

Evidence-based Investment Decision Making for 3 Waters Networks (Pipe Renewals) – Developing the National Pipe Data Portal

For a few years now the Quake Centre has been interested in tackling issues related to the investment, service delivery and resilience of New Zealand's underground infrastructure with a particular interest in the management of 3 waters assets. The Centre has a number of activity streams ongoing including: applied research and the development of guidelines, standards and tools with a focus on smarter ways of tackling problems from a coordinated, national perspective. The aim is to assist local authorities to make local decisions based on sound data and in a way that reflects national best practice.

A couple of key projects are the furthering of the NZ Asset Metadata Standards (NZAMS) and the creation of a National Pipe Data Portal.

Pipe Renewals Project and NZ Asset Metadata Standards

The Pipe Renewals project is a collaboration between the Quake Centre, Water New Zealand and IPWEA (NZ). It is joint venture project aimed at helping councils make better decisions around when to replace water pipes with the potential to save millions of dollars.

The project has many facets and recently activity has merged with the development of the NZ Asset Metadata Standards (NZAMS). The purpose of the NZAMS is to develop and facilitate the implementation of common data standards across NZ in roading, 3 waters and light commercial and residential buildings.

One of the major planks of the Pipe Renewals project and the NZAMS is the National Pipe Data Portal.

National Pipe Data Portal

The National Pipe Data Portal is a plan to allow data sharing across NZ. The purpose of the National Pipe Data Portal includes:

- The use of larger datasets to better understand the attributes of NZ's pipe networks and to create improved models to manage these networks
- Providing a national picture on the state of, and associated risks to, NZ's pipe networks
- Developing ways of better managing asset data
- Developing national and local alignment with the NZ Metadata Standards and inform the development of those standards.

Hosted by

- Developing a pathway to nationally consistent Digital Engineering processes including design, consent, handover, long-term management.
- Enabling experts from different councils and agencies to work collaboratively on problems that affect many councils across the country.

It is hoped that the Pipe Portal will become a layer of a National Digital Infrastructure Model that will allow similar benefits to be shared across all of NZ's assets. Creation of the Portal is partly funded by the Building Innovation Partnership.

Building Innovation Partnership (BIP)

The BIP is a Quake Centre initiative that is funded 60% by the Quake Centre's industry partners and 40% by MBIE. Theme 1 (of 3) of this initiative is focused on better investment decision-making with a particular focus on the 3 Waters pipe networks. This theme is being led by Theuns Henning from the University of Auckland. Currently 5 projects have been initiated:

1.1 Pipe Condition Technology Assessment

Objective(s): Review technologies for in-situ assessment of pressure pipe condition.

1.2 National Infrastructure Model

Objective(s): Develop digital twin and metadata standards for New Zealand's infrastructure.

1.3 Data, Metrics and Reporting for Wastewater Pipe Networks

Objective(s): Develop improved models for residual life, failure risk and costs of pipes.

1.4 Holistic Decision-Making for Three-Waters

Objective(s): Develop holistic framework for three-waters investment decision-making, including: economic, environmental, cultural and social dimensions, and well-being.

1.5 Strategic Review of Procurement of Three-Waters

Objective(s): Understand the key issues faced by industry for the procurement of three-water assets and benchmark practice in New Zealand with other countries.

What has been done on the Portal to date?

The National Pipe Data Portal is a testing ground for a number of activities. Over the summer, a group of Masters of Applied Data Science (MADS) students from the University of Canterbury undertook internships at councils around the country. Three students worked with Christchurch City Council, Tauranga District Council and Auckland Council – Healthy Waters. Their project was to:

1. Assess the quality of the councils' storm water data both internally and against an external standard.

- Map the councils' data to the external standards and federate the data by use of that standard.

