Water System Reliability
A Survey of Small Indigenous Communities in the Kimberley

Co-operative Research Centre for Water Quality and Treatment Summer Scholarship

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Executive Summary

The Kimberley is a remote region situated in the far North-West of Western Australia and home to 202 discrete Indigenous communities. In 1999 the Community and Housing Infrastructure Needs Survey collected data indicating that equipment breakdown was the major cause of water restrictions in Indigenous communities across Australia, and the region most affected was the Kimberley. The aim of this project was to develop a more in-depth and authoritative understanding of the issues of water system reliability in the Kimberley Region.

A phone survey was developed and 24 small Indigenous communities were surveyed providing a 19% representative sample of the 128 communities considered in this study. The survey found that

- the rate of water system failure in small Indigenous communities is high with 79% of communities having experienced system failure
- there is a high variability of water systems and issues contributing to system failure
- system failure is not simply a systemic equipment problem, maintenance and service delivery issues play an important role in water system reliability

It is recommended that further work be done to address the issues of service delivery, technology choice, capacity of involved parties to install and maintain technology, succession of knowledge, and information sharing.
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Thanks to the regional councillors, regional managers, environmental health officers, and representatives from resource centres for making the time to meet with us in ATSIS offices in Kununurra and Derby and at resource centres around the Kimberley. You have given helpful feedback on the project’s preliminary results and recommendations, and provided us with additional ideas and perspectives.

Thank you to all the CAT staff that assisted me in every way possible. From generating maps to lending bikes to taking me out bush, your friendly support was a warm welcome to Alice Springs and a great help to this project. Thanks to the staff in the Derby office for your assistance with the Kimberley region. In particular thanks to Marc Seidel who spent much time on the phone and email to me in Alice Springs, trying to paint a picture of the context of this survey, and for dedicating a week to guiding Robyn and me around the Kimberley.

Finally, thanks to my supervisors Steve Fisher and Robyn Grey-Gardner for your guidance. This project really has been an amazing learning experience. I hope that this report can assist your work and the livelihood of Indigenous communities.
Acronyms

ABS  Australian Bureau of Statistics
ATSIC Aboriginal and Torres Strait Islander Commission
ATSIS Aboriginal and Torres Strait Islander Services
CAT  Centre for Appropriate Technology
CDEP Community Development Employment Program
CEO  Chief Executive Officer
CHINS Community Housing and Infrastructure Needs Survey
CRC  Cooperative Research Centre
KES  Kimberley Essential Services
RAESP Remote Area Essential Services Program
NT  Northern Territory
UV  Ultra Violet
1. Introduction

This project was initiated through the CRC Water Quality and Treatment Summer Scholarship Program. The project was based at the Centre for Appropriate Technology in Alice Springs, NT. The project was created to find out more information about the equipment breakdowns that small communities in the Kimberley region experience.

My task as a summer student was to develop a survey to assess water technology breakdowns in remote Indigenous communities, conduct the survey, do additional research as required, analyse the survey data, and complete a written report. The resultant analysis is to inform future work to identify and address systemic factors contributing to water treatment technology breakdowns.

The survey was carried out by phone from the CAT office in Alice Springs. A visit to the Kimberley was made on completion of the survey once initial analysis of the data had been completed. Some feedback was given to ATSIS offices, Regional Councils, Environmental Health Officers, and Resource Centres around Wunan and Malarabah. A number of visits to communities around Kununurra were also made.
2. Background of Project

2.1. The CHINS Survey

In 1999 the Community Housing and Infrastructure Needs Survey (CHINS) was conducted, providing the first quantifiable evidence to indicate the extent of equipment failure problems affecting water supply in remote Indigenous communities. CHINS was first conducted in 1999, and anticipated to be conducted every 2 years by ATSIC. It assesses the status of community and housing related infrastructure in discrete Indigenous communities to inform future development planning.

CHINS 1999 collected detailed information about the water use and water restrictions of communities with populations greater than 50. These communities will be referred to as ‘large communities’. A total of 943 communities with a population less than 50 were not included in this part of the survey.

The data revealed that water supply restrictions affected 35% of large Indigenous communities across Australia. ‘Water restrictions’ was defined as:

’Restrictions on the amount of water used, the purpose for which water could be used or the times when water was available in the 12 months prior to the survey‘\(^1\).

