

A THREE WATERS VISION FOR DUNEDIN

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Abstract

With the completion of a number of substantial water and wastewater infrastructure projects in recent years, which were the result of strategic decisions made in the early 1990's, the time has arrived when a new strategic direction is required for the City of Dunedin.

This paper presents an overview of how the City of Dunedin is developing a long term strategy for the future management of the three waters (water, wastewater and stormwater). The strategy suggests an integrated approach to dealing with the decline in service performance that would otherwise be evident in a network of ageing infrastructure and is also expected to meet the new 21st century challenges of increased community expectations, a more stringent regulatory environment and climate change.

With the project now well in progress, the paper will describe the approach taken by the team to confirm levels of service, to build and calibrate the strategic models and develop a framework for the catchment management plans for the city based on an initial pilot study. Later stages of the project will include the development of master plans outlining a programme to address system deficiencies at each of the future planning scenarios and identifying prioritised areas for further investigation work, using an integrated decision-making approach.

Key Words: Three Waters Master Planning, Climate Change, Sustainability, Optimised Decision Making.

Introduction

Dunedin on the east coast of New Zealand's South Island experienced rapid growth in the late 1800's during the "Goldrush". Some infrastructure dating back as far as 1860 is still in service with approximately 173 km of wastewater pipes older than 100 years and 850 km water pipes older than 1930, many of unknown age. It is evident that often age bears little relationship to pipe condition.

With the completion of a number of substantial water and wastewater infrastructure projects in recent years, which were the result of strategic decisions made in the early 1990's, the time has arrived when a new strategic direction is required for the City of Dunedin.

In this paper we will present a phased method of determining the appropriate capital and renewals response to ensure that the future investment in the infrastructure is appropriate, optimised, sustainable and affordable, utilising a range of modelling tools and multi-criteria decision-making techniques.

A Business Improvement Strategy

In order to drive the necessary investment programme, Dunedin City Council (DCC) has

developed an integrated asset management approach and has embarked on a business improvement project in order meet its capital and operational delivery targets.

The process has two main components. The first being a review of the existing structure of the Water and Waste Services business unit and the second being to undertake a significant Three Waters Strategy Study that includes the development of hydraulic models to examine the entire water cycle within Dunedin's urban catchments and to provide critical information on the performance of the networks.

A Restructure of the Business Unit

Running in parallel with Phase 1 of the Dunedin Three Waters Strategy Study was a fundamental re-structuring of the DCC Water and Waste Services business unit.

The removal of the previously prominent operational "silo" based structure and introduction of an integrated "Three Waters" strategic structure was seen as key to the future success of the business unit. The nature and requirements of the "Dunedin Three Waters Strategy Study" would serve to reinforce this new approach and there is no

doubt that the study has helped to reshape the operating philosophy of the Water and Waste Services business unit. This has perhaps been the most significant benefit of the project outside of the key project deliverables.

Integration and streamlining of business systems and processes as well as the personnel has been a key objective of the restructure.

A Collaborative Approach

Promoting a collaborative and inclusive approach was identified as key to ensuring the success of the Three Waters Strategy project. Given that tenders were received from six strong consortia, this proved to be a principal criteria used for selecting the consultant team to work with DCC on the project.

In December 2007 DCC appointed a consultant team lead by Opus International Consultants (Opus) to undertake the project. The consultant team comprised Opus and URS New Zealand, and sub-consultants would be appointed throughout the project to undertake specialist tasks such as flow monitoring and stream assessments. Additionally, Metrowater (a Council Controlled Organisation from Auckland City) were appointed as “industry advisors” to the project and Beca were appointed as “project reviewers”.

As the Water and Waste business unit was being re-organised during Phase 1, a number of new and often inexperienced staff were joining the DCC team as the project progressed. It was essential that these new team members were able to draw upon and learn from the knowledge and experience of the combined project team, and a collaborative approach and willingness to share knowledge was essential.

Guiding the Project

A Project Control Group (PCG) was formed that would provide guidance and strategic direction throughout the project. The PCG would meet monthly and comprised key members of the DCC Water and Waste Services business unit together with representatives from the consultant team, the industry advisors and the project reviewers.

Open discussion and a shared desire to achieve a successful outcome for the project have proved to be the hallmarks of the PCG.

