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Gold Coast, Miami Beach - Samuel Lindsay

# LoRaWAN® is Transforming Water Network Operations

## To Become More Sustainable

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LoRaWAN®


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# FOREWORD

Water is a resource that increasingly needs to be protected and better managed. Around the world, water utilities are facing challenges to improve their efficiency by providing better information about water usage to end-users and to better control assets management and operations.

To achieve these goals, water utilities are embarking on a digital transformation journey. Globally, they have been at the forefront of the smart revolution, with the large deployment of smart meters and over devices. However, many utilities have yet to be connected effectively. They provide only limited benefits, because the related data is only valuable once it has been aggregated so it can be analysed and acted on.

Connectivity, therefore, has become the final frontier for enabling truly smart utilities. So-called smart meters can't achieve their potential intelligence and value without being reliably, robustly and cost-effectively managed.

Connecting all the sensors, meters and controls is complex, with many variables to take into account. As the landscape becomes more sophisticated, with a range of business models to choose from, utilities recognise that easy-to-deploy, simple-to-manage, resilient, robust and cost-effective connectivity is an essential ingredient for their 'smart' plans.

Operating in one of the driest regions of the world, water utilities in Australia face unique challenges. Along with the United Nations Sustainable Development Goal Number 6, to protect water resources, the global LoRa Alliance® is putting sustained effort into Australia and New Zealand to help water utilities access best-in-class solutions through a large ecosystem encompassing Solution Providers, Systems Integrators, Device Manufacturers and Operators.

Many local companies have started to deploy solutions. These include NNNCo in Australia who has been contracted by the Council for City of Gold Coast to deliver a LoRaWAN network that underpins a variety of Smart City use cases. This includes 12,000 smart water meters that have been forecast for deployment over the next few years, which will also open up opportunities for third party applications to use the existing network.

Traditional options such as hardwired connections, cellular networks, RF Mesh or satellite connectivity have limitations, including the complexity of the deployment, a lack of interoperability and the challenge of reaching remote areas or deep indoors due to high installation and/or maintenance costs.

In this paper, we explain why LoRaWAN® is the ideal connectivity choice for water utilities.

As a leader of the LoRa Alliance, I foresee exciting opportunities in the water utility sector in Australia and New Zealand. The LoRa Alliance is committed to supporting the efforts of NNNCo and other LoRaWAN partners in the region to ensure that LoRaWAN solutions are widely embraced.

**Derek Wallace, Vice President of Marketing,**
**LoRa Alliance®**

# THE AUSTRALIAN CONTEXT

### The World's Driest Inhabited Continent

As the world's driest inhabited continent, everyday life in Australia is heavily dependent on a steady supply of freshwater.

According to the Australian Bureau of Statistics, Australians consumed an average of 82,000 litres[1] of freshwater per person in 2019[2]. A further 80 litres of water per connection every day on average are lost by utilities before even reaching homes. For small utilities, this figure is around 110 litres per day.[3]

By the World Health Organization's standards, Australia is classified as being under high water stress – meaning that demand for water is up to 80% of the available supply.
While 99% of the population receives adequate quality drinking water, some parts of the country (particularly rural areas) still do not enjoy quality water services consistent with Goal #6 for clean water and sanitation from the United Nations' Sustainable Development Goals (UNSDGs).

## POLICY AND SOCIAL SETTINGS

### Policy Diversity

The Australian Government is taking a proactive stance towards water management, with the Department of Agriculture, Water and the Environment overseeing water policies. Combined with a federal level to apply water policies, there is an ongoing effort to improve overall efficiency with more customer-focused water operators.

### Population Growth

Pressure on Australia's precious freshwater supply is on the increase, with projections from the Australian Bureau of Statistics that the Australian population will reach 29.8 million people by 2030 – an increase of 21.5% from 2017[4]. To support this growth, water utilities will be under pressure to continue delivering quality water from reserves that are already constrained due to changing weather conditions. This pressure is driving investment in smart-city initiatives, including using Internet of Things (IoT) technology to enhance visibility and better manage water and sewage assets and resources.

### Environmental Requirements

In 2015, the United Nations General Assembly laid out 17 Sustainable Development Goals, including Goal 6: "Ensure availability and sustainable management of water and sanitation for all".[5] However, meeting this objective will become more difficult as Australia's supply of freshwater becomes stretched and more vulnerable to climate change.

*1. 1.8 millions of megaliters were consumed per year spread over 9.7 millions housholds (Australian Bureau of Statistics)- average of 2.61 persons per household- equals to about 200 liters per day per person (522 litres per household per day)*
*2. Australian Bureau of Statistics 2019, 4610.0 – Water account, Australia, 2016-17, Australian Bureau of Statistics, Canberra, Table 1.1, available via: www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4610.02016-17?OpenDocument#Data*
*3. Bureau of Meteorology 2019, National performance report 2017-18: Urban water utilities, Part A, Bureau of Meteorology, Canberra, p 61, available via: www.bom.gov.au/water/npr/*
*4. Australian Bureau of Statistics, https://www.abs.gov.au/statistics/people/population/population-projections-australia/latest-release*
*5. United Nations, https://sdgs.un.org/goals/goal6*

Several droughts this century have forced states to take extraordinary measures to ensure freshwater supplies. For example, in 2006, the Perth Seawater Desalination Plant, in Kwinana, became the first seawater desalination plant used by an Australian city to improve resilience to droughts, with all other major cities following since then.