Figure 1 Reason for restriction by region

\(^1\) Data Dictionary 1999 p 61
The data also showed that equipment failure was the greatest cause of water restrictions, and that there were more communities in the Kimberley region having experienced water restrictions by equipment failure than any other region. Figure 1 shows that unlike other regions that experienced water restrictions for a number of reasons like lack of power or normal dry season, the only recorded cause of water restriction in the Kimberley was equipment failure. This suggests that there is some systemic issue affecting water system equipment in the Kimberley that is preventing good levels of system reliability being achieved.

A trend was also revealed that as population decreased, the incident of equipment failure increased (Figure 2). As CHINS 1999 only collected detailed information on water restrictions for large communities, there was a gap in information about the level of system reliability communities less than 50 people were experiencing.

![Figure 2 Percentage of communities affected by equipment failure (CHINS 1999)](image)

### 2.2. Water strategies

The Centre for Appropriate Technology and the Cooperative Research Centre for Water Quality and Treatment have adopted a focus on water treatment technology as one of the four themes within the Water Strategy, *Soaking up the Future*. The recommendation to increase efforts in this area came from a review of the progress that has been made through the partnership between the two organisations since it commenced in 1999. The water strategy’s objectives are outlined in Appendix 1 Objectives of Soaking up the Future.

After identifying the extent of large communities’ water restrictions due to equipment failure across Australia, CAT and the CRCWQT were interested in finding out more about the water systems reliability of small communities. A decision was made to

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2 CRCWQT Project 3301, 2003
focus the study on small communities in the Kimberley because the region appeared to have the greatest incident of equipment failure, and data suggested some systemic issue with the region’s water equipment.

3. Project Objectives

The objectives of this project are embedded within the objectives of both CAT and the CRCQWT, as outlined in the following documents:

- “Soaking up the Future” CRCWQT and CAT’s Water Strategy for 2003 to 2005
- “Planning for the Future”, CAT’s plan for 2003-2006
- “Regional Strategy for the Centre of Appropriate Technology in the North-West of Western Australia for November 2002-December 2005

This project, ‘A Survey of Small Indigenous Communities in the Kimberley’ is the first step in a larger project, ‘Improved water system reliability for communities in the Kimberley’. The purpose of this project is

To develop a more in-depth and authoritative understanding of the issues of water system reliability in the Kimberley Region

The objectives that contribute to this overall purpose are:

1. To undertake a survey of Kimberley Indigenous communities and to collect information relevant to addressing the problems
2. To research and analyse the data in order to identify gaps and overlaps in services and possible infrastructure or regulatory problems
3. To identify the cultural, environmental and temporal factors (such as mobility, water quantity and service delivery) that may affect the implementation of water supply technologies, transfer of knowledge, succession planning and the relationship between the community of users and the service suppliers

This work will inform next step of the larger project, to develop a strategy for addressing the problems identified, taking into account the views of a range of local stakeholders.

4. Background of Region

The Kimberley is in the far north corner of Western Australia and is composed of three ATSIC regions, Broome (Kullarri), Derby (Malarabah) and Kununurra (Wunan) (Figure 3 ATSIC Region Map). It has an area of 421,451km², including rainforest, rugged escarpments and arid deserts. Main town centres are Broome, Derby, Fitzroy Crossing, Wyndham, Halls Creek and Warmun (Turkey Creek), as and Kununurra. Pastoralism, mining, fishing and tourism are mainstays of the market economy.
Indigenous people make up 45% of the region’s population of 25,000. There are 202 Aboriginal communities, of which 160 have a population less than 50 (79% small communities).  

Table 1 Discrete Indigenous Communities in the Kimberley

<table>
<thead>
<tr>
<th>ATSIC REGION</th>
<th>TOTAL INDIGENOUS COMMUNITIES</th>
<th>SMALL DISCRETE COMMUNITIES (&lt; 50 PEOPLE)</th>
<th>PERCENTAGE SMALL INDIGENOUS COMMUNITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kullarri</td>
<td>62</td>
<td>55</td>
<td>89%</td>
</tr>
<tr>
<td>Malarabah</td>
<td>67</td>
<td>48</td>
<td>72%</td>
</tr>
<tr>
<td>Wunan</td>
<td>73</td>
<td>57</td>
<td>78%</td>
</tr>
</tbody>
</table>

The average population for small Indigenous communities is 15 people. Typically these communities live on traditional lands; excisions from pastoral leases, lands claimed under native title and cattle stations owned and operated as enterprises.

