DATA: WE HAVE LIFT-OFF

Stuart Joyce, Australian Manager, Morphum Environmental

Dean Watts, Director, Morphum Environmental

Barry Carter, Service Delivery Manager, Morphum Environmental

Abstract

Before we can take flight for the future, we need a strong launching pad to start from. Understanding the quantity, location and condition of assets is an essential starting point for the implementation, development and maintenance of a successful asset management system.

While all local government bodies across Australia and New Zealand will have undertaken some level of data collection projects in the past decade, too often the outputs will now be considered out of date, inaccurate, in the wrong format or occasionally locked away in a spreadsheet on the c: drive of someone's computer who left 5 years ago.

Some Councils will have the funds to regularly redo these assessments, but often this is considered to be too hard, too expensive or a combination of both. As a result, assets such as drainage infrastructure and water sensitive urban design devices, which may not be easily assessed or accessed are often left in the too hard basket.

This paper discusses:

- Cost effective methods available for identifying and prioritising data collection projects needed to launch or refresh successful asset management systems.
- A range of low cost GIS data collection tools and processes that can be readily used both internally by Council staff as well as externally by consultants, to undertake the assessments.
- Examples of how such data can be easily displayed and utilised in the GIS environment.

Key Words: Data capture, GIS, Council, Asset Management, Asset Register, Metadata, Spatial, Data

Introduction

Morphum Environmental is an environmental engineering consultancy, with over 15 years of experience in data capture, GIS and environmental engineering.

During this time, we have worked with a wide range of clients around Australia and New Zealand of varying sizes. No two councils are the same, but there are often similar messages when it comes to asset management and data capture.

Data capture can be the largest element of an asset management program, sometimes accounting for up to 90% of the establishment costs (IIMM, 2015).

Based on our experiences with a variety of councils across Australia and New Zealand, a lack of time, money, priority or ownership regularly come through as reasons for not undertaking data capture for these assets.

An Asset Data Collection Benchmarking survey was undertaken by Colac Otway Shire Council in April 2017(refer table 1) through the IPWEA “Ask Your Mates Forum”. The survey of 33 local government agencies across Australia showed, that of the main asset categories managed by councils, stormwater drainage, along with recreation & open space assets, are the asset categories least likely to have complete data capture (Colac Otway Shire Council, 2017).

Table 1:Summary table from the Asset Data Collection Benchmarking Survey by Colac Otway Shire Council

	% of surveyed Councils with All assets mapped	% of surveyed Councils with Some assets mapped	% of surveyed Councils with no mapping for any assets
Roads (sealed)	85%	12%	3%
Roads (unsealed)	82%	14%	4%
Bridges & Major Culverts	79%	15%	6%
Buildings & Facilities	64%	27%	9%
Stormwater Drainage	61%	30%	9%
Recreation & Open Space	55%	42%	3%

This may be due to the “out of sight, out of mind” approach to underground assets, or sometimes just the sheer scale of drainage assets that are managed by Councils making it a seemingly overwhelming task to undertake.

As such, this paper provides some background on the key elements to consider when looking to start a data capture project, as well as some cost effective methods available for the identification and prioritisation of data capture for stormwater drainage assets.

What Do You Know?

In order to determine what level of data capture should be undertaken, councils need to identify what they already know.

An effective approach is to apply a “health check” of the system, to take stock of what information already exists, ensure it is in a single location and then assess the quality of that information. As with all health checks, the more regularly they are undertaken, the less daunting they are.

The structure of a health check will vary between Councils, largely based on the maturity of their asset management system. The following tasks give an outline of some of the checks and tasks that can be undertaken.

Collate Existing Data

Understanding what data is available is a critical step before undertaking any data capture projects. Councils commonly undervalue the existing data they have from previous assessments. Whether it be a street scale assessment, capturing data on a few key stormwater pits that have a history of flooding, or a city wide condition audit of all the garden beds, all captured data can provide some level of value when determining what level of additional data capture is required

Data can be found in a multitude of data sources and formats, including Geographic Information Systems (GIS) geodatabases, hardcopy plans, photos, aerial photography, CCTV inspections, financial asset registers or often in simple excel spreadsheets.

