How is being an Asset Manager going to make us better Waterway Managers?

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Key Points

- Asset Management and Waterway Management are well aligned
- Disciplined Asset Management is organization wide, requiring a policy, a system, processes and importantly continuous improvement
- Melbourne Water is on an Asset Management journey
- Recent benefits include triggering maintenance activities by performance monitoring

Abstract

Melbourne Water manages a large and growing asset base (over 8,400km of waterways and over 200 natural and constructed wetlands). Asset Management principles traditionally used for civil assets (such as pipes and bridges) hold promise for ensuring the nexus between high level strategic services and on-ground activities. Although in many cases 'asset management' and 'best practice waterway management' principles are analogous, the use of different terminology has required significant translation. Melbourne Water has implemented changes across people, processes and systems to transform how the organization delivers its waterways asset management function. The first step in this shift towards using an asset management approach has been to develop a Strategic Asset Management Plan (SAMP) for waterways as a whole, a specific Asset Management Plan (AMP) for Stormwater Quality Treatment Systems (SWQTS) and the development of Failure Mode Analysis.. Improvements in asset information including condition and performance data for waterways assets are now being used to develop maintenance and renewal programs. This paper will present Melbourne Water's new approach to managing waterways using asset management principles.

Keywords

Asset Management, risk, levels of service, failure mode analysis, systems, processes, people, stormwater quality treatment systems, Melbourne, Waterway Management

Introduction

Melbourne Water's role in managing Assets

The Melbourne region supports a population of about 4 million people – more than 80% of Victoria's population – and is set to grow to more than 5 million by 2030. Melbourne Water (MW) is a service delivery organization with a broad set of responsibilities in managing water, sewerage and a large and growing waterways asset base of over 8,400km of waterways and greater than 200 natural and constructed wetlands across the Port Phillip and Westernport region.

While management activities are guided by strategies, there is growing need for better systems and processes to ensure assets are efficiently and effectively managed to provide the services they are designed to deliver. A consistent framework is required to help manage the diverse and growing waterways asset base. Asset Management principles traditionally used for civil assets hold promise for ensuring the nexus between high level strategic services and on-ground activities. While in many cases 'asset management' and 'best practice waterway management' principles are analogous, the

use of different terminology has required significant translation. For example 'levels of service' is equivalent to objectives, 'performance monitoring' encompasses monitoring and evaluation and 'failure mode analysis' is essentially understanding the cause and effect relationships which we often express through conceptual models. However there are many aspects of asset management which will force a more disciplined way of managing waterway assets. Melbourne Water has implemented a new Asset Management Information System (AMIS), Maximo and processes are in place to ensure all waterway assets are captured and categorized, that condition data is routinely collected, that maintenance activities are programmed and that the costs of various activities can be easily reported. The first step in this shift towards using an asset management approach has been to develop a Strategic Asset Management Plan (SAMP) for waterways. This paper will demonstrate how asset management at Melbourne Water is evolving.

Figure 1. Melbourne Water's operating area across Port Phillip Bay and Westernport

What is Asset Management?

Asset Management is a discipline that was developed to assist in the management of civil assets. The International Standard for Asset Management - ISO 55000 outlines the principles and approaches required to implement good asset management within an organization.

Melbourne Water's Asset Management System encompasses a number of elements including a high level policy through to detailed instructions and forms for managing specific assets Figure 2. Asset Management is embedded within all activities (including planning capital programs and maintenance) across the whole organization to enable assets to deliver on Melbourne Water's Services.

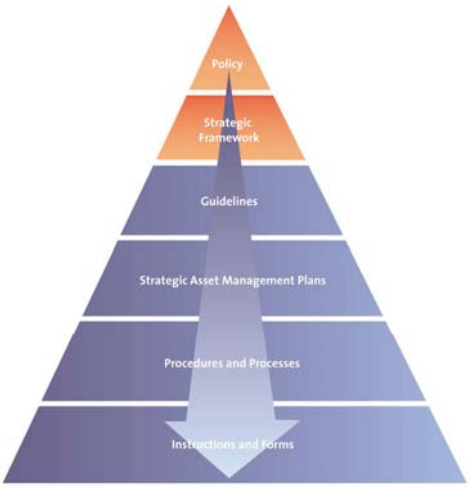

Figure 2. Overview of Melbourne Water's Asset Management System

What has Melbourne Water done to implement Asset Management for Waterways?