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3 CHINS 2001 data
5. Survey Development

5.1. Aim of Survey

- To develop a picture of the types of water systems small communities have and the amount and type of service and maintenance that the systems receive
- To find the incidence water system failure in small communities in the Kimberley.
- To identify the main factors affecting water system failure

5.2. Initial Selection Process – Determining the sample frame

The communities to be considered in this survey have the following criteria:

- a usual population of less than 50
- no service agreement with RAESP contractors (other than CAT)
- an independent water supply (not on town supply)

There are 128 communities in the Kimberley that meet this criterion.

Table 2 Number of communities selected in survey

<table>
<thead>
<tr>
<th>REGION</th>
<th>NO. OF COMMUNITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kullarri</td>
<td>52</td>
</tr>
<tr>
<td>Malarabah</td>
<td>25</td>
</tr>
<tr>
<td>Wunan</td>
<td>51</td>
</tr>
</tbody>
</table>

5.3. Sample Size

A simple random sampling method is used to select communities for the representative sample. According to Broughton and Hampshire (1997) a sample size of 15% will produce results that statistically significant for a sample frame of between 100 and 200 communities.

A 15% representative sample for the 128 communities considered in the survey is 19 communities.

5.4. Secondary Selection Process

Communities are selected randomly over a range of

- Geographical regions (including inland or coastal)
- Population sizes
- Proximity to towns

Many communities are inaccessible on the telephone during the surveying period in December and January. This provides an additional means of selection, although uncontrolled (see Chapter 6.2 Method of contacting indigenous communities).

The surveying process proceeds by attempting to contact communities from a range of the above criteria until the four week period is complete, or all the contactable communities have been surveyed.
6. Survey Method
A copy of the survey questions can be found in Appendix 3 Telephone Survey.

6.1. Process and Protocol
All regional councils and ATSIS offices in the Kimberley were contacted and informed of this project and the project’s objectives prior to the commencement of the survey or communication with individual communities.

6.2. Method of contacting indigenous communities
The following factors lead to difficulty in getting someone on the phone

- Many communities don’t have phones at their outstation
- Surveying took place in January when it is wet season in the Kimberley. Many communities go to town\(^4\) during this season because the roads to the outstation will be cut off in the rains.
- January is also the time for Aboriginal cultural business. People often travel a long way from their outstations for ‘business’, having meetings etc.

Sometimes community members can be contacted away from their outstation. If a community is in town, sometimes the chairperson or another spokesperson can be located by ringing their communities’ administrative body, usually an Aboriginal corporation that manages the affairs of a few communities in a district. Someone at the office will usually know the whereabouts of community members, and sometimes a phone contact for a spokesperson in town. Sometimes the only way to get someone on the phone is to ring at the right time when someone in the office offers to go and see if they can drum up a community representative that might happen to be socialising in a crowd out the front of the office, and see if they will have a yarn on the phone with the girl in Alice Springs who wants to know ‘something about the water’!

The survey method is thus based on random sampling, as random as the availability of the survey candidates at any particular time.

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\(^4\) ‘town’ is a relative term referring to the largest centre of administration and economy in each outstation’s district. In the Kimberley ‘town’ usually refers to the closest of Broome, Derby, Kununurra, Kalumburu, Halls Creek, or Fitzroy Crossing.
7. Results and Analysis

7.1. Survey Results

The survey results have been summarised and are included in Appendix 4. A total of 24 communities were successfully surveyed, representing 19% of the sample frame. As discussed in Section 5.3, a 15% representative sample is required for statistically valid results therefore a 19% response should supply a good representation of the 128 communities in the sample frame.

<table>
<thead>
<tr>
<th>REGION</th>
<th>NO. OF COMMUNITIES SURVEYED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kullarri</td>
<td>6</td>
</tr>
<tr>
<td>Malarabah</td>
<td>8</td>
</tr>
<tr>
<td>Wunan</td>
<td>10</td>
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The surveyed communities were geographically spread over the three regions of the Kimberley (See Figure 4 Location of Surveyed Communities).