Develop/update the asset register

Joining this data into a single source, the asset register, is an essential task to be undertaken. The asset register may be in a simple format such as an excel spreadsheet or database, or stored within an asset management software package.

The level of detail included in the register will vary between councils, based on resourcing capabilities to establish and maintain the register and the specific purposes the register is intended to fulfil.

It is equally important to maintain control of the asset register with strict ownership and access rights to the information. Poor data management when entering data into the asset register will greatly restrict the ability to undertake a meaningful assessment of the outputs. Simple tools such as dropdown menus can assist greatly in mitigating the risk of poor data being captured within the asset register.

Include Metadata

Another key factor in combining data from a range of sources, is ensuring that the level of confidence in each piece of data is recorded. This is done through metadata; data which describes and gives information on the asset data.

The level of confidence of each data source needs to be determined by council staff. The International Infrastructure Management Manual 2015 (IIMM 2015), recommends the following confidence grades to be applied:

Table 2: Data Confidence Grading System (IPWEA, 2015)

a) Highly Reliable	Data based on sound records, procedure, investigations and analysis, documented properly and recognised as the best method of assessment. Dataset is complete to +/- 2%
b) Reliable	Data based on sound records, procedures, investigations and analysis, documented properly but has minor shortcomings, for example some data is old, some documentation is missing and/or reliance is placed on unconfirmed reports or extrapolation. Dataset is complete and estimated to be +/- 10%
c) Uncertain	Data based on sound records, procedures, investigations and analysis which is incomplete or unsupported, or extrapolated from a limited sample for which grade A or B data are available. Dataset is substantially complete but up to 50% is extrapolated data and accuracy estimated +/- 25%
d) Very Uncertain	Data based on unconfirmed verbal reports and/or cursory inspection and analysis. Dataset may not be fully complete and most data is estimated or extrapolated. Accuracy +/- 40%
e) Unknown	None or very little data held

This confidence rating is critical in the overall assessment of the data and in helping to identify areas that could be prioritised for targeted data capture.

See the whole picture

Once the asset register is populated, representing the data spatially can provide a much better understanding of the quantity and quality of the data available.

GIS software has progressed significantly over the past decade and should be used as a key tool within any asset management system to spatially represent the asset register.

Basic GIS tools can be utilised to turn an asset register in a spreadsheet or database format with x & y coordinates or street addresses, into spatial geodatabases that can be combined with other GIS tables to provide a visual representation of the existing data right across the catchment.

Visual representations can range from simple mapping of the location of asset where significant gaps in the data can be identified, through to thematic mapping of assets with and without key attribute data included.

Health Check

When the asset register is populated with all the available information, and a spatial representation of it is in GIS, a basic health check can quickly be undertaken.

By identifying significant data gaps both in attributes in the asset register and spatially in GIS, the outputs of the health check will be the identification of key areas for improvement.

What Do You Need to Know?

In an ideal world, councils would have budget to go inspect and map every asset, but in a world of rates capping and limited budgets, this is often not feasible.

The health check of data will provide a good, basic level of understanding of where there are data gaps. Further spatial assessments can subsequently be undertaken on the updated asset register to provide additional analysis unable to be achieved through visual inspections. Through the use of innovative GIS tools and methods, data can be analysed on a whole-of-council or catchment scale with the click of a button.

Large scale spatial assessments

Local planning laws and requirements should be utilised when developing rules for wide-scale spatial analysis.

For example, utilising legal point of discharge requirements where a stormwater outlet point needs to be identified for an individual property. An analysis can be run to identify all properties not within a reasonable distance (30m) of an acceptable stormwater discharge point, i.e. public stormwater network, waterway or viable kerb & channel discharge. Where multiple properties in an area are highlighted as a result of this analysis, consideration should be made for undertaking data capture to identify where connections are viable.

Risk assessment

An alternative approach is to consider the data that Council needs from a risk perspective, rather than the overall data it doesn't have. Risk is an assessment of different consequences (or impacts) coupled with what their respective likelihood (or probability) of occurring is.

For stormwater assets, the consequence is typically associated with the impact of flooding as a result of failure. For example, flooding impacts to major roads or essential facilities (hospitals, emergency services, schools etc) will potentially have high consequences and therefore should be considered critical.