In 2015 several new strategies including a Relationship Strategy, a Service Delivery Strategy and a new Asset Management Strategy, all contributed to a new 'service' and 'customer' focus. The new Asset Management Strategy sets the framework for asset management within the organization using the four key principles of: Meeting Agreed Levels of Service by working with our customers to challenge and refine service levels appropriate to their needs; Service Based Performance Assessment to determine how customer centric services can be assessed and monitored; Adaptive Decision Making by defining the problem ahead of the solution and incorporating diversity, innovation, flexibility and incentives into the process; and Flexible Delivery Solutions through robust consideration of all delivery models including non-asset solutions, knowledge sharing, partnering and facilitation solutions to deliver the best outcomes for customers and Melbourne Water.

Implementing the Asset Management Strategy has required considerable change around systems, (including a new Asset management IT system called Maximo) people and processes. Some examples of these changes are described in the following table:

Table 1. Examples of change management for Asset Management at MW

People	Processes	Systems
• Implement new organizational structure and roles • Review of governance from several decision-making teams to a centralized approach • Skills and training	• Review existing processes to ensure alignment with customer focused business model • Ensure better processes not more processes • Looking at risk analysis from the perspective of Failure Mode Analysis	• Improve integration of different IT systems through Maximo, including capital planning, asset condition and GIS • Input 'good' data • Improve reporting to enable monitoring and evaluation

The development of a Strategic Asset Management Plan for Waterways and Failure Mode Analysis are two recent initiatives (explored below), which have fundamentally moved waterways into the Asset Management realm.

CASE STUDIES

A Strategic Asset Management Plan for Waterways

In 2015 Melbourne Water developed the first Strategic Asset Management Plan for Waterways. It has been developed for rivers, estuaries, and natural wetlands in the Port Phillip and Westernport Regions.

The first iteration of the SAMP interprets Melbourne Water's current approach to waterways management, outlined in the Healthy Waterways Strategy, and presents it within the context of an asset management framework. The information presented in the Waterways SAMP is intended to reflect Melbourne Water's current approach to managing its waterways as assets. It is being used as the basis for a disciplined asset management approach that will mature with time.

The Healthy Waterways Strategy was implemented in November 2013 to outline MW's approach to managing waterways in the Port Phillip and Westernport Region and to guide MW's investment in waterways from 2013/14–2017/18. In developing the Waterways SAMP the system key value trajectories, environmental conditions of waterways and outcome specifications and regional program priorities were redefined as the levels of service hierarchy for Melbourne's waterways (**Error! Reference source not found.**).