The Respondents

An attempt was made to speak with the person on each community that usually looked after the water system. This person was not always available, and the most appropriate community member available was then surveyed.
Six survey responses were not directly obtained from community members but from the following parties:

- CAT staff member in Derby who periodically services the community
- A spokesperson (chairperson, CEO or CDEP coordinator) from the resource centre/aboriginal corporation affiliated with the community

7.2. General Community Profile

Population
The majority of communities surveyed had usual populations between 10 and 20 (Figure 5 Usual Populations).

![Figure 5 Usual Populations](image)

Population commonly fluctuates in outstations due to a number of factors. Increases in population can be due to extended visits from family, whereas decreases in population can be due to trips to other communities, or the whole outstation population moving away during the wet season if they are likely to be cut off by inaccessible, flooded roadways. Mobility patterns are complicated and have an impact on water system reliability although determining each community’s mobility pattern was beyond the scope of this project.

Dwellings
The outstations had between one and ten dwellings, with most communities (75%) having between one and 4 dwellings. Dwellings were houses, dongas\(^5\) or sheds.

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\(^5\) A donga is a portable room
7.3. Community Water Systems

There are a diverse number of water supply systems in operation in the Kimberley region of varying technical sophistication. Any part of the system can fail in some way that would cause failure of the entire system. Figure 6 is a schematic of all the elements in a typical water system.

![Water System Schematic](image)

**Sources of Drinking Water**

The communities surveyed used the following water sources:

- Bore water
- Rainwater
- Soak
- River/reservoir
- Carted in

**Primary water source**

Bore water was the primary water source for 92% of surveyed communities. The two communities not using bore water drew water from ponds in creeks.

**Distance of primary water source**

Most communities’ (79%) primary water source was within a kilometre of their dwellings. The greatest distance of a community’s water source was 5km.
Alternative Water source
For 62% of communities, this primary source was their only source of water. The communities with alternative water sources had either a second bore, access to surface water of some kind, or means of rainwater collection (Figure 7).

![Pie chart showing water sources: Surface water 21%, Second bore 13%, Rainwater 4%, No alternative water source 62%]

Figure 7 Alternative water source

Water System Equipment

Pump
Types of pumps used were
- Submersible
  - Shaft drive pump, belt driven
  - Shaft drive pump, directly attached to motor

Power Source for Pump
Power sources identified were
- Solar system
- Diesel generator
- Petrol genset

![Image of Diesel generator at Miniata, Wunan]
The most common power source for water systems was the diesel generator. Other systems had solar systems, solar/diesel hybrid systems, and there were two communities using petrol generators (Figure 9).

![Pie chart showing power sources]

**Figure 9 Power source for water systems**

**Reticulation**

96% of communities had underground reticulation to the outstation. Not all outlets were in the dwellings, some were located on tanks next to the dwelling, or in ablution blocks that were shared by the whole community.

**Storage**

The types of water storage identified were:

- Header tanks
- Storage tanks

![Storage tanks]

**Figure 10 Header tank at Emu Creek, Wunan**
Outstations had between one and three tanks that ranged in volume between 200L and 20,000L. These tanks were either header tanks (Figure 9) or storage tanks (sitting on the ground).

**Water Treatment**
The only water treatment reported was disinfection. The types of disinfection used were:

- UV
- Chlorination

Most communities (76%) reported that they did not have water treatment of any kind (Figure 11).

![Figure 11 Water Treatment](image)

Two communities reported to have chlorination, two had UV treatment, and two communities were unsure whether or not their water was treated. Neither of the communities whose primary water source was from a pond had water treatment.

**Age of system**
37% of communities had water systems that had been installed between one and two years ago, with over half (56%) installed within the last five years (Figure 12).
7.4. Water Quality

87% of communities reported to have potable water supplies. The three unpotable supplies were in:

- A community told that their bore water was not fit to drink without first boiling. At the time of the survey they were unsure of the current quality of the water and would have liked an update in information, or to have some quality testing results.
- A community who’s water supply had been tested and according to the Resource Centre, the water ‘has the wrong pH and it stinks’.
- A community without potable water that found the saltiness of their bore water on the whole unpalatable. They were only drinking water skimmed from the top of the tank ‘where it isn’t so salty’.

One respondent, in reply to the question of what they thought about their water responded, ‘Don’t question the quality it is the only source we have got’.

