintenance for built assets – plan and implement periodic activities to extend the life of our drainage assets.
3. Renewals or upgrades for assets beyond their service potential
 - a. Schedule for renewals
 - b. Define the physical shape and form of an upgraded asset to ensure that it meets the required standards.

4.2 New Underground Drainage Assets

- The City sets the design standards for drainage in these developments, so that the proposed pavement and surfaces take into account site features and the level of use of the drainage. The City then considers the drainage design and other features such as drainage capacity in the planning approval process.
- All new drainage structures such as pipes, pits, culverts and other ancillary assets required for new developments are built by the developers and their contractors and approved by the City. City staff supervises the works to ensure compliance to Council's specifications.
- When the works are completed and after a 12-month maintenance period, the developer hands these assets over to the City for ownership and maintenance for the remainder of their useful life.

4.3 Reliability Centered Maintenance

Routine inspections are to be carried out to assess the need for maintenance and are primarily concerned with checking the functionality of the stormwater drainage structures such as pipes, drainage pits, box culverts, stormwater sumps.

The City also addresses the repairs and minor faults of drainage structures on the basis of defined intervention levels and response times. Response time is defined as a reasonable time frame within which residents can expect the City to remedy the defect.

4.4 Periodic Maintenance

Every drainage system needs some periodic inspection to see that the system performs properly. Periodic maintenance is more extensive than routine maintenance, but does not involve the full rebuilding of drainage infrastructure. Typically, periodic maintenance involves programmed pit inspection, clearing, pipe enhancements and pit upgrades.

4.5 Renewal and Upgrade Works

This is the most extensive form of drainage works. Typically, it involves the replacement of old or malfunctioning pipes and pits. Assets requiring renewal are identified from customer requests, analysis of the network condition and estimates of remaining life. It is also part of Council's upgrades during street improvement and rehabilitation works.

Upgrade refers to works which improve an existing asset beyond its current capacity. This may result from growth, social or environmental needs. Upgrade of infrastructure will contribute to the overall infrastructure inventory and will require ongoing maintenance and renewal.

Renewal and upgrade of drainage assets result in an asset that will have a life expectancy equivalent to a new asset. The intervention levels and response times are contained in the AMP.

4.6 Inspecting Drainage Assets

The DMS describes the future scope and program of such audits and assessments. The methodology of assessment is contained in the DMS and Asset Management Data Collection Guidelines. The typical items that will be assessed are:

- Structural condition of the pipe
- Capacity rating of the pipe

4.7 Prioritisation of the Drainage Improvement Program

The framework with which the City will prioritise its drainage renewal program is defined by the Drainage AMP and is informed by the DMS.

The condition, performance and sustainability of assets are criteria for determining the prioritisation index for the drainage assets program.

- Condition - drainage asset that requires preventative or remedial action to bring it back to its original state.
- Performance - drainage infrastructure that has the capacity and adequacy to manage the flow requirements, based on defined levels of service.
- Sustainable - meeting the needs of the present without compromising the future by working towards reducing pollutants entering the storm water system and discharging to receiving waterways.

4.8 Management of Storm Water Quality

Stormwater has traditionally been regarded as a nuisance, causing many negative social and economic impacts, usually associated with flooding. The stormwater management planning process now identifies a shift toward focussing on issues that affect the health and amenity of waterways, the quality of open space and the well being and long term viability of communities.

The City's Drainage AMP provides a strategic framework to protect stormwater quality through the municipality, thereby protecting local and downstream waterways that receive stormwater run-off.

One of the main actions identified by the Stormwater Management Plan and directly linked to the Drainage Asset Management Plan and DMS is the installation of Gross Pollutant Traps. The City has established priorities through the Drainage AMP to install Gross Pollutant Traps at various strategic locations such as: Atwell - Atwell Reserve, Munster - Market Garden Park, South Lake - Broadwater Gardens Reserve and others in Spearwood, Success and Yangebup.

4.9 Strategy and Actions

As previously outlined, Council's vision is to 'Ensure that Council's drainage assets are sustainable, appropriate, accessible and responsive to the community'.