To classify critical (and non-critical) stormwater assets, specific asset factors such as type and size/diameter of the assets, or location factors such as the asset's proximity to other critical services are identified based on drivers identified in workshops with key stakeholders at Council. By applying weightings to each of these factors, criticality scores can be prepared assigned to every asset in the dataset.

Thematic mapping, as can be seen in Figure 1, gives a visual representation of all the assets, coloured by their respective criticality score (most critical (red) to the least critical (light green)).

By using this approach, Councils can focus on targeting the critical assets within their municipality for data capture over those which have been identified as non-critical.

As the data set improves, so does the criticality model. As more data is captured and added to the model, i.e. condition ratings, the outputs of the model will also improve. This allows further studies to be undertaken including the prioritisation of maintenance and capital works and sensitivity analysis

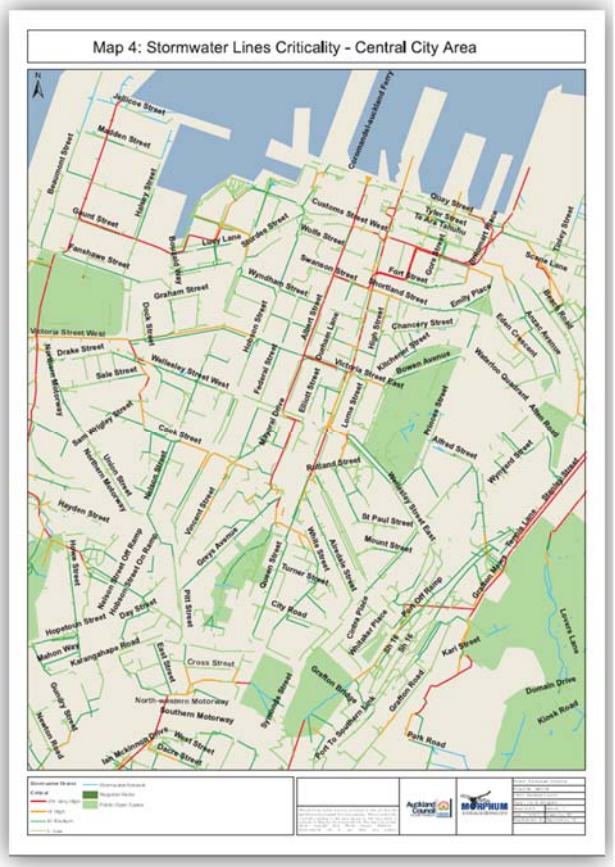

Figure 1: Thematic mapping of critical stormwater assets (red- most critical, light green- least critical) (Morphum, 2013)

How Do You Get There?

Direction should be taken from business drivers such as the Asset Management Strategy and Policy, as well as internal considerations of budget and resourcing on how to fill the identified data gaps.

It is important to identify how much additional data is required to do this. Collecting too much data or too little data can both be expensive mistakes to make. A good asset hierarchy will assist in defining the scope of works.

Similarly, a hierarchy of data capture processes should also be considered when identifying how to fill the data gaps. Data capture can be completed on-site, but consideration should also be made for desktop based assessments.

On-site data capture (i.e. surveying, CCTV inspections) is typically the most expensive process, but will produce the data with the highest confidence. However, consideration needs to be made for the current and future uses of the data. As an example, the data confidence levels for Councils using drainage data for hydraulic modelling will need to be much higher than Councils simply meeting their legal requirements with valuation.

Another point to consider, is the wealth of knowledge of the local assets attained by Council Contractors. They are the eyes and ears of any Council, and with data capture systems setup correctly, can provide a cost effective solution for data capture while already in the field.

Councils requiring cost effective and quick solutions to plug initial data gaps should also consider their options with desktop based data capture. This data will typically be flagged with low data confidence, but as budgets and resources allow, it can be replaced with high confidence data captured on-site.

However, consideration needs to be made to ensure there is not too much low confidence data or data that does not fit the combined needs of Council. When end users don't have sufficient confidence in the overall dataset, it can lead to users creating their own personal datasets and spreadsheets, and repeating work completed by others.

