THE URBAN WATER SERVICES PROVIDERS INFRASTRUCTURE SURVEY

Aneurin Hughes

Associate, Cardno MBK (QLD) Pty Ltd Queensland

Rolf Rose

Principal Engineer, Dept of Natural Resources and Mines, Queensland

Abstract

During 2000 the Queensland State Government commissioned a comprehensive state-wide survey of urban Water (and Sewerage) Service Providers (WSPs). The survey required the collection of a significant amount of core and detailed data in relation to the water and sewerage services for all Queensland settlements having a permanent population of greater than 50 persons. The purpose of this survey was to:

- provide an overview of the current status and future trends associated with the provision of water and sewerage services to Queensland's urban communities;
- Identify important issues and constraints impacting globally and sectionally on urban water services providers in the delivery of water and sewerage services;
- provide an assessment of future needs to sustain and/or improve water and sewerage services;
- provide an assessment of the cost implications of meeting future needs; and
- identify priority issues that the State Government, peak bodies and WSPs will need to address.

The required survey information was classified as information necessary for identifying sustainable capacity, ie social, business and environmental sustainability.

Generally, most of the larger WSPs have sufficient expertise and resources to deliver services in a cost-effective, sustainable manner. Many of the larger WSPs have the expertise and systems in place which are comparable to best practice in any developed country in the world.

Most of the issues of concern relate to the performance and problems being experienced by the smaller WSPs. A number of WSPs generally serving a population of less than 5,000 persons but in particular, those serving a population of less than 1,000 persons, are experiencing a wide range of problems.

Key Words: Performance, Assessment, Sustainability, Capacity, Survey, Queensland, Communities, Local Government.

Introduction

Urban water supply and sewerage services are mainly provided by 124 local governments in Queensland. The State Government provides a regulatory framework for service delivery and subsidies on certain infrastructure components. Urban Water (and sewerage) Service Providers (WSPs) are dispersed throughout the State with the larger WSPs located in the south east of the State and along the eastern coast.

This paper describes the approach to undertaking the survey and outlines the findings of the survey in relation to the sustainable capacity of water and sewerage services.

Queensland

Queensland accounts for nearly 25% of the total land area of the Australian continent. It covers seven times the area of the United Kingdom and is more than twice the size of Texas and five times larger than Japan. Its population is nearly 3.6 million. 65% of the population resides in the South East of the State. This region has a population growth rate of 1.8% pa. The remote west of the State accounts for over 50% of the land area but sustains only 1.2% of the State's population.

Survey Methodology

Challenges in undertaking the survey included:

- The scope of the required information was extensive;
- Data collection from dispersed and remote WSPs. (Over 124 local government WSPs) and also from nearly 70 private WSPs (eg holiday resorts);
- No central source of data within WSPs;
- The reluctance by many WSPs to provide data due to lack of resources and the fact that many local governments are overwhelmed for requests to respond to surveys from a range of government and non-government organisations;
- Obtaining consistency between data collection teams; and

Deriving a database structure that would accommodate, in a rational and consistent manner, the range of permutations and relationships which exist between entities.

Key elements of the methodology included:

- Defining and agreeing the outcomes, outputs and objectives of the project at the commencement of the project. This was achieved through the development of a number of issues/discussion papers. The desired outcomes from the project included:
    - an overview of the current status and future trends associated with the provision of water and sewerage services to Queensland's urban communities;
    - the identification of important issues and constraints impacting globally and sectionally on urban water services providers in the delivery of water and sewerage services;
    - an assessment of future needs to sustain and/or improve water and sewerage services;
    - an assessment of the cost implications of meeting future needs; and
    - identification of priority issues that the State Government, peak bodies and WSPs will need to address.
- A project Quality Manual was prepared which assisted in efficient and effective data collection and ensured effective communication by the project consulting team; and
- Workload on WSPs was minimised through accessing all available State Government information. Available State Government data sources included:
    - its Urban Water Infrastructure Information System (UWIS);
    - Total Management Plans (TMPs) produced by local government

WSPs. TMPs are strategic planning documents which cover issues such as customer service, infrastructure planning, asset, financial, environmental and risk management

Outstanding data was collected through visits and telephone calls to WSPs While this approach was quite laborious, it proved quite successful in maximising the amount of data collected. The response of most WSPs to the approach was very positive.