The key outcome of this vision is to keep the drains clear, keep the drains working and bring them up to an acceptable standard.

To ensure that Council will achieve its vision, the following actions are identified:

4.9.1 Maintenance Actions

- Continue with the proactive inspection and cleaning program for all pits - once annually;
- Develop an on-going proactive program to flush all drainage pipes - over two-years; and
- Upgrade pit lids on all key locations of risk and high maintenance.

4.9.2 Network Condition Actions

- Using CCTV inspection to identify the condition of these assets; and
- Documenting the processes to ensure that Council's Drainage Asset Register and Corporate GIS is regularly updated with condition data from the CCTV inspections, pit inspections and pipe flushing work.

4.9.3 Flood Mitigation Actions

- Review all overland flow paths and develop a targeted program to keep these paths clear of obstructions;
- Define the locations that are most likely to be affected by flooding and implement a pro-active capacity upgrade program;
- Develop a plan to upgrade under-capacity pipes/system; and
- Liaise with Main Roads WA to ensure that all roads owned and maintained by them, meet the current criteria to be able to act as overland flow paths during storm events of 1% AEP.

4.9.4 Design Standard Actions

- Review road design standards to ensure that all roads when reconstructed meet the current criteria to be able to act as overland flow paths during storm events of 1% AEP;
- Design new drainage assets and upgrades of existing drainage assets by implementing the best practice WSUD to the new road and subdivision projects;
- Design of new drainage assets and upgrades of existing drainage assets will be designed so that they drain completely within 96 hours to prevent mosquito breeding;
- Review the City's standard drawings regarding drainage assets to ensure that they comply with current standards.

4.9.5 Water Quality and Environmental Protection Actions

WSUD is an approach to water quantity and quality management through the implementation of sustainable 'soft' engineering measures which improve water quality while also enhancing the landscape and providing amenity to the local community. WSUD systems are primarily used to tackle non-flood management issues, in particular improving storm water quality and reducing mains water use.

The choice, scale and design of a WSUD system will ultimately be dependent on case and site specific factors which need to be established and assessed before a conceptual design is drawn up. Factors which might need to be assessed include site conditions, runoff management requirements and characteristics of the existing environment, catchment area and the desired end-quality of water.

Incorporating WSUD within the City's existing drainage system may offer a variety of means of minimising pollution and mitigating the environmental impact on the City's watercourses, valuable wildlife areas and wetlands.

With proper implementation into new and existing infrastructure, WSUD systems can have far reaching benefits not only on environmental and social levels, but also on economic ones. From cutting down on capital costs of a new developments through the reduction in the size of pipe work and storm water infrastructure, to the improvement in market value of existing developments, the implementation of WSUD systems can prove to be a cost-effective measure to the City's overall water management strategy.

Most WSUD measures can be retrofitted, in a cost effective manner, into the existing drainage systems where capacity issues are noted. The merits of retrofitting WSUD over upsizing existing infrastructure are:

- More cost effective than upsizing sumps and pipes;
- Avoids deep excavations;
- Can be fitted into existing verges; and
- Contributes to enhancing biodiversity.

4.9.6 Drainage and Mosquitos

The City provides a unique environment for mosquitos making it a hot spot for Ross River Virus (RRV) in the Perth metropolitan area. Approximately 20 wetlands within the City and a high groundwater table provide ample mosquito breeding sites. There are also more than 900 drainage structures in the City which hold water through summer and act as potential breeding sites. Many of the structures are bubble-up-

sumps that have been badly designed and/or installed. To minimise the impacts of mosquitos, the following action is identified:

- All new drainage structures must drain fully within 96 hours.

4.9.7 Reduction Targets

A reduction in pollutant loads according to national or regional best practice guidelines should be aimed for in the performance assessment of any proposed treatment system, with the results from this study used as baseline pollutant load. Pollutant load reduction targets to be adopted as reported in Better Urban Water Management (WAPC, 2008), compared to traditional urban drainage where storm water is not treated, and are as follows:

- 80% reduction in total suspended solids.
- 65% reduction in total phosphorus.
- 40% reduction in total nitrogen.
- 90% reduction in gross pollutants.

