Australasian Hydrographer

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AUSTRALIAN HYDROGRAPHERS ASSOCIATION

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Photo Credit:
Mic Clayton, Hydrographic Program Improvement Lead, Snowy Hydro Limited.

Photo Information:
Gauging the Thredbo River flood
(in late 2020).

Contents

Acknowledgement of Country

The AHA acknowledges the Australian Aboriginal and Torres Strait Islander peoples of this nation. We acknowledge the traditional custodians of the lands on which our association is located and where we conduct our business. We pay our respects to ancestors and Elders past, present and emerging. The AHA is committed to honouring Australian Aboriginal and Torres Strait Islander peoples' unique cultural and spiritual relationships to the land, waters and seas and their rich contribution to society.

JACQUIE BELLHOUSE

Editor In Chief's Introduction

Season's Greetings to our readers! I hope that this edition of the Australasian Hydrographer ends a brilliant 2021 and leads in to an even better 2022.

Personally, for me 2021 has been a bit of a mixed bag. On one hand we have seen some impressive hydrologic events from the almost record-breaking July rainfall in WA's South-West, to the recent rains that have caused widespread flooding across the Northern Murray Basin. However, on the other hand over the last couple of years, I and others have suffered the loss of some unforgettable mentors and friends that during their time, have significantly influenced the Hydrographic profession. You will find consequentially this edition has the unfortunate honour of presenting two Vales. One for my good friend and co-conspirator during the review of Australia's National Industry Guidelines for hydrometric monitoring, David 'Buck' McPhee and a second for a man that was considered by many WA Hydrographers as the "Godfather of Hydrography in WA" Keith Barrett. Both gentlemen and all others that the Australasian Hydrographer has remembered will be missed but never forgotten.

On the professional front another National Guideline was added to the stable, see September's edition for the article *'New Surface Velocity Guidelines - Setting the standard internationally'* for further details. In this instance the guideline is not only the first of its kind around the globe but is also being looked to as the foundation for a new ISO Standard. On the organisational front the AHA has also been going through some significant changes which Arron has kindly elaborated on within his blurb.

Yet all through this our readers keep on giving. Thanks to all that have shared either their profiles, papers, and photos with the Australasian Hydrographer, and in particular our regular contributors such as Daniel Wagenaar (check out his latest contribution *Determining Total Volume of Sediment in Residential Lake)* and staff from Aquatic Informatics such as Rich Prinster (author of Harnessing the *Power of Data to Solve Global Water Challenges - Four key water data management milestones to ensure the sustainability of water)*. I freely admit that without these contributions the Australasian Hydrographer would simply not exist.

The same goes for our brilliant Publications Think-Tank Team, thank you for all your hard work this year Harrison Schofield, Zac Ward and especially my great friend Grant Robinson who has unfortunately decided that now is the right time to retire from the role.

An on that note I ask that our members keep the papers, profiles and photos flowing in (pun intended) during the year ahead. I love reading about all the great work my fellow Hydrographers are undertaking across Australia and New Zealand and I am sure our readers do as well. And if anyone wishes to join the Publications Think-Tank you are more than welcome to email us at Journal@aha.net.au.

Happy New Year!

From your Editor In Chief,

Jacquie Bellhouse CPH

Providing Australia with Water Information

Australian Government
Bureau of Meteorology

www.bom.gov.au/water

Have you checked out the Bureau of Meteorology's water information web pages recently?

They provide a comprehensive and reliable picture of Australia's water resources for the benefit of all water users.

The published water information is based on data provided by almost 200 organisations across Australia. Working closely with data providers and stakeholders, a portfolio of water information products has been developed covering historic information and trends; current status; forecasts; and planning tools to provide users with both a local and national perspective on water resources in Australia. Key products include:

Water Data

- Water Data Online provides a single access point to data for more than 6000 monitoring stations across Australia.
- Water storages dashboard compares daily water levels and volumes for more than 300 storages.
- Design Rainfalls provide Intensity-Frequency-Duration rainfall estimates for designing hydraulic structures.
- Australian Water Market website tracks and reports water trading.

Water Status

- Our suite of national water assessment products, groundwater information products, National Water Account and Urban Performance Report provide information to support water policy and planning.
- The Landscape Water Balance Model assists in understanding how catchments have responded to rainfall and runoff both currently and in the past.

Water Forecasts

- The 7-day streamflow forecasting service and Seasonal Streamflow Forecasts provide streamflow forecasts to assist river operators with decision-making.

MORE INFORMATION

For more information come and talk to us at Booth 13; visit www.bom.gov.au/water or send an email to waterinfor@bom.gov.au

ARRAN CORBETT

From the President

Season's Greetings to my fellow AHA members! I hope that this edition of the Australasian Hydrographer finds you well rested and ready for the year ahead.