Finding the right balance between high cost, high confidence data capture and low cost, lower confidence data capture is the key to a successful data capture program, and the asset management system overall.

Below are some examples of the range of high and low cost solutions for data capture.

Digitisation of plans

Stormwater drainage plans can vary significantly in age, quality and accuracy, but even a poor plan can provide some value in the development of an asset register.

GIS software is readily available to all Councils, from free packages such as QGIS through to the extensive suite of innovative solutions on offer from ESRI.

Simple GIS tools now allow drainage plans to be easily overlaid over aerial photography (refer Figure 2) and aligned by property boundaries and other known assets. Once in place, pit and pipes can quickly be digitised into GIS as points and lines, as well as recording all key asset attributes.

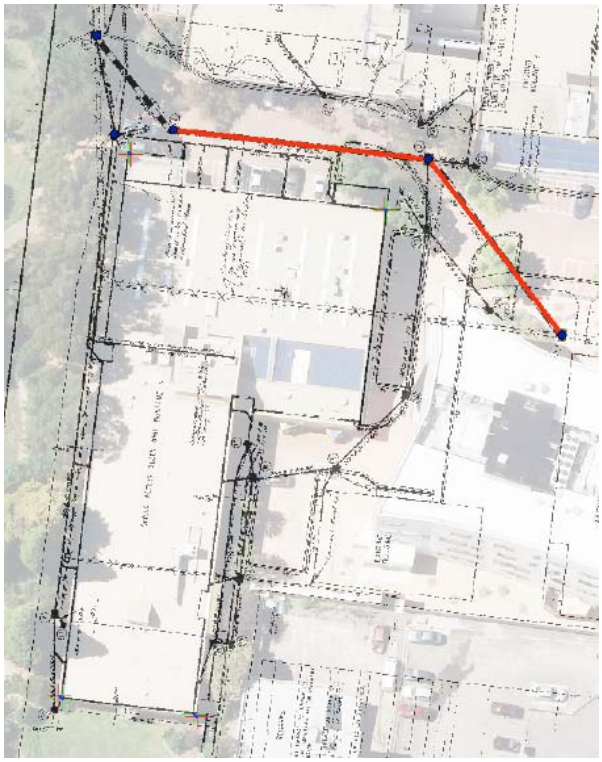

Figure 2: Drainage plan overlaid over aerial photography. Pipes (red lines) and pits (blue points) are digitised by tracing over the plan (WCC, 2013)

Data confidence will vary between the type and age of the drainage plans that are being used. While a recent As-built would likely be considered highly reliable, a fifty year old plan with imperial measurements will have a lesser level of confidence. However, by considering the quality of the data and mapping, these older plans may provide a good level of accuracy, suitable for inclusion into the asset register particularly where no other information is available.

The time and resources required to capture data from existing drainage plans, is significantly less than undertaking field assessments. Digitising all available drainage plans can be a cost effective means of creating the building blocks of a stormwater asset register.

Engineering Judgement

Engineering judgements apply local knowledge and understanding of the drainage network through innovative GIS tools to fill data gaps.

Engineering judgements can range in scale and complexity, based on the requirements of each council.

Examples of engineering judgements applied for stormwater assets include:

- All pits are assumed to be 1m deep unless existing data shows otherwise
- Where upstream and downstream sections of a pipe are both 225mm concrete pipes, an assumption can be made that the middle section will also be 225mm concrete pipe.
- Pipe grades and levels assumed based on ground levels, pit depths and surrounding asset attributes
- Reversing the grade of pipes that are shown to be flowing up hill.

The intention of this approach is to focus on the big picture, and build a network that is connected and flowing in the right direction (refer Figure 3), with all engineering judgements flagged.