7.5. Maintenance, Service, and Responsibility

Parties and Roles

There are a number of different parties that can be responsible for a community’s water system:

- Community members
- Resource Agencies/Aboriginal Corporations
- RAESP Program contractors

These parties can act in different roles, organising or performing the following:
• regular maintenance and upgrades
• emergency repairs
• Installation of capital works

Because there is a number of different parties and roles it is often difficult to collect reliable information regarding service and maintenance.

**Organisation and Administration**

All surveyed communities were affiliated with an Aboriginal Corporation or Resource Agency. These organisations are usually situated in a region’s largest town or Aboriginal community and act as administrative bodies for the smaller communities in their region. Resource Agencies/Aboriginal Corporations were responsible for the organisation of maintenance and emergency repairs, they were the ‘middle-man’ that contacted a contractor to do the work. In some cases the Resource Centre also did the technical work.

**Maintenance by community members**

All communities surveyed took some responsibility for maintenance and upkeep of their water systems. Figure 13 shows that most communities have 10-30% of their usual population (one to five people) able to look after the water system. Community members knew how to operate and complete minor repairs to their water supply system. More complex repairs required the services of a contractor.

![Figure 13 Percentage of community members looking after the water system](image)

**Maintenance by external parties**

Respondents were asked whether any external parties looked after their water systems, and who these parties were. The response to this question was on the whole
unreliable. One community might have had a string of different parties come to service their equipment over the years, organised by their Resource Centre. There was a general lack of communication between service providers and community members. This makes it difficult for the community to identify where the most recent mechanic came from and what their responsibility was.

![Figure 14 Frequency of Service](image)

**Figure 14 Frequency of Service**

**Frequency of regular service**

Although it was difficult to reliably identify parties that serviced communities, respondents could more clearly identify whether or not some external party came to service their water system regularly, and if so, how often. Most of the communities we spoke to (67%) did not have regular service agreements with a service provider (Figure 14).

**Emergency repairs**

The survey response suggested that there was very little effective warranty or liability period for the water system equipment after installation. All communities have access to emergency repairs from contractors employed through ATSIS program RAESP.

**7.6. Water System Failure**

**System Failure**

79% of communities had experienced system failure (Figure 15). System failure is when some element in the water system fails to work as it is designed to.
System failure by region

The proportion of communities experiencing system failure in each region is relatively even (Figure 16).
Communities surveyed reported that their water systems failed in three main ways:

- failure due to equipment breakdown
- external damage to the system
- lack of standard maintenance

Dividing system failure into these three types of failure is an attempt to get closer to identifying why systems are failing. The categories are difficult to distinguish because in most cases the cause of breakdown is ambiguous and a matter of opinion.

The three categories are defined as follows:

**Equipment breakdown** is when an element of the system fails under ordinary conditions and treatment. For example:

- “generator broke”
- “pump stopped pumping”
- “tank split”

**External Damage** is when an element of the system fails due to misuse or “acts of God”. For example:

- animals destroying parts of equipment, ‘animals chewed through the wires on the solar system’
- theft of equipment, ‘the solar panel was stolen’
- extreme weather, ‘cyclone blew the tank away’
Figure 17 Types of system failure

Figure 17 illustrates 21 incidents of failure occurring in only 19 communities.

Length of system failure

The length of system failure was variable. During the time of the survey, some communities were using a secondary source or carting water because their regular water supply was in permanent failure. Other water systems were reported as failed and were fixed within the day. Factors affecting the time taken for a failed system to be fixed include

• remoteness and access to community
• availability of equipment parts
• availability of mechanic
• access to telephone

What was done for water during restriction

When a system failure causes water restrictions for a community, they must get water by another means. There were a number of different responses to securing water, these being

• Carting water from town, a nearby community, or a nearby water source
• Using backup equipment such as spare pump (such as the one on fire-fighting equipment) or an alternative (or emergency) water source on outstation, sometimes unpalatable before boiling
• Moving to town or another community
The most common response of communities experiencing water restrictions was to cart water from elsewhere.

One community responded in the survey that they had reported a system failure that was causing them water restrictions. The community were confident that the emergency repair service would visit them within the day, so they did not have to find an alternative source of water.