### Urban and Rural Differences

Although it is a highly developed economy, Australia still struggles with often significant infrastructure variations between rural and city areas. As water utilities look for ways to improve their rural infrastructure, they must also factor in poor or absent mobile phone voice and data reception in many regional and remote areas.

## INDUSTRY CHALLENGES

### Aging Infrastructure and Inefficiencies

Most of Australia's water infrastructure, built before the 1970s, is nearing the end of its lifecycle, resulting in leaks and breaks that cause water loss, as mentionned previously.

Australian water utilities have been evaluating the condition of their assets and developing maintenance programs for operational efficiency and service continuity. The 2021 Australian Infrastructure Plan[v] mentions "water security" as the most pressing issue for the sector, with the need to "source better data and information on the economic viability and sustainability of water resources. Robust, up-to-date data is essential".

New technologies can help support these goals, but their implementation requires integration with legacy mission-critical systems such as those used for Supervisory Control and Data Acquisition (SCADA) systems. They must also add security controls to protect infrastructure against escalating cybersecurity threats.

### Financial Pressure on Utilities

More than 11.6% of Australia's total water supply is lost as non-revenue water losses.[7] This increases the cost of supply for end consumers and businesses. Demand from population growth and losses in the system inevitably increases cost pressure for ongoing supply and management of water resources.

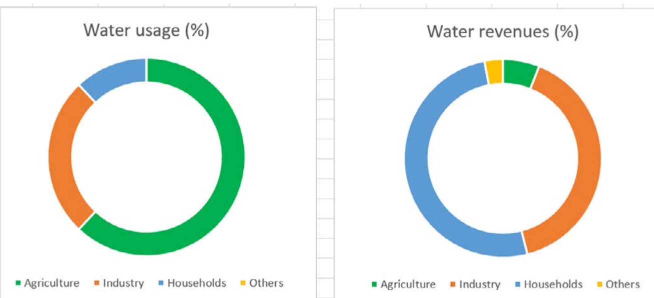



*Figure 1: A strong imbalance between water usage and revenues in Australia*

*Source: Bureau of Meteorology, National performance report 2020-2021*

Australia's water supply also suffers from an imbalance between consumer and industrial usage, with industrial and agriculture users contributing around 46% of total revenues while consuming 88% of the water. This imbalance is exacerbated in the agricultural sector, which contributes 6% of total revenues nationally while consuming 62% of national water resources.

- Data source: about water usage in Australia[8,9,10]
- Australians consumed a total of 1.8 millions of megaliters in 2019 spread over 9.7 million housholds (Australian Bureau of Statistics) - average of 2.61 persons per household - equaling about 200 liters per day per person.
- Australia's urban water sector generates annual revenue of more than $15 billion.[11]
- Australia spends an estimated US$6 billion per year on water and wastewater treatment services.

## DIGITAL TRANSFORMATION OF WATER MANAGEMENT SECTOR IN AUSTRALIA

The confluence of major information technology (including cloud computing, big data analytics, artificial intelligence (AI), etc.) and IoT has opened up exciting new possibilities for the modernisation of water infrastructure in Australia and worldwide. By standardising the collection and analysis of enormous pools of data - generated by IoT sensors installed across water networks and stored in cloud databases - these technologies allow water authorities to monitor and view the status of their networks in detail in near real-time .

Intelligent analytics, which use AI to detect potential changes in sensor readings that may indicate an imminent fault, allow water authorities to proactively maintain or replace elements of the network that are close to failing. This will reduce manual inspections and help focus resources where they are the most needed.

Live communications between central monitoring sites and remote equipment will be fundamentally important - and, since conventional mobile network coverage is spotty or absent across much of Australia's landmass, outside of major cities, alternatives will be needed.

Many operations in the water cycle can leverage IoT to improve global water management efficiency. Possible applications are represented below.