Database

The Infrastructure Survey Database (ISD) was developed in ACCESS 97. The database table relationship is illustrated in Figure 1. The ISD was set up to be compatible with the existing UWIS database.

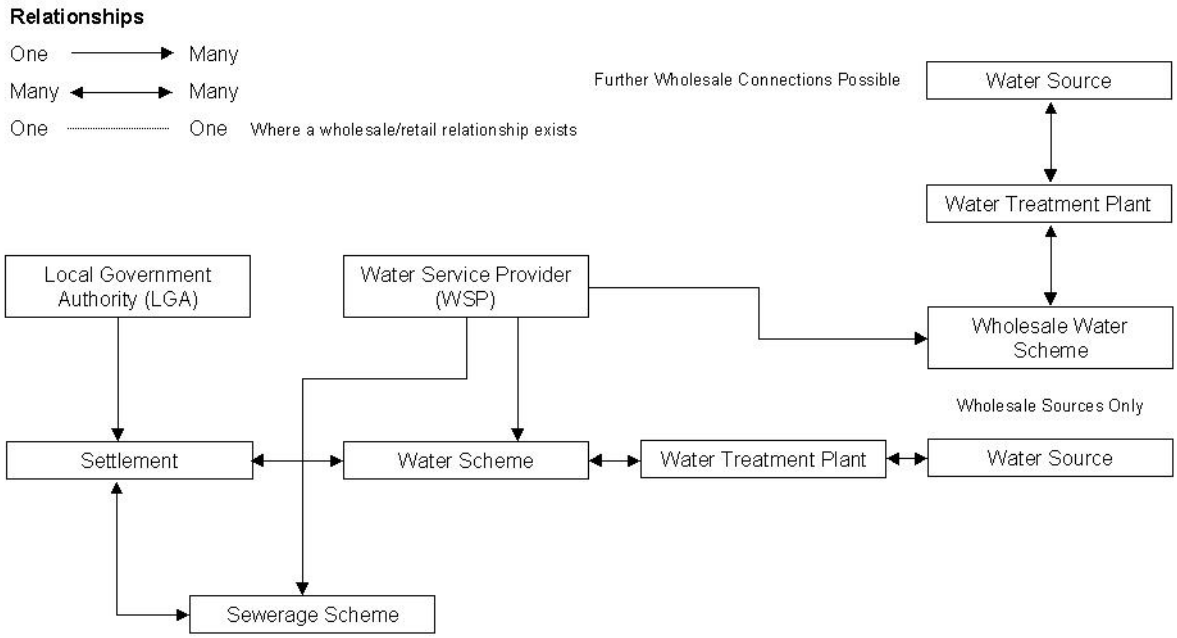


Figure 1 Database table relationships

Sustainable Capacity

Sustainable capacity requires the assessment of a range of factors including:

- Settlement capacity;
- Infrastructure capacity;
- Service level capacity;
- Financial capacity;
- Environmental capacity; and
- Management and systems capacity.

The level of sustainability was evaluated in terms of:

Business

- water service providers' financial and revenue raising capacity, ability to provide community service obligations; (Financial Capacity);
- management (operation, maintenance, demand management and asset management of the scheme and infrastructure; and (Management Capacity); and
- the condition or state of the infrastructure. (Infrastructure Capacity).

Social

- community commitment (including ongoing financial commitment), plans and support for the ongoing proposals (Settlement Capacity);
- appropriateness of the proposed service or scheme for operation and maintenance within the community skill base. (Settlement Capacity); and
- service levels (Service Level Capacity).