Project Drivers

A number of key project drivers were identified, which included;

- Reviewing and setting appropriate Levels of Service
- Developing an optimised investment plan for network renewals
- Building multiple redundancy into the networks where appropriate
- Optimising the operation of the three networks
- Investigating alternative water sources and demand management as a water conservation tool
- Investigations of future water storage options
- Sustainable solutions and inter generational equity
- Integrated catchment management planning
- Protect the environment and prevent sewer flooding incidents

A Three Phased Approach

It was decided to adopt a three phased approach to the study.

- Phase 1 – Developing Strategic level Water and Wastewater Models, Capital Works Masterplans at Strategic Level and a Pilot Catchment Management Plan
- Phase 2 – Detailed investigations Capital Works Masterplans extended to reticulation level, – complete remaining Catchment Management Plans
- Phase 3 - Construct projects & continued iteration and refinement of phases 1 & 2 - Improvement in accuracy of expenditure profiles

Using a phased approach, starting with the development of strategic level models, meant that early benefits could be gained using existing knowledge complimented with an appropriate level of additional network data. The results of the first phase would prioritise areas of further study in subsequent phases, which will involve more detailed investigations.

What is an Integrated Solution?

In the original Three Waters Vision statement it was established that the strategic objectives of the business unit could only be met by understanding the entire water cycle within the city environment, which would require an integrated approach to catchment management and infrastructure planning as each of the three water states has an influence on the other in some way.

However at the start of the Dunedin Three Waters Strategy Study it is fair to say that neither DCC nor the consultant team had a clear understanding of what “integration” meant in practice, with respect to the project and for the wider operation of the newly restructured DCC Water and Waste Services team.

A key outcome for the Dunedin Three Waters Strategy Study as a whole is to develop optimised and integrated solutions across the Three Waters as far as is practical – but what does this mean and what is practical? A series of workshops have been held which have resulted in a clearer understanding of the potential for the project to deliver integration across a number of areas. These were summarised under a number of sub-headings including;

- common business systems,
- growth and planning,
- modelling,
- innovative solutions,
- understanding interactions and
- common 3 waters issues.

Significant progress has been made in many of these areas within a short space of time, through the business improvement process and as the Three Waters Strategy Project has progressed.

Whilst the processes of integration in the context of the project are now better understood, the potential for a more integrated set of capital investment decisions will only really be possible during the later stages of the project. For example, as the team gains a better understanding of system demand, growth potential and the predicted effects of climate change on the principal water sources, the need for demand management, grey water re-use or stormwater harvesting may become

essential or may be demonstrated as unnecessary and/or uneconomic.

Setting Appropriate Levels of Service

One of the first defined objectives of the project was reviewing the agreed Community Outcomes, setting appropriate Levels of Service (LOS) and detailing Key Performance Indicators (KPIs).

The Community Outcomes were essentially defined by consultations and development of the Long Term Council Community Plan (LTCCP) and LOS targets are to a certain extent driven by these agreed Community Outcomes, DCC’s Strategic Objectives and the community’s willingness and ability to pay. A wide range of Activity Management Plans from other New Zealand Territorial Authorities were reviewed to determine typical Levels of Service adopted across the Country.

New Zealand and Australian benchmarking data was also reviewed, enabling DCC to set a target level for performance that would be both appropriate and affordable for the City of Dunedin.

In developing the capital works investment programme, the sensitivity to LOS targets was to be investigated using the hydraulic models, enabling more informed decision making and providing surety in investment decisions and equity for the current and future generations.

Prioritisation and Optimised Decision Making

A key part of the Phase 1 works was to develop an Integrated Decision Making (IDM) process. This would allow issues to be ranked against a risk based framework and for resulting projects to be scored based on their benefit related to the agreed Community Outcomes and prioritised across the three waters. Indeed, if this process proved successful it was likely that this could form the basis for project prioritisation across the Council as a whole.

“Issues” were identified in a number of ways. Firstly, detailed discussions were held with the system operators, who were encouraged to share their knowledge and experience gained from running the systems over many years. Secondly, system performance information was collated and analysed. This information included records of customer

complaints for low or high pressure or poor water quality, bursts, sewer blockages, sewer/stormwater overflows etc. These were geo-coded and entered into the GIS system and imported into the hydraulic models for more detailed analysis. System deficiencies were identified through analysis of the hydraulic models under current and future demand conditions.