Meeting these reduction criteria through the use of treatment systems is to be done according to best practice principles. The control measure hierarchy for improving water quality is as follows, with the recommendation of using natural systems where possible:

1. Source control at allotment level.
2. Conveyance control during the transit phase.
3. Discharge control at the estate or catchment level before storm water enters watercourses.

Current best practice approach is to utilise treatment measures at two or more of the above levels, thereby forming a 'treatment train' along the storm water flow stream. The advantages of a treatment train include minimising the size and cost of treatment measures further downstream of the flow and preventing total system failure should one of the treatment measures fail.

5 Summary of Community Consultation

The City maintains a complaints register for drainage issues. As part of the Drainage Catchment Study (2017) the following information was provided.

Cardno reviewed residents' complaints received by the City between January 2009 and December 2016. Over the period, 513 complaints were received. The complaints can be broken down into the following areas:

Complaints Area	Number of Complaints	DTS Approaches
Maintenance issues	267	Ongoing routine maintenance Periodic maintenance
Drainage infrastructure	220	Network Condition Actions Flood Mitigation Actions
Non-drainage related	26	N/A

Of these complaints seven are in relation to sumps which have overflowed. The remainder is in relation to insufficient drainage inlets being provided and crossover issues (typically after roadworks have been completed).

Other notes of interest:

- Complaints were received when drainage was redirected to POS and water was observed in the previously dry parks;
- A large proportion of complaints relating to blocked drains also mention newly mulched areas; and

To meet the commitments of the DMS and community expectations the following strategies will be implemented:

- Continue to utilise the complaints register to address community concerns in a timely manner; and
- Undertake community consultation prior to capital and re-development works being undertaken to inform the community of what is occurring in their area.

6 Resourcing the Plan

The successful implementation of the DMS's Action Plan will require a substantial funding commitment from Council.

The City's Asset Management Policy was adopted in April 2012 and includes the following policy statement:

'Ensure appropriate resources and funding for Asset Management activities are made available to facilitate integration and application of Asset Management policies, Asset Management strategies and Asset Management Plans within the corporate governance framework'

To meet requirements of this DMS, a projected operating expenditure of \$11.7M and capital expenditure of \$13.48M is required over the next 10 years.

Based on the above policy statements and taking into consideration Council's projected capital expenditure as outlined in the Drainage AMP the following Programs have been identified over the following ten years:

6.1 Drainage Maintenance Program (10 year)

Maintenance includes reactive, proactive and cyclic maintenance work activities.

Reactive maintenance is unplanned repair work carried out in response to service requests and management/supervisory directions.

Proactive maintenance is repair work that is identified and managed through a regular cycle.

The regular cycle activities include inspecting, assessing the condition against failure/breakdown experience, prioritising, scheduling, auctioning the work and reporting what was done to develop a maintenance history and improve maintenance and service delivery performance.

These works bring an asset from under capacity to their full service potential. Projected maintenance expenditure is provided in Table 1.

Table 1: Projected Maintenance and Operations Expenditure

Year	Maintenance	Operating Exp.	Total
18/19	\$895,449	\$83,941	\$996,529
19/20	\$912,139	\$85,505	\$1,032,868
20/21	\$928,830	\$87,070	\$1,070,173
21/22	\$945,520	\$88,634	\$1,108,468
22/23	\$962,210	\$90,199	\$1,147,775
23/24	\$978,901	\$91,764	\$1,188,119
24/25	\$995,591	\$93,328	\$1,229,523
25/26	\$1,012,282	\$94,893	\$1,272,012
26/27	\$1,028,972	\$96,457	\$1,315,612
27/28	\$1,045,662	\$98,022	\$1,360,349
TOTAL	\$9,705,556	\$909,813	\$11,721,428

6.2 Drainage Reconstruction program (10 years)

The City identifies the piped assets to be replaced via information gathered from requests, cleaning of pipes, analysis of the pipe network and investigation of the pipes via CCTV. Verified proposals are ranked by priority and available funds and scheduled in future works programs and planned future developments.