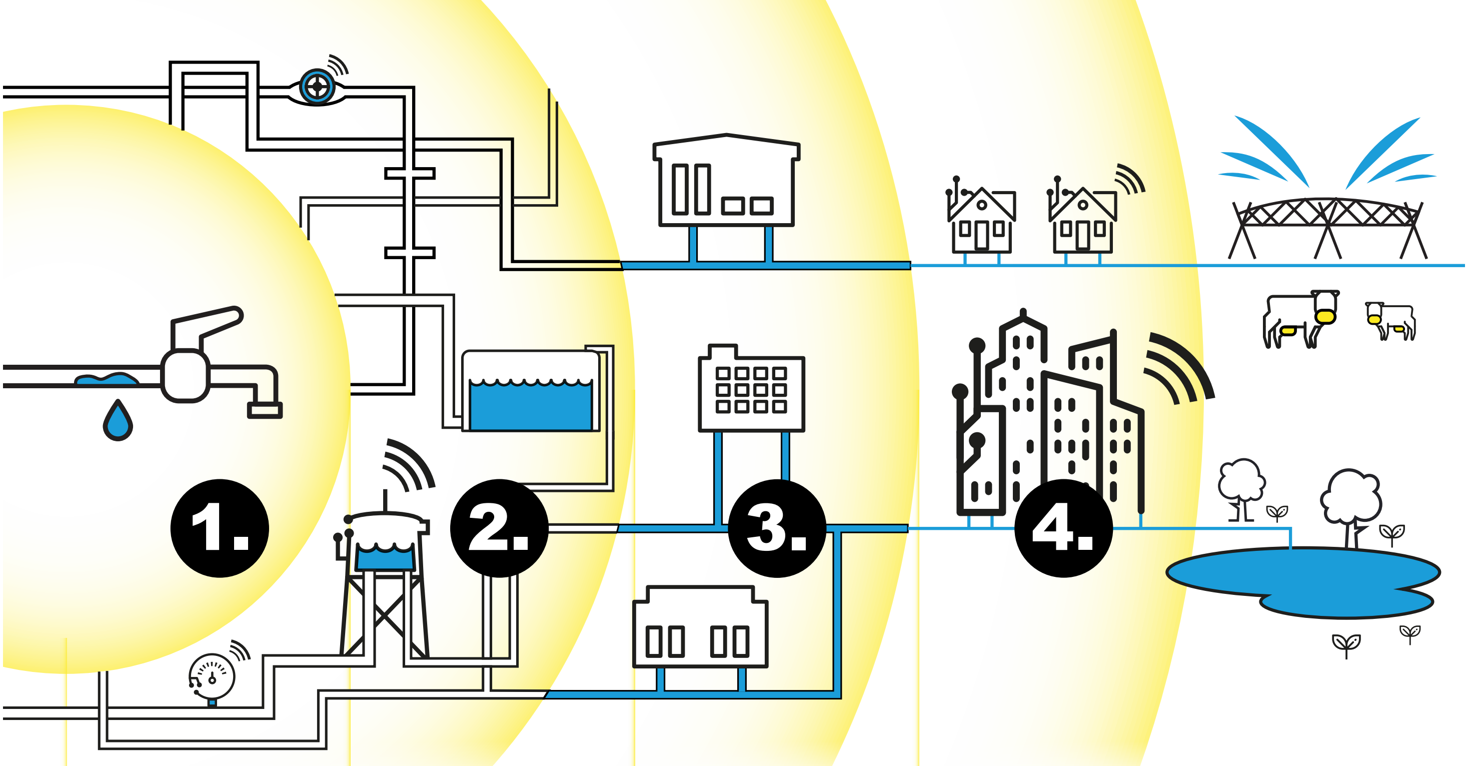
*6. 2021 Australian Infrastructure Plan, Chapter 6: Water, https://www.infrastructureaustralia.gov.au/sites/default/files/2021-09/2021%20Master%20Plan_1.pdf*

*7. Bureau of Meteorology, National performance report 2020-2021: urban water utilities, Part B, The complete dataset as of 30/11/2021, indicator W10.1 and W11.3, excluding Bulk Water Utilities,, available via: www.bom.gov.au/water/npr/*

*8. Australian Bureau of Statistics, 2019, 4610.0 – Water Account, Australia, 2016-17, Canberra, Table 1.1, available via: www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4610.02016-17?OpenDocument#Data*

*9. ibid. 10. ibid., Table 12.1, available via: www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&46100do012_201617.xls&4610.0&Data%20Cubes&2E2F199C0BE58A92CA2583AC00195CA9&0&2016-17&26.02.2019&Latest*

*11. Water Services Association of Australia and Infrastructure Partnerships Australia 2015, Doing the important, as well as the urgent: Reforming the urban water sector, Sydney, p 9, https://www.wsaa.asn.au/publication/doing-important-well-urgent-reforming-urban-water-sector*




| | 1. Leaking pipeline | 2. Water infrastructure | 3. Household | 4. Whole city |
|---|---|---|---|---|
| GOALS | Identify leaks for high water users (such as buildings, swimming pools, agricultural sites and hospitals) including concealed leaks | Reduce energy costs through remote monitoring and better control of power usage at water assets (including pumps, reservoirs, storage, water and wastewater treatment plants) | Empower households to better manage their water consumption and detect network leaks and water leaks | Leverage the IoT LoRaWAN network to deploy third-party use cases and scale up |
| ACTIONS | • Deploy DMA-connected water meters at strategic end points<br>• Deploy consumption-monitoring capability for high-usage customers, known through historical billing data<br>• Plug leaks for high-usage customers and provide an opportunity to drive behavioural changes | Use LoRaWAN IoT technology to complement SCADA systems by connecting LoRaWAN-enabled sensors (including pressure reduction valves, smart valve controls, water quality probes, flow monitoring systems and water level sensors) | Roll out automated meter reading (residential water metering) | • Use LoRaWAN network roaming capabilities to support new use cases (such as city networks and planning, other utilities and agricultural irrigation)<br>• Enable versatile smart city connectivity for parking, smart street lighting, people counting, smart waste management, asset monitoring and other use cases |
| BENEFITS | • Improve billing efficiency<br>• Increase visibility<br>• Reduce environmental and social impacts<br>• Reduce financial burden | • Manage water use more efficiently<br>• Reduce energy and carbon footprints<br>• Better balance supply and demand<br>• Create digital twins of water infrastructure | • Support water savings via water protection programmes<br>• Improve customer experiences<br>• Support water strategy programmes<br>• Reach sustainable development goals | • Amortise the cost of the LoRaWAN network by reaching out to new users<br>• Create more collaboration between city agencies<br>• Enable smart city collaborations with local governments and/or with utilities that share smart city infrastructure<br>• Leverage LoRaWAN's versatile connectivity and device offerings to enable collaboration, resulting in a lower total cost of ownership |

## LoRaWAN®: THE BACKBONE OF NEXT-GENERATION WATER INFRASTRUCTURE

### LOW-POWER, WIDE-AREA NETWORK TECHNOLOGY

Low-power wide-area network (LPWAN) technology provides wireless communications at low speeds over long distances, with low power requirements. That mean IoT devices can stay connected using battery power for years without replacement, making them ideal for water utility and smart city networks.