Environmental

- environmental impact of operations;
- sustainability of effluent disposal and biosolids management policies; and
- sustainability of source water demands (Environmental Capacity).

The survey information was used to generate 6 profiles – settlement, infrastructure or scheme, financial, management, service levels and environmental.

The capacity factors were derived through the assessment of a number of profiles as illustrated in Table 1.

Table 1 Capacity factors

Capacity Factor	Profile	Typical Survey Questions	Triple Bottom Line Component
Settlement	Settlement	Population and growth projections. Development potential Serviced by water or sewerage schemes. Level of support for servicing settlement.	Social
Infrastructure	Water Supply Scheme Profile – Infrastructure Sewerage Scheme Profile – Infrastructure	Source type. Treatment process. Infrastructure condition. Collection system type. Treatment process. Infrastructure condition.	Business
Service Levels	Water Supply Scheme Profile – Service Levels	Water consumption. Source failures. Customer water quality problem severity. Source quality problems. Reticulation pressure. Main Breaks	Social

Capacity Factor	Profile	Typical Survey Questions	Triple Bottom Line Component
Service Levels/Environmental	Sewerage Scheme Profile – Service Levels / Environmental	Sewer blockages. Infiltration/inflow. EPA licence type. Effluent compliance level. % effluent and biosolids re-use. Performance of BNR plants.	Environmental
Financial	Financial	Revenue. Tariff type. Current cost and value of infrastructure. Capital works expenditure. OM&A costs.	Business
Management and Systems	Management and Systems	Service delivery constraints. Drinking water compliance monitoring. Environmental compliance monitoring. Operator training status. Rating of Management Plans.	

The survey is a snapshot in time. The data will need to be reviewed on a 3 – 5 year basis to assess trends.

Survey Results

Settlement Profile

A summary of settlement size is included in Table 2. This illustrates the fact that most of the State's population resides within the larger urban centres. However, nearly 75% of settlements have less than 1,000 population. The settlement profile indicated that urban water supply services are provided for 99.4% of the urban population and for sewerage services for 96% of the urban population. The survey also indicated that 100 of the State's settlements (ie 17%) do not have a reticulated water supply and (344 No. 57%) do not have reticulated sewerage. Most of these settlements have a population of less than 500.

Table 2 Summary of settlements

Population Range	Number of Settlements	Percentage of Settlements	Percentage of Urban Population
50 – 500	344	55%	2%
501 – 1,000	109	18%	3%
1,001 – 5,000	114	18%	8%
5,001 – 10,000	22	4%	5%
10,001 – 50,000	19	3%	14%
> 50,000	12	2%	68%

Local governments indicated that six to seven percent of unserviced settlements had significant public health and/or environmental impacts due to on-site systems. An additional twenty to twenty five percent of unsewered settlements had the potential for significant public health or environmental impacts.

A reasonable level of support exists within local governments for providing reticulated water to nearly twenty percent of currently unserviced settlements. For sewerage, this percentage increases to nearly twenty five percent of unserviced settlements. For the remainder, the support was limited possibly for the following reasons:

- no perceived problems;
- high cost; and
- unwillingness of ratepayers to pay the full cost of service, particularly for sewerage.

Infrastructure Profile

The survey indicated that a significant number of smaller settlements currently have problems meeting service levels or would have problems in the future. Table 3 summarises some of the results. While issues impacted on a number of schemes the population impacted was relatively low.

Service Level Profile

Drinking water quality is generally of a reasonable standard for most schemes particularly the larger schemes servicing the bulk of the State's population. Quality and pressure issues are summarised in Table 4.