The City has developed a ten year renewal program which will inform the budget planning process and form the basis to the City's long term financial planning as shown in Table 2.

Table 2 - Projected Renewals Expenditure

Year	Projected Renewals		
	Drainage	Sumps	Total
18/19	\$1,130,000	\$210,000	\$1,340,000
19/20	\$1,160,000	\$220,000	\$1,380,000
20/21	\$1,190,000	\$220,000	\$1,410,000
21/22	\$1,270,000	\$230,000	\$1,500,000
22/23	\$1,270,000	\$230,000	\$1,500,000
23/24	\$1,300,000	\$240,000	\$1,540,000
24/25	\$1,330,000	\$240,000	\$1,570,000
25/26	\$1,370,000	\$250,000	\$1,620,000
26/27	\$1,370,000	\$250,000	\$1,620,000
TOTAL	\$11,390,000	\$2,090,000	\$13,480,000

This is based on an annual need for drainage pipe and pit renewals and improvements of storm water sumps that have been identified as reaching the end of their useful life.

New works that create a new asset that did not previously exist, or works which upgrade or improve an existing asset beyond its existing capacity are also considered in the reconstruction program. They may result from growth, social or environmental needs. Assets may also be acquired at no cost to the Council from land developments.

6.3 Storm Water Drainage and Sumps Program (five years)

The City of Cockburn commissioned Cardno in 2017 to undertake a review of the drainage catchments to identify system deficiencies and provide a prioritised list of upgrade projects that could be undertaken for storm water disposal.

The report identified \$8.4M worth of projects needing to be completed in a five year period between 2017 and 2022. Based on the LTFP allocation per year, the five year drainage and sump program has been developed as detailed in Table 3.

Table 3: Five Years Capital Works Drainage and Sumps Program

	Location	Action	Cost	Year
MUNSTER	114 Holmes Road Flooding	Construction	197,800	18/19
ATWELL	Brenchley Dr Outflow	Construction	125,000	18/19
ATWELL	Jakovich Park upgrade	Construction	245,000	18/19
COCKBURN CENTRAL	Junction Blvd Flooding	Construction	62,500	18/19
COOLBELLUP	Menas Pl- Rinaldo Reserve upgrade	Construction	100,000	18/19
COOGEE	Amity Blvd (Powell Reserve)	Construction	22,000	18/19
SUCCESS	Evelyn Massey Park sump	Construction	59,000	18/19
COOLBELLUP	Hartley St Sump	Construction	145,000	18/19
SPEARWOOD	Peace Park sump fence upgrade	Construction	12,000	18/19
HAMILTON HILL	Tolley Court Sump	Construction	165,000	18/19
VARIOUS	Minor Drainage Improvements	Study/Construct	206,700	18/19
		TOTAL:	1,340,000	18/19
HAMILTON HILL	27 Clara Rd, Hamilton Hill	Construction	168,350	19/20
YANGEBUP	27 Guidace Way, Yangebup	Construction	293,800	19/20
ATWELL	Cornet Bartram Road and Brenchley Drive, Atwell	Construction	169,000	19/20
WESTERN SUBURBS Sporting Precinct Study	Wally Hagan and Dixon Reserve, Davilak Oval,	Study	300,000	19/20
SPEARWOOD	Spearwood Ave (Cockburn Rd to Hamilton Rd)	Study	150,000	19/20
WATTLEUP	194 Wattleup Road	Study	50,000	
VARIOUS	Minor Drainage Improvements	Study/Construct	248,850	19/20
		TOTAL:	1,380,000	19/20
SPEARWOOD	14B Scales Wy, Spearwood	Construction	129,350	20/21
HAMILTON HILL	157 Clontarf Rd and 52 Tolley Ct	Construction	403,000	20/21
SOUTH LAKE	North Lake Road Drainage Basins	Study/Construct	350,000	20/21
WESTERN SUBURBS Sporting Precinct Study	Dalmatinac and Lucius Reserve, Beale Park, Watsons and Edwardes Reserve, Santich Park	Study	300,000	20/21
VARIOUS	Minor Drainage Improvements	Study/Construct	227,650	20/21
		TOTAL:	1,410,000	20/21
HAMMOND PARK	Russell Road	Construction	111,150	21/22