Several LPWAN technologies are on the market, but LoRaWAN is the most suitable for IoT applications demanding low power, long-range and ease of deployment. LoRaWAN is the leading LPWAN technology, managed by the LoRa Alliance®, with a large ecosystem of +500 members, rolled out in +175 countries (including Australia and New Zealand) by +165 network operators.

LoRaWAN builds on the fact that not all sensors have to transmit large volumes of information. For example, a sensor might only send a few bytes at a time to indicate the time, its current status and its identification. The rest of the time, the unit can sit idle, conserving battery power and only transmitting regular keep-alive pings back to a central monitoring station.

Deployed across a wide area, LoRaWAN can support massive numbers of connected devices – sensors, meters, digital controls and analytic tools – allowing water authorities to deploy sensors where they're needed, without worrying about connectivity.

LoRaWAN supports a broad range of use cases including monitoring, metering, and command and control. It is also suitable for heavily connected 'smart city' rollouts, where extensive use of sensors and monitoring devices can keep complex digital infrastructure operating at its peak.

LoRaWAN has been designed from the ground up for open access as a global, open standard that supports any application developers might want to build. It is backed by more than 500 LoRa Alliance members.

This wide support means water and other utility customers already have access to a broad range of compatible and innovative IoT devices, applications and services. A robust LoRaWAN certification program makes sure devices operate as intended.

### Case Study: Using LoRaWAN® and Tanks to Address Water Scarcity in remote and rural communities - New Zealand and Oceania

Water scarcity is an ongoing challenge in remote and island communities in New Zealand and Oceania, where there is a lack of reticulated water as well as pollution of rainwater catchments due to rising sea levels. Communities often run out of water without warning, particularly during dry seasons when increased consumption and reduced rainfall pose dual threats.

To improve the water resilience of these communities, New Zealand IoT pioneer, IoT Ventures, has developed TankView, a remote water level and rainfall monitoring solution that regularly measures water levels and communicates them via a LoRaWAN network to a centralised monitoring app.

**Read more**

The broad reach and flexibility of LoRaWAN have made it a favoured standard for network operators. It operates in Australia within the framework of the Radiocommunications (Low Interference Potential Devices) Class Licence 2015 as administered by the ACMA.

Within Australia and New Zealand, Telecommunications operators, such as NNNCo and Spark, have invested heavily to create far-reaching infrastructure to support all manner of applications, providing a low-risk solution as well as enabling interoperability across many different brands of gateways, endpoint devices, cloud network servers, development kits

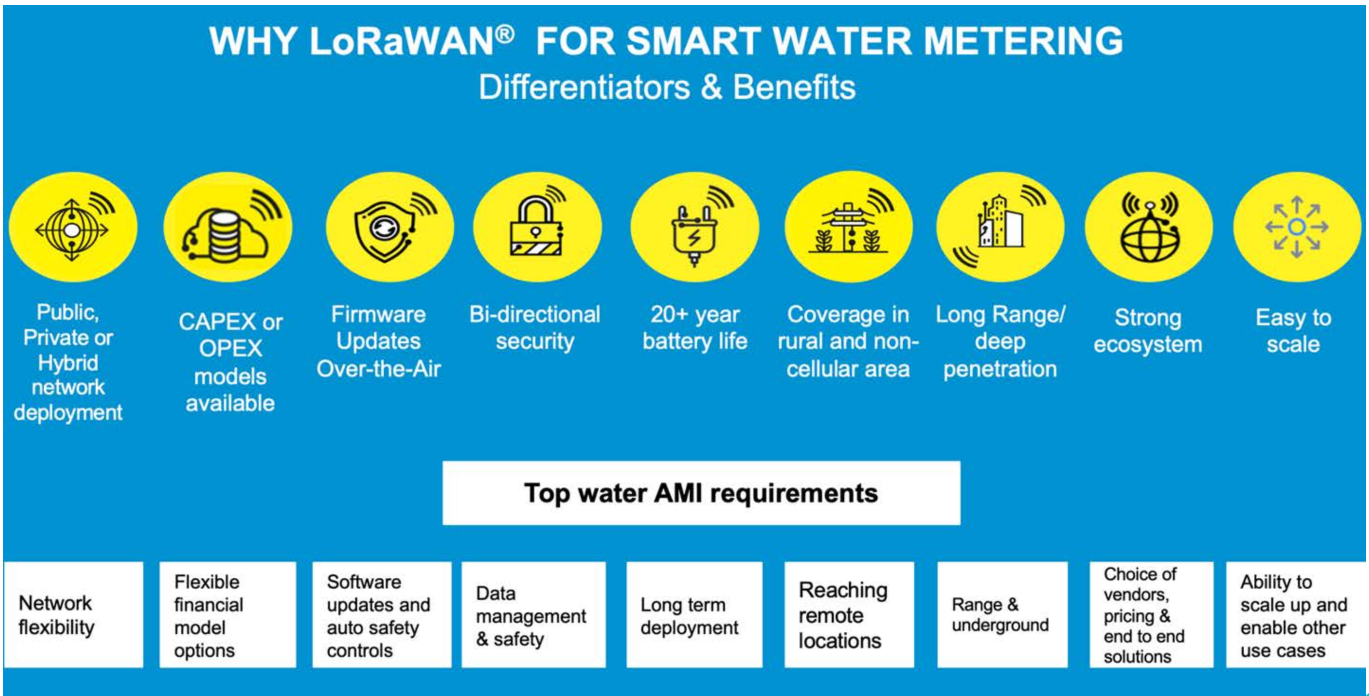



*Figure 3: LoRaWAN® – An Open Standard*

and other devices. This approach contrasts with the use of proprietary technologies, which lock water utilities into a small device ecosystem.