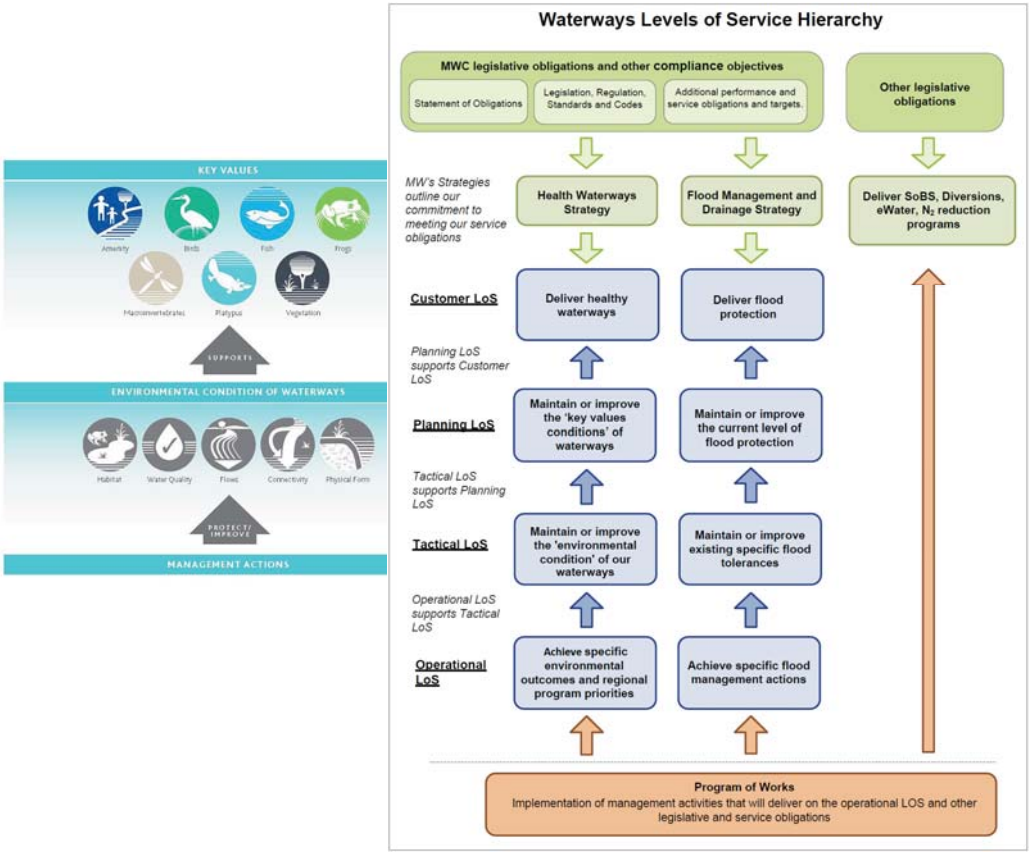

Figure 3. Translation of Healthy Waterways Strategy in Asset Management Levels of Service

The Waterways SAMP provides the framework to manage waterways assets in a consistent and contemporary manner and ensure they are delivering valued services for MW's customers, consistent with MW's Asset Management System (AMS) and the new Asset Management Strategy.

The Waterways SAMP will be used as the basis for a disciplined asset management approach to managing our waterways for the services that the community values.

The Waterways SAMP identifies and details the intended asset management actions for waterways assets over their Service Lifecycle. The purpose of a Waterways SAMP is to define our asset performance requirements, what is being done to meet these requirements, and propose how our service levels will be sustained.

Specifically the Waterways SAMP will consolidate asset information and knowledge, facilitate the development of the capital and operational investment programs, in the short and medium terms, facilitate asset management decision making processes by clearly identifying the processes undertaken in making investment decisions through the Service Lifecycle and then recording the outcomes of those processes and communicate with and provide guidance for asset stakeholders.

This SAMP includes (or references where appropriate) the core information that justifies the recommended asset management activities for each waterway asset to support specific levels of service. Melbourne Water can manage asset risks for each waterway to a reasonably practicable and acceptable level and can achieve optimized investments in its waterway assets. As such, the Waterways SAMP should enable MW to meet its legislative, customer and stakeholder service requirements in the most cost efficient manner. Asset Management Plans are typically developed for a specific asset class and sit underneath a broader SAMP. The process has now begun to develop AMPs for a range of waterway asset classes including Stormwater Quality Treatment Systems, erosion control structures, fishways and habitat.

Advancing Asset Management for Stormwater Quality Treatment Systems

Stormwater Quality Treatment Systems (SWQTS) include a range of constructed systems to treat urban stormwater, including litter and sediment traps, bio-retention systems and constructed wetlands. Being a mix of hard and soft assets, SWQTS have been a useful test case for applying the asset management framework and principals to waterways assets. Once tested on SWQTs, the same methods are then applied to other assets classed such as fishways, erosion control and habitat.