Table 3 Infrastructure capacity issues

Issue	Percentage of Schemes of Concern	Percentage of Population Impacted
Water source capacity	30%	15%
Water treatment capability	20%	2.7%
Water distribution system condition	9%	7%
Sewage collection system condition	15%	12%

Table 4 Service Level Issues

Issue	Percentage of Schemes of Concern	Percentage of Population Impacted
Physical water quality	12%	0.6%
Firefighting capacity	33%	4%
Reticulation pressure	14%	0.4%

Water consumption is generally higher in the drier central, north and western regions of the State. The survey indicated that a two-part tariff is an effective means of reducing consumption.

The survey indicated that the challenge of meeting sewerage service levels was not confined to the smaller WSPs. The issues related to infrastructure condition and infiltration/inflow levels.

Environmental Profile

There is increasing effluent reuse in the State, particularly in smaller schemes. However, biosolids reuse is minimal although thirty percent of schemes serving populations greater than 50,000 persons transfer biosolids to a specialist contractor for processing and reuse.

Infiltration/inflow is potentially a large problem with over eighteen percent of schemes reporting a maximum day to average day flow ratio exceeding 4.5.

The larger WSPs are moving towards incorporating nutrient reduction facilities, but the majority of licences still relate to a secondary treatment standard. WSPs generally reported a reasonable level of compliance with EPA licence requirements.

Nutrient plants perform to within the design criteria for nitrogen reduction although the achievement of effluent phosphorus levels appears to be a problem in a few plants.

Improving effluent quality from secondary to nutrient reduction has resulted in a reduction of 3,935 tonnes/annum of total nitrogen and 730 tonnes/annum of total phosphorus entering watercourses from the 26 plants evaluated serving approximately 2.0 million equivalent persons (EP).

Financial Profile

Urban water service provision is a major business in Queensland with a revenue from rates and charges of just over $A1.1 billion pa, operational expenditure (including depreciation but excluding interest) of $A0.8 billion pa and a proposed capital works expenditure over the next 5 years averaging some $A455 million pa ($A370m new works, $A85m replacement/rehabilitation works) with an estimated additional $A200 - $A400 million pa worth of infrastructure being donated by the private sector (eg developers). The largest 10 WSPs (local governments and urban water boards) account for approximately 65% of all revenue and expenditure.

The current cost of infrastructure is A$15.9 billion with current value of A$9.3 billion.

The survey indicates that many WSPs servicing less than 3,000 – 4,000 persons may not be currently charging sufficiently to sustain their infrastructure in the long term.

Significant diseconomies of scale exist for providing water and sewerage services to settlements of less than 1,000 persons as illustrated in Figures 2 and 3.

Figure 2 Water supply full cost of service

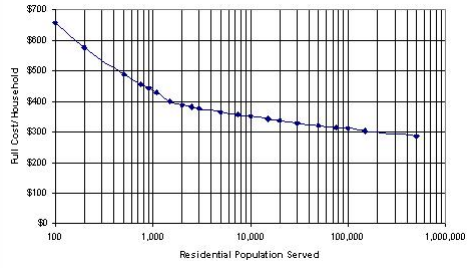
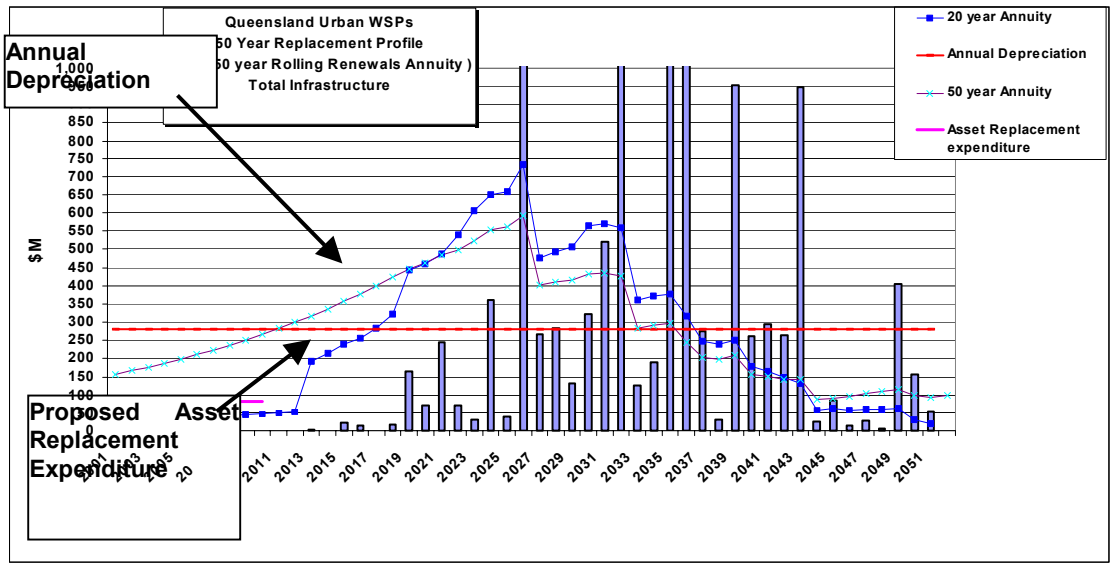