Compared with other wireless connectivity options, LoRaWAN provides the best balance of coverage and power consumption with ranges of more than 10 kilometres (see Figure 4).

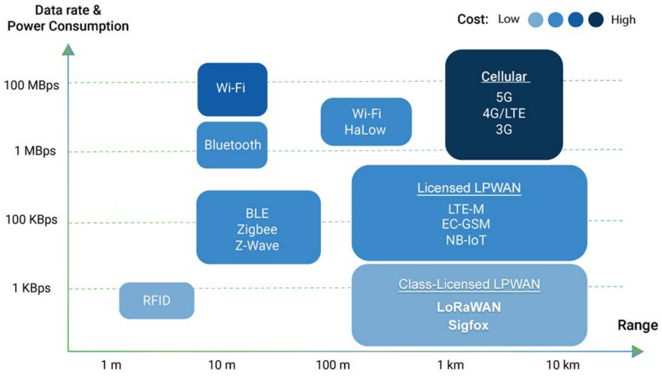


*Figure 4: Network Connectivity Options*

LoRaWAN's wide range, long battery life and total cost of ownership make it the best way to cost-effectively deploy IoT network sensors across a wide area. Water operators can start reaping the benefits of remote monitoring and control immediately, then build on those benefits as more IoT devices are deployed.

## LoRaWAN® USE CASES

### Water Metering

LoRaWAN's superior communications protocols and penetration capability mean that water utilities can collect metering and operational data remotely in even the most challenging radio frequency environments. This enables easier access to metering infrastructure. Water authorities can then better monitor water usage and leakages across the water network to address the issue of non-revenue water.

By implementing smart metering with LoRaWAN, water utilities can:

- read meters remotely to improve operational efficiency and at a much higher frequency, which allows for quicker reactions and avoids estimates
- monitor consumption and alert providers of leakages
- monitor pressure relief value operations.
- manage and control pumps
- quickly detect leaks and repair them
- enhance the customer experience through access to real-time metering data
- provide detailed reports and alerts to help customers better manage their water usage
- reduce calls to customer contact centres
- improve compliance through regular water quality monitoring
- track moving assets - pumps, vehicles, or personnel
- more accurately predict demand, making it possible to optimise pumping schedules, hence reducing energy costs, managing water turnover in service reservoirs, and making possible direct treatment and water pumping through valves and reservoirs.

### Case Study: City of Gold Coast empowers customers with smart meters – Australia

A smart water meter rollout across the City of Gold Coast in the Australian state of Queensland has proven invaluable in tracking down concealed leaks on customer properties to save valuable water supplies and minimise costs to customers and the City.
The implementation of a ubiquitous LoRaWAN network has provided unprecedented visibility into water usage patterns, helping the water business and customers pinpoint previously unknown concealed leaks and the act to address the associated water loss and financial impacts. The smart meters identified that approximately 10% of customers were experiencing leaks on their properties of more than 10 litres per hour. Detected leaks were more prevalent in certain cohorts of customers, for example, one-third of schools were identified as experiencing concealed water leaks, particularly associated with irrigation systems. In addition, 92 large concealed leaks – each losing over 100 litres per hour - were identified during the initial smart metering programme phase. Repair of these previously undetected leaks represents significant water and financial savings for the customers and the City. Expansion of the programme continues, with further smart meters being installed at customer properties and also at points within the City's drinking water network to support the identification of network leaks, reduction in water loss and non-revenue water costs, and gathering flow data to support network modelling and design. Additionally, use of the City's LoRaWAN by the water business has expanded beyond smart meters, with water network pressure monitoring devices and other sensors being deployed across the City's drinking water network to provide near real-time information on elements including the performance of pressure reduction equipment allowing more sophisticated management and response to any detected problems.

**Read more**

### Water Supply Network Monitoring

LoRaWAN-connected sensors provide real-time data that can help utilities monitor hydraulic and water quality, such as allowing forearly detection of pipe stress for immediate rehabilitative action before pipes leak.

This, in turn, reduces the risk of damaged pipes and water loss. Similarly, continuous monitoring of water quality in distribution pipelines can provide early warnings of potential water contamination, leading toproactive remediation.

Better, real-time data feeds will also pay off in reduced maintenance costs, with the smart meter grid and the access to low-cost accurate sensors for measuring pressure, flow, valve operation, pump monitoring and level monitoring. That data will allow water utilities to have access to the information, replace time-consuming processes.The benefits of using LoRaWAN for real-time water supply network monitoring include:

- the ability to plug water leaks at various locations
- high-value sensing at multiple network locations, at a fraction of the cost of SCADA solutions
- better water network modelling, allowing more data to be collected via less expensive communications and devices
- pressure-monitoring sensors at both inlet and outlet systems on pressure-reduction valves (PRVs).

### Case Study: Western Municipal Water District Taps LoRaWAN® for Advanced Metering Infrastructure-as-a-Service

Manual reading of water meters was costing time and money, and causing frustration, for Western Municipal Water District (WMWD), a water utility with more than 24,000 retail customer accounts servicing Riverside County, California.