As part of developing the SWQTS Asset Management Plan (AMP), a Failure Mode Analysis (FMA) has recently been undertaken on constructed wetlands. FMA is a logical and transparent process (structured decision making) of how an asset may fail to meet its desired 'level of service', the risk of failure and what monitoring and management regimes are required to predict and prevent failures from occurring. Asset Management typically refers to maintenance activities in the following way:

> **Corrective (CM)**: management action in response to performance data
> **Breakdown (BM)**: management action triggered by an observed failure
> **Programmed (PM)**: scheduled action

The FMA for SWQTS was a consultative process involving Asset Practitioners, Waterways and Land Officers and Maintenance Coordinators. Starting with defined Levels of Service Figure 4 outlines the process involved in the FMA.

Failure Modes including cause and effect are captured. An assessment of the 'risk of the particular failure' is then used to help determine whether or not monitoring is warranted i.e. can you predict and therefore potentially mitigate failures (CM), or is it acceptable to allow failures to occur and then rectify the problem (BM). Some failures can be predicted by an event e.g. a known storm event frequency is likely to block an inlet. When it is difficult to predict a failure through data or where historical data indicates a trend, it may be cost effective to simply schedule maintenance at set intervals (PM).

Four different Levels of Service (bay health, safety, amenity and biodiversity) were identified for SWQTS. SWQTS can be very large and complex comprising a multitude of separate component assets. As such to understand how levels of service may fail to be achieved, the asset was broken into several 'functional zones' i.e. the inlet, the sediment pond, the wetland waterbody and the outlet.

Predicting and responding to failure

The FMA has allowed the knowledge of both asset practitioners and maintenance coordinators to be captured and used to identify the causes and effects of *failure modes* associated with component assets within a SWQTS. The analysis provides the fundamental information in ensuring the link between the on-ground works delivered and how they support the hierarchy of levels of service that the asset supports.

Through identifying both the failure mode and the cause of failure a clear link with performance indicators was made. For example as shown in Table 2 percent blockage of an inlet pipe is a good indicator of whether or not flows into the asset are adequate. In most cases a failure could be predicted through either inspections or a combination of inspections and desktop analyses of infrared data on vegetation cover.

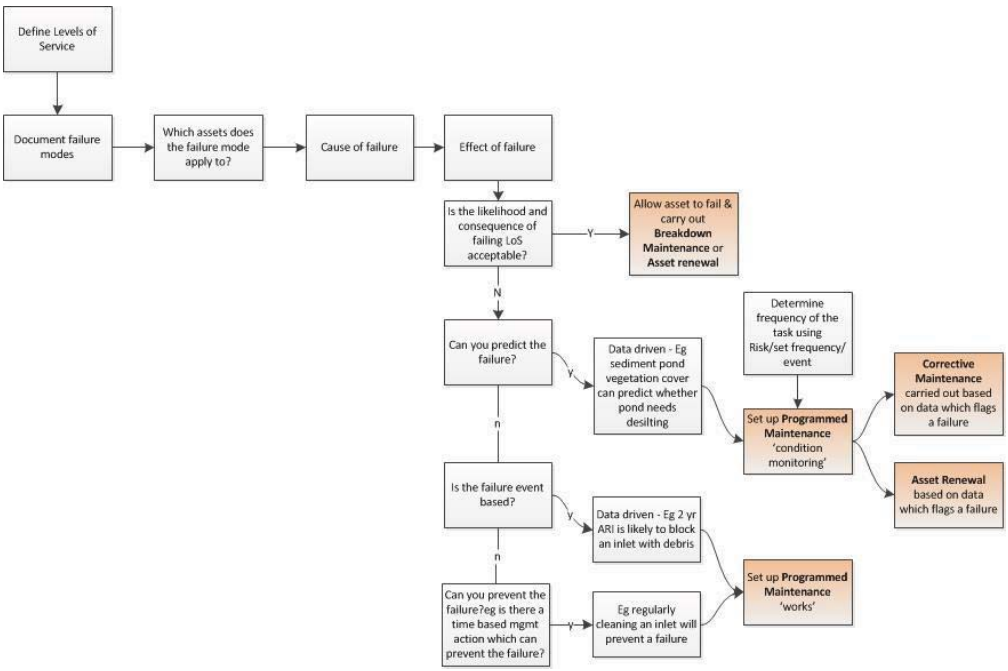

Figure 4. Flow diagram showing approach to the Failure Mode Analysis

The failure mode analysis for SWQTS has delivered improvements in asset information quality through the definition of key asset information types such as the *attributes* of the asset that support its function, performance and condition parameters and thresholds (*metrics and meters*).