HAMILTON HILL	19B Jean St, Hamilton Hill	Construction	293,800	21/22
COOLBELLUP	18 Hartley Street, Coolbellup	Construction	273,000	21/22
BANJUP	868 Armadale Rd, Banjup	Construction	65,000	21/22
BIBRA LAKE	Cascara Cnr	Construction	172,250	21/22
HAMILTON HILL	Grand Pre Crescent	Study/Construct	175,000	21/22
SUCCESS	Success Open Drains	Study	75,000	21/22
COCKBURN CENTRAL	Cockburn Central Open Drains	Study	80,000	21/22
VARIOUS	Minor Drainage Improvements	Study/Construct	254,800	21/22
		TOTAL:	1,500,000	21/22
COOLBELLUP	Cordelia Ave	Construction	195,000	22/23
SPEARWOOD	273 Spearwood Ave	Construction	426,400	22/23
YANGEBUP	111 Plover Dr	Construction	323,700	22/23
VARIOUS	Minor Drainage Improvements	Study/Construct	319,900	22/23
WATTLEUP	Power Avenue	Study	100,000	22/23
ATWELL	Atwell Open Drains	Study	85,000	22/23
SPEARWOOD	Fitzwater Way	Study	50,000	22/23
		TOTAL:	1,500,000	22/23

6.4 Labor Resources

The successful implementation of the DMS will also require labour resources to deliver the program.

The labor resources required can be delivered via:

- Employing more internal staff to service the requirements of the DMS;
- Utilising external consultants to undertake design work and progress projects identified in the DMS, led by and/under supervision of a City officer; or
- Utilising a secondment program employing an external resource to complete works to meet success criteria of the DMS.

7 Measuring Achievement / Performance Measures

7.1 Cost Performance Measures

The effectiveness of the storm water management strategy can be measured in the following ways:

- The degree to which the resulting cash flows are incorporated into the Long Term Financial Plan.
- Total maintenance funding spent per annum.
- Total renewal funding required in five year periods.
- Benchmarking of maintenance and capital budgets – externally and internally from year to year.
- Unit rates for each maintenance activity, renewal and upgrade activities.
- Continue to develop plan to better reflect acquisitions, renewals, upgrades and disposals
- Ensure the financial and operational asset registers replicate the same data.

7.2 Condition Performance Measures

- Network level asset condition state.
- Asset consumption measures – network level transition of assets into poor condition per annum.
- Quantity of assets classified as being ‘under-capacity’.
- Quantity of assets classified as being below acceptable service level.
- Damages from storms and floods.

7.3 Maintenance Performance Measures

- Inspection quality standard based on audits as per Drainage AMP.
- Repair quality standard based on internal audits and external benchmarking with industry standards.

7.4 User Satisfaction Performance Measures

- Based on comparative surveys from year to year.
- Include more detailed questions, specific o levels of service, in the customer satisfaction survey.
- Investigate customer requests based on comparative surveys from year to year.
- Include more detailed questions, specific to levels of service, in the customer satisfaction survey.
- Investigate customer request configuration.

8 Reporting

The DMS's Action Plan actions will be reviewed during annual budget preparation and amended to recognise any changes in service levels and/or resources available to provide those services as a result of the budget decision process.

Where outcomes are not being met, modification to actions can be made to ensure the end of the fiveyear time frame the plan's objectives are achieved.

The ultimate success of this DMS will be dependent on Council's ability to implement the strategies and progressively review effectiveness.. DMS is a dynamic document, reflecting and responding to changes over time. A full review of the DMS should take place every three to five years to document progress and make adjustment to the LTFP as required.

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