Working with managed advanced metering infrastructure (AMI) provider Neptune, WMWD ran a pilot in which 100 legacy water meters were replaced with LoRaWAN-connected smart meters that can be read remotely at any time. A successful trial demonstrated 99% accuracy, leading to a subsequent commercial-scale rollout using LoRaWAN coverage across the county to support over 20,600 additional meters.

Better monitoring of water usage has cut the network's previous 12% water loss to around 3.5% -saving WMWD money and optimising its use of water resources so scarce they must often be piped in from elsewhere in the state.

**Read more**

### Sewage Systems

Real-time monitoring helps improve the preventive maintenance of sewage assets.

Sensor data and decision-support tools improve network assessment and planning using accurate and timely data related to issues such as flow control, content composition, overflows and pump stations.

The benefits of LoRaWAN for sewage systems include the ability to:

- implement preventive maintenance via pressure sensors and sewage level and pump monitoring.
- proactively manage sewage overflows during heavy rain periods, allowing crews to be dispatched in a timely manner before customers complain, both improving customer experience and minimising water loss.
- monitor changes in flow and pressure through water infrastructure.
- monitor diesel fuel storage levels for emergency pumps, power generation sites, and vehicles and machinery.
- install remote monitoring sensors for manhole covers to monitor sewer level and manhole movement to determine an overflow or downstream blockage.

## ENVIRONMENTAL BENEFITS

### Ensuring Water Quality

Improving the management of water and sewage infrastructure is particularly important in water-depleted countries like Australia for supporting community environmental expectations. By leveraging IoT infrastructure to improve water management, water companies can reduce the risk of water loss and avoid environmental issues.

Water and sewage operators need to move away from relying on customers to be their 'sensors' by reporting problems such as discoloured water or sewage overflows. Such conventional and reactive methods leave water utilities open to reputational damage and increase the risk of fines under environmental protection laws. Using IoT Sensors to measure turbidity, water quality, and sewage overflow in an empirical way reduces the subjective nature of the management of the system and provides a method for continual improvement in contrast to the aforementioned reactive approach.

### Energy Usage and Net Zero Emissions

Growing awareness about climate change is leading Australian utilities to commit to a policy of net zero emissions by 2050. Reaching this goal will be important in helping water utilities play their part in minimising the impacts of climate change.

Within the water management context, one of the largest and most challenging sources of emissions is the treatment of wastewater. Key issues contributing to emissions are high energy usage and the production of gases, such as nitrous oxide and methane.

The water industry currently undertakes a range of emissions-reduction initiatives, as described in Figure 5. LoRaWAN technology can be used to support these objectives by providing a framework for the monitoring and control necessary to increase network efficiency, reduce the need for onsite interventions and reduce water loss across the network.

| Operations-based Solutions / Business Schemes | Infrastructure-based Solutions |
|---|---|
| Negotiating terms with power suppliers for minimum targets around a portion of energy supply being sourced from renewable energy sources | Solar PV |
| Multiple water businesses banding together to form Bulk Power Purchase Agreements (e.g. zero emissions water) | Digestion / co-digestion |
| Latent anaerobic digester use for commercial customers | Pilot studies for more advanced processes – converting biosolids to pellets to use as additives in coal-fired power plant, sidestream anammox |
| Reducing truck movements | Hydropower |
| Networks optimisation | Reducing aeration demand at sewage treatment plants through smart controls and monitoring |
| Attenuating network flows overnight to 'hold back' flows overnight and then deliver to sites with solar in the morning | Sewage pump station (SPS) 'preventative jetting' – which reduces fugitive emissions and odours from SPSs |

*Figure 5: Net Zero Initiatives Aim to Reduce Water Networks' Carbon Footprints*

*Source: https://www.wsp.com/en-TH/insights/net-zero-for-australian-water*

### Case Study: Goanna Ag Enables Smarter Cotton Production, Australia

Cotton is one of the world's most water-hungry crops, and the processes used to produce it vary dramatically depending on the availability of water. Optimising production requires better information about water distribution, but traditional manual monitoring has been difficult across cotton valleys that may span hundreds of thousands of hectares of arid and semi-arid land.

A pilot program, led by Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Cotton Research and Development Corporation (CRDC), has demonstrated the significant value of deploying networks of moisture and canopy temperature monitors across five different cotton farms.

Researchers worked with LoRaWAN operator NNNCo and agricultural technology firm Goanna Ag to deploy 175+ LoRaWAN gateways across 55,000 square kilometers in New South Wales, Victoria and Queensland, providing fast, reliable connectivity in areas where satellite options were too slow and mobile networks absent.

Data from real-time soil moisture sensors and canopy temperature sensors is fed across the LoRaWAN network into a central server, where it is combined with local weather forecasts and fed to proprietary CSIRO algorithms that allow farmers to forecast crop water use on a day-to-day basis.

The platform was found to deliver an additional $177 per hectare per season in net benefits, with an outlay of just $25 per hectare per season - promising a significant boost to cotton production that will allow Australia's cotton producers to make the best possible use of whatever water resources they have available.

**Read more**

## EIGHT REASONS WHY LoRaWAN® IS THE BEST CHOICE FOR WATER UTILITIES

A range of LPWAN technologies allows network operators to establish connectivity between water network control stations and remote IoT sensors. Options such as narrowband IoT (NB-IoT) and satellite connectivity require compromises in areas such as coverage, penetration to reach below-ground assets, and power demands that shorten battery life.