Once the issues had been identified the question was posed “does this cause a problem (related to one or more LOS criteria)? If no apparent problem was evident the issue was recorded in the “System Performance Report” and no immediate action was taken. If a “problem” was identified the issue went forward for a risk analysis.

The risk was assessed against an agreed scoring methodology and the problem was classified as “manage actively” or “manage passively”. For those classified as “manage actively” a range of potential solutions were developed and discussed at workshops held with DCC operations and planning staff. Each Option was scored in terms of their effectiveness to solve the problem and on their benefit related to the agreed Community Outcomes and the quadruple bottom line of the “Four Wellbeings” (Cultural, Environmental, Social and Economic). Finally, budget costings were developed for the favoured solutions which could then be ranked across the three waters and a prioritised staged capital investment programme established. This staged capital plan would form the cornerstone for the future “Activity Management Plan” (AMP). For the first time it would be possible and indeed desirable to create a single integrated AMP covering the three waters.

This prioritisation across the three waters marked a fundamental shift away from the previous policy whereby each of the waters was allocated a separate “pot” of money. In the future, a single budget covering all three waters could be adopted and the projects prioritised and programmed across the three waters in order of importance.

Integrated Modelling

One of the most interesting aspects of the project to date has been the integrated approach to the hydraulic modelling. At the commencement of the project a review of the

available hydraulic modelling packages was undertaken.

Key to the selection would be the ability of the modelling software to model water, wastewater and stormwater. An added complication was that modelling the raw water system was also added to the project, and this comprised a mixed pressurised and non-pressurised system.

It was also agreed that since a vast amount of system information was to be collated an asset management tool would be advantageous.

The InfoWorks modelling platform was selected as the most suitable common modelling platform for the project, and this was complimented by the InfoNet asset management system.

A single integrated, user-friendly common modelling platform would also provide the best long term solution for DCC as well as for the Three Waters Strategy project, since it was planned to have a small but flexible permanent modelling team as part of the Water and Waste Services business unit. Great care was taken to design the database architecture within the InfoWorks WS and CS models to ensure a co-ordinated approach was taken from the start. Good examples of this were developing a common node/asset naming convention and using a common set of data flags. Common background mapping was used and a single ground model developed. Essentially the look and feel of the models would be similar whichever of the waters was being modelled.

Throughout the modelling aspects of the study the modelling team would meet on a regular basis to discuss progress and ensure continued integration across the models. Additionally data and modelling results were to be shared, for example the total inflow into a zone and the calculated leakage from the water model were shared with the wastewater and stormwater modelling teams so that the inflow could be compared with the dry weather flow and inconsistencies could be flagged and further investigated if necessary. This level of co-operation and integration across disciplines is rare, perhaps surprisingly so, but proved to be very useful and once again demonstrated the benefit of the collaborative approach to the project. Particularly close collaboration between the stormwater and wastewater modelling teams

was also essential, as the “separated” system proved to be less separated than the team had initially been lead to believe! Workshops with the system operators and even the roading engineers helped to throw light on a number of issues, providing clarity for the modellers and the Water and Waste team and once again demonstrating how a project of this nature asks questions of an organisation and helps break down barriers and encourage co-operation across Council departments.

As the project proceeds the integration of the models will come to the fore, as inter-related issues are further investigated and integrated solutions are sought.

Climate Change and Sustainability

The long term effects of climate change are the subject of much debate, but it was considered essential to factor the best available data for the Dunedin area into the optimised decision making progress for this project.

The expected effects of climate change vary across the three waters and developing integrated solutions that would balance these different effects will ultimately be a key factor in defining the success of the Three Waters Strategy project.

It is expected that less rainfall/snowfall will be collected in the principal catchments used to supply water to the city, combined with increasing spells of hotter drier weather that could increase peak demands.

Key predictions for the stormwater system include potentially shorter storms of higher intensity together with rising sea levels which affect the discharge conditions. Additionally, sea water infiltration into the aging infrastructure in low lying areas would further reduce system capacity.

Saline water intrusion into the waste water system from rising groundwater levels would also impact on the capacity of the wastewater system and could significantly impact the treatment plant operation. High intensity storms would also impact in the wastewater system as it is evident from initial flow monitoring that there is a significant stormwater inflow through direct connections and overland flow entering through manholes. DCC has developed a corporate sustainability framework, which has recently been adopted as the basis for guiding/influencing all of

DCC’s core activities. Sustainability principles would therefore be integral to the Capital Works Master Plans for Water and Wastewater and the Integrated Catchment Management Plans which are the key output of the first two phases of the project. For example, strong emphasis has been given to developing operational rather than capital works solutions for problems wherever possible.