The FMA has also identified the maintenance regimes (maintenance and renewal) required to mitigate the risks of levels of service failures by supporting decisions in how to apply different maintenance regimes (PM, CM and BM's) to prioritize and optimize the SWQTS maintenance and renewal program. The same process is currently being applied to other waterway asset classes such as erosion control structures, fishways and riparian vegetation.

Table 2. Failure Modes for various component assets of a wetland inlet for the nutrient and sediment tactical levels of service.

Functional Location	Failure Mode	Component Asset/s	Cause of Failure	Condition data	Inspection Frequency	Trigger levels	Management response
Inlet	Flows less than design enter wetland	Pipe Control pit Low flow weir	Blockage, sediment or litter	% blocked	Monthly	10%	PM Inspect and Clean
		Pipe Control pit	Collapse/failure	Y/N structural failure	Annual	Y	CM Repair
	Flows greater than design enter the wetland	Low Flow weir	Collapse/failure	Y/N structural failure	Monthly	Y	CM repair
		High flow weir	Blockage, sediment or vegetation	% blocked	Monthly	10%	CM clean
		Bypass Chanel	Blockage, sediment or vegetation	% blocked	Annual	10%	CM clean
Sediment Pond	Sediment passes through	Sediment Pond	Full of sediment Short circuit Undersized	% veg cover[1] Y/N Catchment ratio	3 yearly Annual One-off	60% Y <1%	PM desilt PM desilt Review
	Fine sediment captured	Sediment Pond	pond is oversized to its catchment	Catchment ratio	One-off	>1%	Review
Wetland	Low veg cover	Vegetation	various causes	% veg cover[1]	3 yearly	<80%	Renewal
		Wetland floor	Scour	% veg cover1	3 yearly	<80%	Renewal
		Wetland floor	Sedimentation	Y/N sedimentation	Annual	Y	Renewal
	Poor hydraulic flow	Wetland floor	Sedimentation	% veg cover[1] Y/N sedimentation	3 yearly	<80% Y	Renewal
		Porous rock weirs	Sedimentation/woody weeds	Water level	Annual	< 100mm	CM Repair
		Vegetation	Weed infestation	% weed cover	Annual	>10%	CM weed control
Outlet	ED too long	Outlet control (pit/weir)	Blockage	% blocked	Monthly	10%	PM Inspect and Clean
	ED too short	Outlet control (pit/weir)	Blockage	% blocked	Monthly	10%	PM Inspect and Clean

[1] % veg cover is assessed using Infrared imagery

Discussion

Applying asset management to waterways has largely been an exercise in translating NRM into asset management language, as the approaches and principles are otherwise very much aligned. As asset management is routinely used for civil, mechanical and electrical assets the benefits of adopting asset management for waterways will bring greater organizational acceptance and understanding of the waterways program. But not only has Melbourne Water been dealing with a language barrier, we have also introduced a new IT system for asset management MAXIMO, which has brought its own language interpretation complexity. Overcoming each of these linguistic barriers has proven fundamental to connecting people to the process changing the approach to waterways management (see Table 3).

In order for the asset management approach to deliver a more transparent, logical and optimized investment program, the fundamental asset information that underpins good asset maintenance and renewal decision making (including condition, failure modes, risk, criticality, management regimes, monitoring and costs etc.) is being improved, particularly for SWQTS. The failure mode analysis process has helped bridge the gap between NRM and asset management.

One of the real opportunities from the use of an asset management framework to building maintenance and renewal programs for waterways assets will be the ability to not only establish risk based programs of works, but also the ability to articulate the service gap risks of what risks are acceptable or won't be mitigated. These are the assets which are at risk of failing to meet levels of service but which won't be or cannot be mitigated in the investment timeframe due to constraints.