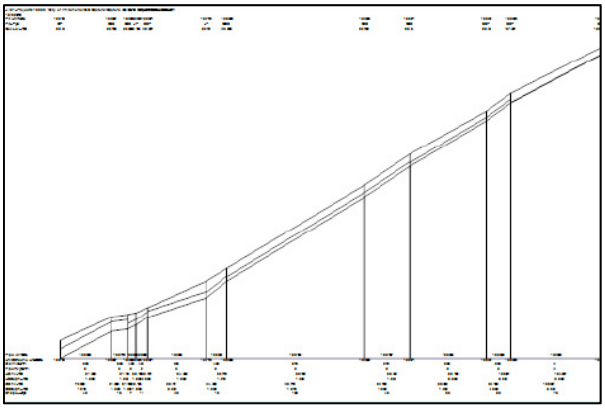

Figure 3: Connected lengths of stormwater pipes all connected and flowing downhill (WCC, 2013)

Utilising engineering judgement to fill data gaps is a low cost, but also relatively low confidence solution. It is typically suitable to

provide plugs until budget can be found for higher confidence solutions.

Field assessments

The method used for field assessments can vary significantly depending on the data required.

Basic validation of pit lid locations and heights can be done rapidly without the necessity to open lids. This approach will only provide the bare basics of an asset register, and would likely need to be supplemented with good quality drainage plans and a number of engineering judgements applied.

Costs in field assessments increase significantly if access is required to verify pipe attributes and connections. Where pit access is easy i.e. footpaths and nature strips, this can be a relatively simple project. Costs increase further when traffic management is required to access pits as well as when any pits need to be assessed in private properties.

Properties with difficult access highlight the benefits of utilising all existing data before having to open pits. If drainage plans cover the area well, it may then be a case of verifying a couple of pits to ensure the attributes and connections from the plan match with what is on the ground. This will determine the level of confidence in the plan and whether further pits need to be accessed.

CCTV inspections are typically the most expensive form of assessment but will provide the highest value data for drainage assets, including condition ratings. Given the cost of undertaking individual CCTV inspections, criticality models as discussed earlier, can provide a very useful tool for prioritising how budget is spent on CCTV. Consideration can also be made of multiple benefits. For example CCTV may be used to gather data for modelling, to check connectivity, to check general asset condition and to check for operational issues such as defective laterals and blockages.

Field assessments are the most costly form of data capture, but are also the most accurate. In order to reduce costs, they should be used in conjunction with the desktop assessments.

Conclusion

A lack of time, money, priority or ownership regularly come through as reasons for not undertaking data capture for these assets.

However, cost and resource effective solutions are achievable if the scope and scale of the project is known.

An effective approach is to apply a “health check” of the system. This involves taking stock of what information already exists, by collating it into a single location (asset register), and assessing the quality of and confidence in the data.

Large scale spatial assessments can be completed using GIS tools to identify data gaps across the municipality to target for data capture. Alternatively, a risk based approach can be applied which focuses on prioritising critical assets for data capture.

It is important to identify how much additional data is required once the scale of data capture has been determined. Collecting too much data or too little data can both be expensive mistakes to make.

A hierarchy of data capture processes should also be considered when identifying how to fill the data gaps. On-site data capture (i.e. surveying, CCTV inspections) is typically the most expensive process, but will produce the data with the highest confidence.

Councils requiring cost effective and quick solutions to plug initial data gaps should consider desktop based data capture including digitising drainage plans and making engineering judgements. This data will typically be flagged with low data confidence, but as budgets and resources allow, it can be replaced with high confidence data captured on-site.

Finding the right balance between high cost, high confidence data capture and low cost, lower confidence data capture is the key to a successful data capture program, and the asset management system overall.

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Author Biography

Morphum Environmental is an environmental engineering consultancy, with over 15 years of experience in data capture, GIS and environmental engineering.

The content of this paper has been developed through our practical experience for a range of clients in Australia and New Zealand. We provide a unique skillset in our with our experience in taking projects from data capture, data analysis and asset management processes, right through to concept and detailed design. This understanding of the complete needs of the asset lifecycle is essential in providing our clients with the best overall outcomes.

We have completed data capture methodologies for a range of asset classes including Stormwater, Roads, Bridge & Pedestrian Structures, Building Facilities and Open Space.

Our data capture experience includes the assessment of stormwater pits/pipes, stormwater outfalls, overland flowpaths, flood affect floor levels, water sensitive urban design assets, stormwater ponds, waterways and streams, vegetation, wastewater and reticulated water manholes and pump stations, open space & parks assets and cemeteries.

Please contact Stuart Joyce (stuart@morphum.com) for any further information on our services or on the information presented in this paper.