**Element of system that failed**

This survey found that all elements of the water system were failing (Figure 20)
Figure 20 Element of the system that broke

Causes of system failure

There are many different factors affecting a system’s functioning and a system failure could be caused by multiple factors. Some responses were:

- “Generator broke – don’t know why”
- “Bore’s too old”
- “Something to do with the safety valve switch”
- “pump in the bore seized up and burnt out the solar motor”

Figure 21 is an attempt to specify the reasons for failure of elements of the water systems. Obviously for most breakdowns reported, the cause of the breakdown was unknown. There were also respondents that thought the cause of the failure was incorrect installation, damage by animals, insufficient maintenance, or aged equipment. There is no obvious correlation between a particular element and cause of breakdown.
Many respondents reported that they’d had a problem and it had been fixed by a mechanic, but did not know what the problem had been, why it had happened, or what had been fixed. The general lack of informed respondents suggested that in many cases there was little communication between people doing repair work and the community. Some respondents also commented that external parties that did work on the equipment had no accountability if the repair was not successful.

Figure 22 Shows Marc Seidel (CAT) and William Manaltadj of McGowan’s Island Beach. They are standing next to William’s solar powered bore. The solar system has not been working for some time.
Possible causes of failure

The following is a description of the different factors that could contribute to system failure. All of these causes were mentioned by survey respondents when discussing their equipment breakdowns. It is possible for breakdowns to be caused by a multiple of the following.

Faulty part
Some part of the system is faulty when installed.

Faulty installation
The technology is installed incorrectly.

Extreme weather conditions
For example cyclones, leading to damage of elements.

Inadequate maintenance
When a system fails but all elements of the system are functioning properly. For example, this situation occurred in one community where they thought they were experiencing equipment breakdown because their solar system was not working. The batteries on the solar system had reached the end of their lifetime and were no longer recharging. Part of standard maintenance required for a solar system’s functioning is the periodic inspection of solar batteries to make sure they are recharging. The community members failed to do this, whether through not knowing it was required, or just not doing it, is unknown. The solar system was not used for two months while
the batteries were dead. The community members used another power source, namely the petrol pump from the fire-fighting equipment, to pump water from the bore.

**Theft**
An element or elements are stolen, making the system incomplete and ineffective. Theft of solar panels and generators in particular are reported frequently.

**Misuse**
The equipment is not used correctly. This can be from a lack of understanding of how to use the equipment. It can also be due to an intentional misuse, for example vandalism.

**Age**
At some point in time equipment will become too old to work properly and require replacement.

**Variable systems and problems**
There appears to be a high variability of type of system, element that is breaking down, and cause of breakdown.

For example, up the road from William Manaltadj of McGowan's Island Beach (see Figure 22 and comment) is Laurie Waina of Pago. Figure 23 shows Laurie standing in front an old bore. His primary water source, a soak in a nearby creek, dried up in the drought last year. Laurie would like to use this old bore to provide his outstation with water. These two communities are within 20km of each other and they have vastly different water systems and causes of water restrictions.

![Figure 23 Laurie Waina of Pago beside an old bore](image)
7.7.  Case Study: Alligator Hole

On the 3rd of February 2004 we visited Alligator Hole with Danee Janz, CDEP coordinator of Kununurra Waringarri Aboriginal Corporation to better understand water supply issues experienced on the ground. There are approximately 20 children and 20 adults living permanently at the outstation.

Water supply
Alligator Hole does not have an ‘organised water supply’. The community currently carts water from the creek near the house. During the dry season this is not always possible and they have to cart water from further away, from Dingo Springs community.
The tank sits beside the house and collects rainwater from the roof to supplement the supply.

**Water system**

A small fuel pump pumps the water from the small water tank on the trailer that they cart with, into the water tank beside the house. Water pumped from the tank into the house sink and toilet, or accessed directly from the tap at the bottom of the tank (Figure 27).

![Figure 27 Getting drinking water from outlet at tank](image)

**Water system failure**

Alligator Hole community’s water system has failed for a number of reasons:

**Theft**

Last wet season they remained in town. On return to the outstation they found their generator had been stolen. In addition the public telephone was gone and the whole verandah, equipped with kitchen had been taken off with an oxy-torch and carted away.