LoRaWAN balances these issues most effectively, leading to its wide acknowledgement as the best choice for water utilities' use cases. Following are eight reasons why.

### 1. More Cost-Effective Coverage

Australia's mobile phone networks cover 99.4% of highly populated areas. But limited service in many regional and remote areas reduces connectivity options in and between these areas. The installation of GSM and cellular base stations to improve regional coverage is expensive and time-consuming.

LoRaWAN provides a more flexible and scalable architecture for water utilities than cellular and NB-IoT solutions, whose communications protocols consume more power and cannot provide the same reach as LoRaWAN. Satellite options are often too expensive or lack the necessary performance characteristics to meet requirements.

One option is for water utilities to make use of the inherent flexibility of LoRaWAN by roaming between their privately owned LoRaWAN network and a telecommunications operator's LoRaWAN network infrastructure. This presents two advantages:

- Private LoRaWAN network access can be expanded by connecting to an operator-based LoRaWAN network, reducing cost and scaling deployments.
- Enterprises are not restricted by the high cost of data transmissions from cellular networks, as LoRaWAN networks do not require use of licensed spectrum.

### 2. Better Ground Penetration, including for Underground, Hard-to-Reach, or Deep Indoor Locations

It is estimated that of the 354,727 kms of pipes[12] in Australia, 85% to 90% are underground or deep indoors, according to Water Services Association of Australia estimates. This represents a major challenge for water utilities, which need to monitor and maintain their entire networks.

*12. This figure also includes sewer channels- Source: National Performance Report: http://www.bom.gov.au/water/npr/*

LoRaWAN provides an optimal solution for this coverage challenge, with tests confirming that it has better deep indoor signal-penetration capabilities than cellular and NB-IoT solutions - making it a superior solution in terms of costs and performance.

Maximum Coupling Loss (MCL) is defined as the maximum loss in the conducted power level that a system can tolerate and still be operable (defined by a minimum acceptable received power level). The MCL for both uplink and downlink of LoRaWAN is 165 decibels (dB); for NB-IoT, the MCL value can be from 145 dB to 169 dB for uplink and 151 dB for downlink based on the device class. NB-IoT solutions normally compensate for lower link budgets by increasing power consumption –reducing the battery life or requiring a larger battery size.

| Technology Parameters | LoRaWAN | NB-IoT |
|---|---|---|
| Bandwidth | 125 kHz | 180 kHz |
| Coverage | 165 dB | 164 dB |
| Battery Life | 15+ years | 10+ years |
| Peak Current | 32 mA | 120 mA |
| Sleep Current | 1μA | 5μA |
| Throughput | 50 Kbps | 60 Kbps |
| Latency | Device Class Dependent | < 10 s |
| Security | AES 128 bit | 3GPP (128 to 256 bit) |
| Geolocation | Yes (TDOA) | Yes (in 3GPP Rel 14) |
| Cost Efficiency (Device and Network) | High | Medium |

Source: ABI Research

*Figure 6: Technology Comparisons between LoRaWAN and NB-IoT*

## 3. Much Longer Battery Life of Up To 10 Years

Two important factors affect the life of IoT device batteries: the end-device current consumption (peak and average) and the contribution of the protocol.

Cellular communication systems are designed for optimal spectrum utilisation, which compromises the end-node in terms of cost and battery lifetime. LoRaWAN devices, by contrast, have the lowest power consumption of any bi-directional communications protocol. By optimising nodes for cost and battery lifetime at the expense of spectrum utilisation, LoRaWAN extensively extends IoT sensor battery life when compared with cellular and NBIoT technologies.

## 4. Two-Way Communication

Another key feature of LoRaWAN is its ability to support bi-directional communication. This means that an end device (sensor) can send a message to the network (containing, for example, sensor data, or occupancy or location information), as well as receiving messages from the network. Two-way transmissions allow acknowledgements, configuration changes in devices, and remote firmware updates. They also can be used for control of connected assets, including inter-device communications for advanced IoT solutions (as noted in Birdz' Lyon's case study referred to in this paper).

## 5. In-Built End-to-End Security

IoT devices lie at the heart of water utilities' operational networks, which means security is a key concern. The LoRa Alliance has kept security front and centre in its development of the LoRaWAN specification and has been highly transparent about the protocol's security features. AES algorithms provide authentication and integrity of packets to the network server, and end-to-end encryption to the application server.

The LoRaWAN specification offers dedicated end-to-end encryption to application providers, with two layers of cryptography. It uses a unique 128-bit network session key shared between the end device and the network server. Messages are then encrypted with another unique 128-bit application session key shared end-to-end at the application level.

## 6. Lower Total Cost of Ownership with Battery Consumption up to 5 Times Less than NB-IoT

When contemplating an IoT deployment, water utilities will ultimately evaluate options based on the lowest total cost of ownership (TCO). LoRaWAN's low hardware, operational and installation costs make it highly competitive compared to other solutions.

LoRaWAN consumes less energy than NB-IoT resulting in far greater battery life – tests confirm battery consumption is five times less than for NB-IoT[13] – significantly reducing capital and operational expenses.

## 7. Complementary to SCADA Systems by Adding Additional Data Points With LoRaWAN At A Lower Cost

LoRaWAN complements traditional SCADA systems, which water utilities rely on heavily for essential network functions. The ideal goal for water utilities is to integrate all data streams from LoRaWAN, SCADA and other systems into one platform for better monitoring, capital and operational expenditure projections, and ultimately, better decision-making.