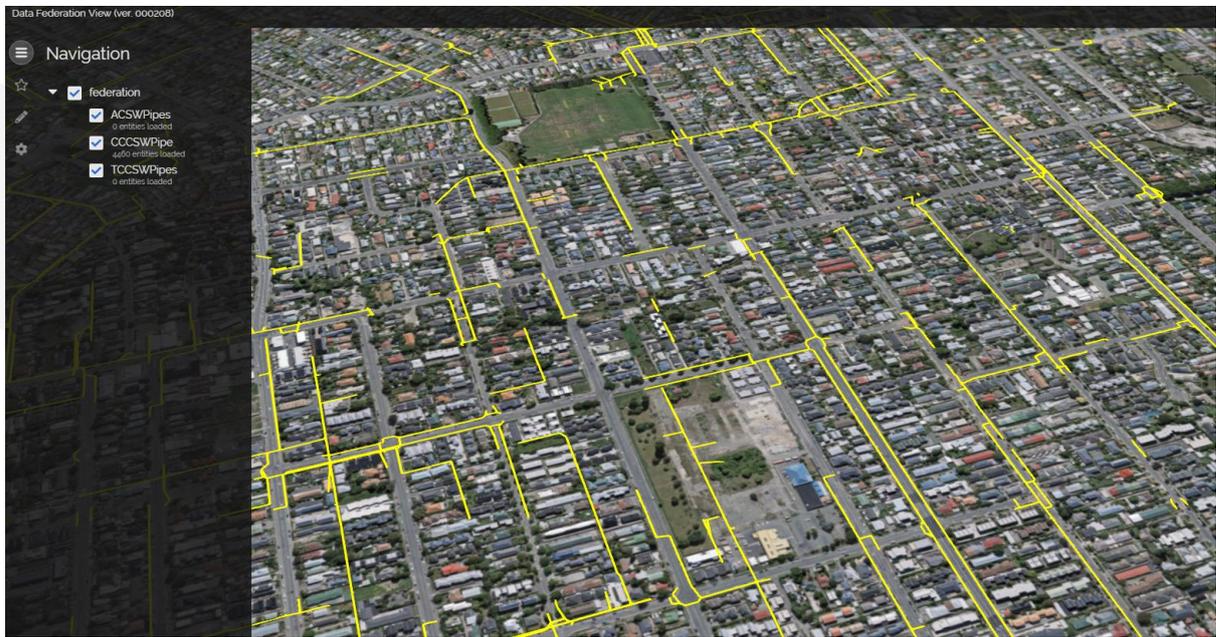


Figure 1: Federated view of storm water pipe data using Nextspace's Bruce software

- Visualise the data as a single entity and runs some basic queries across the federated data set.

This project was proof-of-concept for the Pipe Portal. Its successful completion showed that asset data from disparate sources can be mapped and federated to a single view using a standards-based approach. It showed that there is not necessary to change the data at source. Rather, the data can remain in its native form and native environment. Any mapping, federation and analysis can be done on the fly whenever needed. The data analysis was done using number of tools and scripts developed by the students. Federation, visualisation and simple queries were done in Nextspace's *Bruce* software.

Bruce Entities Explorer

Analytics ▾ Names ▾ Filter By ▾

Name	Minimum	Mean	
Nominal diameter in mm	0	333.57308886289076	999
boundaries.maxLongitude	0	174.05513725511517	176
location.latitude	-43.88714021979651	-39.20259221116364	0
To Asset- Upstream RL at base of pipe in meters (m).	0	1.5924478202830727	275
boundaries.minLongitude	0	174.05495141155274	176
At Asset- Downstream RL at base of structure in meters (m).	0	0	0
Average burial depth to invert of pipe	-9.1	9.073687431825078	174
boundaries.maxLatitude	-43.887135363606056	-39.20252084348362	0
boundaries.minLatitude	-43.88714507598695	-39.20266359003045	0
Internal Diameter Post Treatment	0	2.8194470804074143	130
Length of the pipe	0	25.376798926586343	116
location.longitude	0	174.05504434371127	176
Total: 453879 items			

Figure 2: Simple analytics across federated data

β-Version of the National Metadata Standard

The external standard that the MADS students work towards was the β-Version of the National Metadata Standard. This is an evolution of the LINZ Standard for 3 Waters published in 2017. Some significant work has been done on this standard improve its structure and correct some of the outstanding errors in the first publication. Much of this work was done by Graham Clark, formerly of CCC and now Fulton Hogan.

The aim is to evolve this standard further by capturing any lessons learnt during the MADS project and also creating a working group to ensure review and applicability by a range of councils and organisations. This will include a recommendation of what should be core data, and what is considered supplemental. This will be in line with the International Infrastructure Management Manual's levels of maturity.

In the first instance this scope will be limited to reticulation assets as this is where the greatest value lies. It also is where there is the greatest need for a collaborative approach with other asset types. The aim is to publish Version 1 around the middle of 2019, in line with the publication of NZTA's roading standard.

Planning for the future

Data is becoming an increasingly important asset for owner, managers and operators of 3 waters network with a large knock-on effect to the rate-payer and consumer. With this in mind, the Quake Centre intends to keep facilitating the development and implementation of data standards across NZ. As a consequence we would like to have 80% of councils involved over the next two years and all councils and all 3 waters asset classes within five years. This is a big task in which we hope to have the continued assistance of our partners. Who knows – maybe Central Government may even help?

Investigating Maintenance and Operational Data

In addition to the work undertaken to test the National Pipe Data Portal, there were also a couple of MADS students based at Wellington Water. Their project involved analysing Operation and Maintenance (O&M) data for a couple of the councils in the Wellington region. The aim was to develop some analytics to compare Maintenance and Operations activity across a number of suburbs to develop an understanding of problem areas in regards to O&M. Despite limited data these produce some result that were useful for Wellington Water. This work will continue as more data becomes available.

This project clearly demonstrated the value of data and data analytics across a network. It also highlighted the limitations caused by only having access to limited data sets. This is one of the key aspects that the National Pipe Data Portal plans to address.

Wastewater Renewals Framework – Gravity Pipelines

One key output from the Pipe Renewals programme is the *Wastewater Renewals Framework – Gravity Pipelines* guidance document. This has recently been published and is available from the Quake Centre’s resource portal or Water NZ. This guidance has been developed by Philip McFarlane from WSP-Opus with input from a wide range of industry players.

The Renewals Framework developed in this document provides a structured process that organisations can use to plan renewals. The Framework shows how organisations can use existing data in a meaningful way. Importantly, the Framework can be scaled and modified to suit the needs of an organisations.

The Renewals Framework draws on processes and information described in the International Infrastructure Management Manual, New Zealand Asset Metadata Standards (NZAMS) and the University of Canterbury Pipeline Renewal Programme. While this document is closely aligned to the NZAMS, the advice provided can be applied independent of the NZAMS.

Further information

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