**Money**

When there is no money to buy fuel for the generator the community carries water into the house to flush the toilet.
Incorrect installation
This tank (Figure 28) was delivered to Alligator Hole community when no one was at the outstation and put on top of a hill. Before the tank could be properly installed, winds blew the tank off the hill and it was ruined.
8. Discussion

8.1. Sophistication of Water Systems

In general, the systems of communities surveyed were not highly technologically sophisticated. A good indicator of this is if there is water treatment, and if so, what type of treatment is used. This project’s main interest in water treatment comes from an interest in the technological sophistication of water systems rather than from a concern with water quality (see Appendix 2 Bore water testing).

8.2. Equipment Breakdown

Equipment breakdown and frequency of service

Figure 29 shows the relationship between equipment breakdown and the frequency of regular equipment maintenance. Clearly more communities without regular service agreements experience equipment breakdown than those communities with service agreements.

![Figure 29 Equipment breakdown and frequency of service](image)

Equipment breakdown and age of water systems

Figure 30 shows that breakdowns happened to both new and old systems. This suggests that equipment breakdowns are not simply occurring because equipment is wearing out through age.
Figure 30 Equipment Breakdown and age of system

A chart detailing the likely cause of breakdown shows that a significant proportion of communities with recently installed systems (within the last five years) have identified incorrect installation as the reason for their equipment breakdown.

Figure 31 Age of systems and causes of breakdown
9. Recommendations and Preliminary Feedback

The following is a brief summary of the preliminary recommendations for the continued project of improving water system reliability. These recommendations were presented to Regional Councillors, ATSIS regional managers, Environmental Health Officers and representatives of Resource Agencies at meetings in the Kimberley between the 2nd and 6th of February 2004.

**Better Information**
- Central database on water supply systems
- When a new system is installed or replaced, develop individual community information plans

**Training**
- A training course established in the basics of groundwater and maintaining water supplies from bore to tap

**Lessons Learnt pack**
- Sharing information about what has worked (and what hasn’t)

**Mobile technical support**
- CAT service to broaden to include checking systems and providing basic advice and support to small communities

**More analysis**
- More research and analysis to seek greater understanding
10. Conclusion

This survey has found that the rate of water system failure in small Indigenous communities is high and that there is a high variability of water systems and issues contributing to system failure. This study has shown that most small communities do not have regular service agreements with a contractor and there are water systems in the Kimberley without adequate maintenance that are waiting to break down. Respondents have reported and survey results show that the service provided to small communities could be done so with better communication between community members and servicer. From this study it appears that water system failure is not simply a systemic equipment problem but that maintenance and service delivery issues play an important role in water system reliability.

It is recommended that further work be done to address the issues of service delivery, technology choice, capacity of involved parties to install and maintain technology, succession of knowledge, and information sharing.
11. References

ABS (1999) Housing and Infrastructure in Aboriginal and Torres Strait Islander Communities Australia, ABS Catalogue no 4710.0.

Bailie, Siciliano, Dane, Bevan, Paradies, Carson, 2002, Atlas of Health-Related Infrastructure in discrete Indigenous communities Aboriginal and Torres Strait Islander Commission (ATSIC), Melbourne


CAT and CRCWQT, Soaking up the Future, October 2003

CAT, 2002, Regional Strategy for the Centre of Appropriate Technology in the North-West of Western Australia for November 2002-December 2005


OurPlace Number 18, 2/2002. Centre for Appropriate Technology, Alice Springs.


12. Appendicies

Appendix 1 Objectives of Soaking up the Future

Drawing on the values, mission and purpose of both the Cooperative Research Centre for Water Quality and Treatment and the Centre for Appropriate Technology, the vision for the strategy will be to pursue the following objectives:

1 To understand the aspirations of Indigenous communities and the challenges that they face with access to a reliable supply of good quality drinking water.

Provision of water supplies to Indigenous communities demands understanding of a complex framework of issues. An integrated approach will be undertaken which includes comprehending and working with competing community demands towards sustainable water supplies. “Soaking up the Future” will facilitate an integrated approach to the provision of water through key stakeholders.

2. To provide information to Indigenous people through demand-responsive, participative processes.

To achieve sustainable outcomes it is essential that communities themselves identify a need and seek assistance. The emphasis on a demand-responsive approach is to increase sustainable outcomes by providing options for a community to make decisions based on their identified needs.