Figure 3 Sewerage full cost of service

The diseconomies of scale in the provision of water and sewerage services to the smaller settlements and the reluctance by some WSPs to raise charges significantly results in an unsustainable charging regime. However, larger, commercialised WSPs are moving towards 'commercial' rates of return.

Macro level replacement cost profiles were developed based on the weighted average residual lives of assets from WSP valuations. A total water supply and sewerage infrastructure macro level replacement profile is shown in Figure 4. The costs exclude donated assets and WSP infrastructure installed since 2001. The graph indicates that existing depreciation expense is currently much higher than the proposed asset replacement expenditure and the 20/50 year rolling renewals annuity. However, the rolling renewals annuity is likely to exceed annual depreciation within 10-15 years.

Figure 4 Total Infrastructure Macro Level Replacement Profile



Management and Systems Profile

While many WSPs indicated that most constraints to service delivery were manageable, the survey indicated that a number of issues were dependent on the size of the operation.

WSPs serving populations of less than 5,000 indicated problems with insufficient revenue and inadequate resources. A number of WSPs of all sizes indicated problems with ageing infrastructure and insufficient infrastructure capacity. Some WSPs serving populations of less than 1,000 indicated problems with inadequate skills.

Over sixty percent of WSPs indicated that while short-term needs were being addressed, medium and long term needs may be compromised by the necessity to meet short-term needs at minimal cost. In the case of WSPs serving a population of less than 5,000 persons, 30% indicated that they could just about meet day to day requirements.

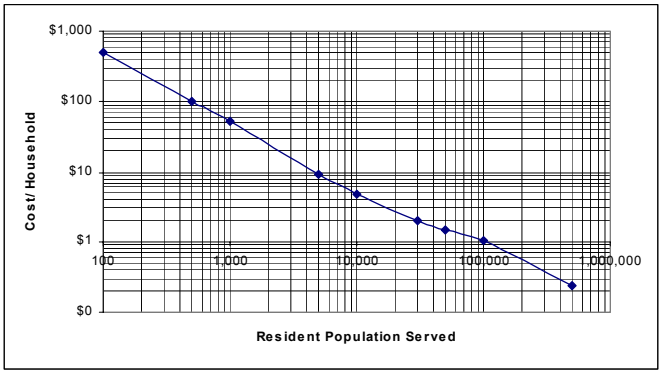
The level of monitoring of chemical and particularly, microbiological quality continues to be less than desirable for many WSPs (particularly the smaller WSPs).

A cost model for drinking water quality monitoring was derived and the results are summarised in Figure 5. The cost of drinking water quality monitoring per household decreases substantially as the scheme size increases. For schemes serving around 1,000 people the cost is in the order of $A50/household/year. For a 5,000 person scheme the cost reduces to $A9/household/year and drops to an insignificant sum thereafter. The State Government provides chemical and microbiological analysis services free of charge to local government.