Project Progress

At the time of writing this paper, the Phase 1 works have been completed. Strategic level Capital Works Master Plans have been completed for Wastewater and Water Supply and the Pilot Catchment Management Plan has been completed.

The Phase 1 works identified areas of the networks where detailed investigations are required in the Water and Wastewater systems. This has formed the basis for the Phase 2 works which are now underway. Development of a Pilot Catchment Management Plan and city wide catchment prioritisation has lead to the development of a delivery programme for the remaining catchments which are to be completed during Phase 2.

Benefits of the project to date

The Three Waters Strategy Project has already delivered a number of significant benefits to the DCC Water and Waste business unit in a number of key result areas, including;

Financial Management

Improved economic outcomes are achievable through prudent infrastructure investments that are optimised to provide the best return on capital.

The business unit is better able to develop compelling business cases to support investment in new capital projects.

Customer Service

The project has enabled a clear line of sight between levels of service, community outcomes and the related costs.

It also provides a genuine opportunity for the public and community groups to meaningfully engage in the planning processes for the three waters.

Organisational Performance

From an organisational perspective, it has assisted in developing a robust and reliable strategic planning capability.

It simultaneously addressed many improvement initiatives that had been identified in the Activity Management Plans and the 2008 Asset Management Process Benchmarking project conducted by IWA & WSAA.

It has assisted the business along the path of developing advanced Asset Management techniques.

Environmental Stewardship

In environmental terms the project has delivered some "early wins" in reducing the impact of sewer overflows to the city's living and marine environment.

Water quality issues that impact on tangata whenua (people of the land) values and their traditional food gathering resources have been identified through the project.

People Development

As far as the people involved in the project are concerned, it has provided an excellent training opportunity for new staff and captured knowledge that will endure within the business unit and our people.

Finally, the working inter-relationships developed through the project have been the catalyst for positive culture change within the organisation which we hope will continue long after completion of the Three Waters Strategy work.

Conclusion

In order to drive their future investment programme, Dunedin City Council has developed an integrated asset management approach and has embarked on a business improvement project in order to meet its capital and operational delivery targets.

The process has two main components. The first being a review of the existing structure of the Water and Waste Services business unit and the second being to undertake a significant Three Waters Strategy Study that includes the development of comprehensive hydraulic models to examine the entire water cycle within Dunedin's urban catchments and to provide critical information on the performance of the networks.

Now that the first of three phases of the Three Waters Strategy Study is complete and the restructure of the Water and Waste business unit has been successfully

implemented, a number of real and tangible benefits have already been demonstrated. This has provided Dunedin City Council with confidence that the project is proceeding as planned and will ultimately result in improved operational performance and a prioritised and staged capital investment programme across the three waters that will be optimised, sustainable and affordable for current and future generations.

The project team are now able to reflect on the success of the work to date and look forward with enthusiasm to the remaining phases of this innovative and ambitious project. Meanwhile the restructured Water and Waste business unit continues to develop, based on a sound knowledge of the system performance and needs developed as a result of the Three Waters Strategy Study together with more robust integrated business systems.

Biography:

Dan Stevens CEnv MCIWEM, MICE

Dan Stevens is a Chartered Environmentalist with 25 years experience in the water industry. He is a Partner and Principal Environmental Engineer with Opus International Consultants and is widely recognised internationally for his work in promoting water hydraulic modelling as a key advanced asset management tool. Dan is the principal in charge of the consultant team carrying out the three waters strategy.

John Mackie, B App Mgt, NZCE(Civil), REA

John is currently the Manager of Water and Waste Services for the Dunedin City Council and commenced his engineering career in the mid 70's with the Ministry of Works and Development. Since that time he has gained over 20 years experience working in local government, primarily in water utilities and has spent the latter ten years in the private sector as New Zealand Manager of ADS Environmental Ltd and later with Abigroup Asset Services Ltd.

Ian Garside

Ian Garside is currently Operations Manager for Beca's NZ Water Operations and a Technical Director of the firm. He is a founder member of the Modelling SIG and a former Chair. With over 22 years of three waters experience he is the Technical Reviewer for the Three Waters Strategy and

was instrumental in scoping the investigations to be performed.