3. To provide advice on existing and emerging policy on the provision of water and water quality for Indigenous people.

Policy, such as the rolling review of the Australian Drinking Water Guidelines (ADWG) has the potential to impact on the values, needs and aspirations of Indigenous people and their communities. An integral part of the “Soaking up the Future” role is advocacy - to inform the CRCWQT and government agencies of the potential or real impacts to communities of Indigenous people, due to water quality policy and regulatory issues.

4. To create a valued source of knowledge of water quality and treatment to support the needs and aspirations of Indigenous people with the capability of pursuing world class research in water provision for communities of Indigenous people.

Many CRCWQT members have an interest in servicing remote and rural Indigenous communities. “Soaking up the Future” provides opportunity to liaise between the CRCWQT members and the communities. The fundamental position includes ensuring that processes are followed such that adequate consideration as been given to ethical implications in particular adequate consideration has been given to community members and their welfare, rights, beliefs, perceptions, customs and cultural heritage both individually and collectively in all interventions and research. Commitment to the benefits to Aboriginal communities is fundamental to all interventions in the strategy.

High quality services include well-researched, reliable and accessible (cross-cultural/English as a second language) information, provided to communities to
enable educated decision-making at a local level. It is necessary that the information remains objective and adheres to best workplace practice.

5 To achieve high standards in the knowledge and information management of research and project work conducted, such that it is available to those who need it.

Strategic dissemination of research outcomes and lessons learnt in relation to water quality will enable the water industry to better serve Indigenous communities for sustainable outcomes and likewise allow Indigenous communities to better understand their own water management issues and the services available to them. A variety of formats and media are appropriate for the many different stakeholders, for example:

- in person presentations,
- CAT and CRCWQT website material,
- written reports,
- booklets,
- pictures and
- videos.

A communication strategy is integral to all “Soaking up the Future” projects which includes production of published papers, booklets, pamphlets or videos would ensure that research findings are widely disseminated.

6. To provide a service for intervention in water quality or water supply at the request of the community to effect practical measures for improved health outcomes

An intervention includes community contacts in a variety of forms – from answering a query on the phone regarding a water supply problem to seeking community participation in water supply research projects. The community members themselves will guide the level of community contact or participation in a project. Interventions will include practices to protect or improve the health of Indigenous people in remote communities.
Appendix 2 Bore water testing

Bore water, because stored in an aquifer, is not as prone to microbiological contamination as surface water. Possible sources of microbiological contamination is from contaminants seeping down into the groundwater. Thus if the bore is located near housing, toilets, or animals, the bore is susceptible to contamination. Another source is contamination once the water has been pumped to the ground surface. Therefore, in remote communities where water analysis is not possible, as long as the bore is appropriately situated, a thorough check of all the bore infrastructure will provide the best assurance of good quality water. This includes making sure storage tanks are completely sealed and all parts of the equipment are functioning properly.
Appendix 3 Telephone Survey

CAT Kimberley Water Survey

Name of Respondent: 

Community: 

Source of Water

- Where do you get your water for drinking? (I.e. bore water, soak, rainwater tank)
- How far away is it from the outstation?
- Do you have any other source of water there? If so, what?
- How many houses are there?
- How many people live there usually?
- How far away from town are you?
- How far away from another community are you?

Distribution

- Is the water piped to the houses? (Underground/aboveground?)
- What type of pump?
- What powers the pump? (solar, diesel, hybrid, motor genset, petrol genset, windmill, other)
- Do you have tanks? (Storage tanks or header tanks) How many?
- Is your water treated? (Reverse osmosis, active carbon, ion exchange, UV, Chlorination)

Service

- How many people in your community look after the water system?
- Who put in the water equipment?
- How long has the current system been there?
- Who do you get to fix bigger problems that you can’t fix yourself?
- Do they come out to the community, or do you go to them?
- Was there training on how to use the equipment when it was put in?
- Is there anyone who comes out to service the system regularly? How often?

Quality

- What do you think of the quality of the water?

Restrictions

- Have you ever not had enough water?
- When? Does it happen seasonally?
- What was the longest time you did not have enough water?
- What did you do for water? (i.e. fixed problem, moved to town, carted water in from town)
- What caused the problem with the water? (i.e. equipment breakdown, poor water quality)
- If equipment breakdown, which part of the system broke, and why do you think that was?

Improvements

- What do you think would fix the problem/improve the water reliability?
Appendix 4 Survey Results