WSPs serving less than 5,000 persons have difficulty in attracting certificated operators. However, nearly 98% of the State's population is served by water and sewerage schemes with a certificated operator. There is an increasing need for technical, managerial, financial and operational expertise at all levels in the provision of water supply and sewerage services. The availability of personnel with this expertise is limited and is likely to remain so in the medium term. This would be particularly severe for the smaller, remote WSPs.

The issues highlighted in the survey indicate that potentially significant risks are emerging in relation to the provision of water and sewerage services by a number the smaller WSPs.

Figure 5 Cost model output for drinking water quality monitoring



Conclusion

Generally, most of the larger WSPs have sufficient expertise and resources to deliver services in a cost-effective, sustainable manner. Many of the larger WSPs have the expertise and systems in place which are comparable to best practice in any developed country in the world.

Most of the issues of concern relate to the performance and problems being experienced by the smaller WSPs. WSPs generally serving a population of less than 5,000 persons but in particular, those serving a population of less than 1,000 persons are experiencing a whole range of problems. In general these WSPs:

- are usually remote;
- have a declining population with limited industries in the area to sustain a population;
- can experience significant diseconomies of scale in relation to the cost and resources required to deliver quality water and sewerage services;
- do not usually charge the full cost of service to sustain their infrastructure;
- in many instances have inadequate infrastructure;
- regularly have difficulty providing the desired level of service;
- in many instances have inadequate resources and skills;
- in some instances can barely meet day to day operational requirements;
- have difficulty in setting up a drinking water quality monitoring programs and assessing compliance; and
- do not have a critical resource mass in order to address the increasingly complex nature of water service provision.

In conclusion, the triple bottom line scorecard for urban water service provision in Queensland is as listed in Table 5.

Table 5 : Triple bottom line scorecard

Triple Bottom Line Component	Rating
Social	Generally high for the majority of the population. Problems experienced by a number of smaller settlements.
Business	Satisfactory. Some problems with ageing infrastructure and unsustainable charging regimes in some smaller WSPs.
Environmental	Satisfactory. Some concern regarding infiltration/inflow. Improvement in wastewater treatment and extent of effluent re-use.

The survey will provide a valuable information resource which can be used by the State Government in partnership with WSPs to target areas which have been identified as requiring attention. This will allow them to develop policies and strategies to ensure a sustainable capacity of water and sewerage service delivery.

Acknowledgements

Consulting Team – Cardno MBK, SunWater Engineering Services, Ipswich Water and Population Information & Forecasting Unit. The views expressed in this paper are those of the authors and may not reflect the views of the Queensland Government

Author Biography

Aneurin Hughes is the manager of Cardno MBK's Asset Management Business Unit and an Associate of the company. Aneurin has 25 years experience in all aspects of the water industry infrastructure lifecycle. Over the past 12 years Aneurin has specialised in asset management and strategic planning. Prior to joining Cardno MBK in 1996, Aneurin worked for the Queensland State Government for 12 years.

Postal Address: Cardno MBK Pty Ltd, PO Box 388, Toowong, Qld 4066
Tel: 3369 9822

E-mail: ahughes@cardno.com.au

Rolf Rose is a Principal Engineer in the Infrastructure Management Group in the Department of Natural Resources and Mines. Rolf has 28 years experience mainly with local government water and sewerage infrastructure together with a short period on irrigation schemes. The first 17 years were spent in the construction of projects and in recent years Rolf has been involved with the Department's guidelines and the implementation of the *Water Act*.

Postal Address: Department of Natural Resources and Mines, GPO Box 2454 Brisbane QLD 4001
Tel: 3224 2733

E-mail: Rolf.Rose@nrm.qld.gov.au