The Waterways SAMP is an interpretation of the HWS and therefore not entirely consistent with other SAMPS across the business. It was as much a change initiative as it was a functioning document in the short-term. It does however reflect the new organizational thinking of the 'service' that an asset supports while many existing SAMPs are overly asset performance centric.

The FMA for SWQTS has helped develop a process which will be rolled out to other asset classes across the business. The process has provided a logical link between levels of service and performance monitoring and resulting works programs.

For SWQTS the process highlighted:

- The need to test condition monitoring frequencies for a range of component assets and failure modes in order to refine and optimise monitoring and resulting corrective maintenance activities.
- SWQTs are a relatively new asset class for MW and as such understanding failure modes and responses has taken a few years to evolve. As AM principles were not being applied, the maintenance program was based on individual's perception of maintenance requirement rather than a strategic LOS based model.
- Solids techniques for condition data exist and through the FMA can be justified and routinely executed through work orders in MAXIMO.
- Levels of Service for amenity and local biodiversity still require some refinement as there is not yet an agreed position on the level to which we will manage systems for these outcomes.

Table 3. Translation of Asset Management (AM) into Natural Resource Management (NRM)

AM Terminology	NRM Translation	What's changing at MW
Continuous improvement (ISO 55000) Continuous improvement of assets, asset management activities and the asset management system	Adaptive Management – Monitoring, Evaluation, Reporting and Improvement eg DELWP MERI framework	A commitment to continuous improvement of the Asset Management Framework – ensuring continuous improvement across all aspects of managing waterway assets
Failure Mode Analysis - process of collecting and analyzing data to determine the cause of a failure	Threatening processes, conceptual models of cause and effect, predictive models, degradation and recovery curves	Consistent approach to describing how waterways 'fail' (or degrade) and which actions will have the greatest certainty of preventing or mitigating the cause
Level of Service - parameters which reflect social, political, environmental and economic outcomes that the organization delivers	Management Objective, target or goal	Translation of high level 'outcome' objectives/LoS into 'tactical' and operational LoS
Performance Monitoring Performance monitoring includes two components: • The assessment of whether level of service is being met; and • The assessment of the effectiveness of management regimes to deliver the level of service.	State of environment, broad condition monitoring, intervention monitoring, Output monitoring	All works triggered by asset condition monitoring and risk Annual evaluation and reporting
Asset Hierarchy - An asset hierarchy is the categorization of assets into tiered groups to help support their management.	No clear guidance, homogenous waterway reaches, Strahler order	MAXIMO requires a location hierarchy
SAMP - documented information that specifies how organizational objectives are to be converted into asset management objectives, the role of the AMS.	Implementation Plan for a strategy – no clear or consistent framework	SAMP outlines how waterways and associated waterway assets will be managed using Asset Management principles. Consistent ToC
Management Regime - the outcomes or plans that we use to manage assets to meet the level of service, such as maintenance plans, renewal plans, operational plans, education/engagement plans and guidelines.	Many ways of describing activities and management options	Defined activities, management regimes, including asset creation, renewal and maintenance – ie programmed, corrective or breakdown

Conclusion

Adoption of the Asset Management System for waterways is leading to changes in the way program planning is being undertaken and how works are executed through MAXIMO. Maintenance and renewal programs will be risk based and performance monitoring is being driven by clear levels of service and failure mode analyses. Based on these new and disciplined asset management approaches, certain waterway asset classes (eg erosion control structures) will be managed differently going forward. The organizational quality of waterway asset information will be greatly enhanced and elements that have never been monitored before will have condition data. AMIS, MAXIMO, will be used to store not only information about on-ground works (as it was in the past) but will house a range of asset information, including management objectives (levels of service) for each asset, condition data and threshold levels. Service Requests will be raised when asset condition data exceeds a threshold and works orders for Corrective Maintenance will be issued. Over time this information will become invaluable for future program planning, optimization, annual State of Assets reporting and funding bids (eg 5 yearly Price Submission to the Essential Services Commission).

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