LoRaWAN can also be gradually introduced in the water and sewage portion of the network for preventative maintenance, improving the life of the assets and reducing TCO. Due to the low cost of deployment and operation, LoRaWAN will complement SCADA in critical control systems and make it possible to monitor assets that otherwise would not be monitored as closely due to cost.

## 8. Multi-Service Platform for Smart City Use Cases

Smart city technologies are aiming at improving residents' quality of life and city services. These solutions lean heavily on IoT technology, which means cities and water utilities can share common connectivity fabrics.

*13. Orange Business Services, Connectivity, protocols, security and IoT needs: a compass to find a path, https://www.orange-business.com/en/*

LoRaWAN is suited to supplement city-wide IoT application use cases because of the complementary nature and large, global ecosystem of devices and solutions... Further, water utilities that deploy LoRaWAN can offer additional value and use the same infrastructure to expand into supporting smart city applications, such as smart waste management, smart parking, smart street lighting and a plethora of others, generating new revenue streams or cost savings.

Cities that own water utilities have the advantage of owning public assets (such as traffic poles, light poles and city buildings) where additional LoRaWAN gateways can be easily deployed, expanding the network by using common network architectures.

### Case study: Real-Time Water Network Monitoring in France's Second Largest City

The network providing water to France's second-largest city, the Metropolis of Lyon, is complex and extensive. Water authority Eau du Grand Lyon (EGL) provides water to the region's 2.2 million inhabitants using a metropolis-managed water network that spans 4,000 kilometres of pipes, 62 reservoirs and water towers, 11 water wells and 396,000 metering points.

To improve visibility and management, network operators engaged specialist network provider Birdz to develop and integrate 400,000 smart water G2 sensors and LoRaWAN gateways. Smart meters, water quality sensors and acoustic correlators were distributed across the network, with each one connecting to a central 'grid management' platform via LoRaWAN.

Installed over four years, the new monitoring network quickly paid itself off by helping network engineers identify and fix more than 1,200 water leaks. These and other network improvements have saved 1 million cubic metres of water annually, which along with other network fault remediation practices, have improved water network efficiency by 8% overall.

Real-time reporting makes possible better reporting for consumers, while better visibility of network asset status has helped Metropolis authorities meet critical key performance indicators to avoid financial penalties for non-performance.

**Read more**

## CONCLUSION

The water industry needs to implement new approaches to manage water infrastructure to cope with the challenges of increasing water scarcity, more frequent and intense extreme climate events, a growing population and ageing assets.

Water distributors are responsible for improving their overall resource management strategies as they push towards net-zero targets and better sustainability and protection of scarce water resources.

So far in Australia and New Zealand, some utilities have experienced the benefits of LoRaWAN to improve water resilience. Gold Coast City Council and IoT Ventures are prime examples of the large-scale deployment of low-cost, long-life sensors creating new data for SCADA systems, so that water operators, agricultural users and water consumers in industrial, commercial and residential can better monitor water usage. This increased visibility promises a revolution in water services, creating cost savings through reduction of non-revenue water and improved customer experience.

LoRaWAN excels in meeting connectivity requirements in a more cost-effective and efficient manner when compared with other communications choices. The real benefits of IoT for water utilities can be unleashed by LoRaWAN to underpin greater water resilience. This is a unique moment in time where technology is available, with a vibrant local ecosystem in Australia-New Zealand, supported by the LoRa Alliance.

By using LoRaWAN to get smarter about how water is used, managed and allocated, Australia and New Zealand can better meet local and global environmental imperatives while maintaining high standards of living and economic productivity.

Lake Macquarie City Council city-wide
LoRaWAN network - Australia
Credit photo: Dantia

# CONTRIBUTORS


**Thanks to:**

Activity: Sourmack Darbouy
Birdz (a Veolia company): Bruno Hamamlian
Goanna Ag: John Pattinson
Gold Coast City Council: Tanya Lipus
Gold Coast Water: Chris Owen
IoTAA Water Workstream Lead: Paul Siemers
IoT Ventures New Zealand: Matt Hector-Taylor
Schneider Electric: Bradley Yager
Tankview: Lee Kirsopp
Veolia: Yves Andre

PROJECT TEAM
Enzen: Nishant Tandon (formerly)
LoRa Alliance: Anne Van Gemert (formerly)
Maravedis LLC: Adlane Fellah
NNNCo: Sophie Nguyen, Tony Tilbrook
Semtech: Remi Demerle


A digital copy of this water whitepaper can be found on the web:
**LoRa Alliance:**
https://lora-alliance.org/resource-hub/?_sft_resource_categories=white-paper

**NNNCo:**
https://www.nnnco.com.au/wp-content/uploads/whitepaper-lora-alliance.pdf

**About the Lead Author:**

Adlane Fellah, Senior Analyst, is the CEO of Maravedis, a leading wireless analyst firm since 2002. Mr. Fellah has authored various landmark reports on 5G; Wi-Fi; LTE; IoT; and technology trends in various industries, including retail, restaurant, and hospitality. He is regularly invited to speak at leading wireless events and consistently contributes to various influential portals and magazines. He is also a Certified Wireless Network Administrator (CWNA) and Certified Wireless Technology Specialist (CWTS). He also regularly serves as Glomo Awards (GSMA) and WBA Awards judge. More at www.maravedis-bwa.com

Learn more about the LoRa Alliance and LoRaWAN specification at admin@lora-alliance.org or by visiting www.lora-alliance.org

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