2021 certainly came to a dramatic conclusion from the Hydrographers perspective. Recent rains have caused widespread flooding across the Northern Murray Basin. Most storages in the affected area are either overflowing or well on their way to capacity. This is a dramatic full stop to the drought that impacted the same area from 2017-2020, being the worst on record since the late 1800s. I know that the Brisbane and Toowoomba based Hydrographers certainly got stuck in and I expect the case will be the same with the WaterNSW teams. Makes me think of the old saying about what flood gauging gets you… "a wet arse and no fish". Hopefully a few rating curve top ends will have tightened up though.

In news on the organisation front, we have a bit to share. But before we do that, I think it prudent to take a second to recognise the outstanding efforts of our new secretary – Krystal Hoult. Krystal has put in an incredible number of hours in managing our current transition. On behalf of the committee – thank you!

One of the key activities that we oversee as an organisation is training. Given our priority on ensuring that our students are properly supported we have taken the following steps:

1. Appointed John Skinner as temporary training officer through to end of Semester 1, 2022.
2. Developed a Training Officer role description, which we advertise in early 2022.
3. Committed to completing a recruitment process and onboarding for the successful applicant prior to the commencement of Semester 2, 2022.

We are making strong progress in many areas of committee organisation, and I hope to bring you further updates soon. Every step we take now is designed to increase value for you our members.

One last, but important, message from me. Stay safe in 2022, whether you are sitting at your desk, in a tinny, behind the wheel, working on your abode or enjoying some personal time with friends!

Happy New Year!!

Arran Corbett CPH
AHA President

Harmful algal bloom monitoring

Stay informed & spend less time in the field

The Aqua TROLL 500 Multiparameter Sonde by In-Situ is a cost-effective multiprobe which enables wireless data collection when used as a handheld, plus easy integration with control systems and telemetry for long-term installation.

Find out more at

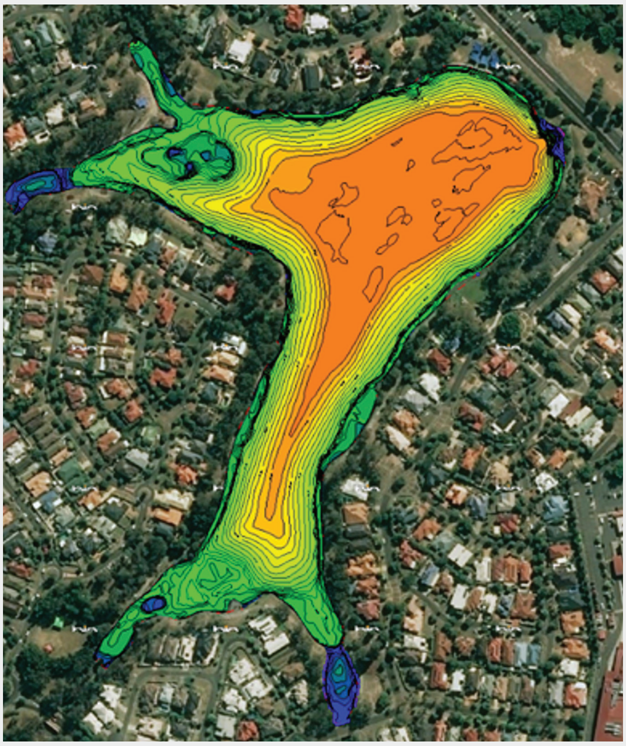
thermofisher.com.au/aquatroll500

ThermoFisher SCIENTIFIC

Determining Total Volume of Sediment in Residential Lake

Daniel Wagenaar, Xylem Water Solutions, Newcastle, NSW, Australia

Introduction



A Survey was performed of a residential lake to determine the total volume of sediment deposited. The survey comprised of the main water body and four inlets discharging into the lake. The survey methods applied during the bathymetry survey varied from bathymetric survey using unmanned surface vehicle/dual frequency echo sounder to topographic survey of the banks and inlets using survey rod and data collector.

This technical note gives a broad overview of the equipment and surveying techniques used during the survey process, as well as the methodology followed in developing surface elevation models and calculating total volume of sediment in the lake.

Survey Equipment

The survey equipment selected for the survey included of two Global Navigation Satellite System (GNSS) Smart Antenna's (Hemisphere S321), CEE HydroSystems CEESCOPE with dual frequency echo sounder and an Autonomous rQPOD unmanned surface vehicle (USV). The survey software utilized during the survey consisted of HYPACK® Hydrographic Survey and Carlson SurvCE software respectively. Water quality instrument selected for the survey comprised of a multiparameter YSI EXO sonde.

GNSS

The base station GNSS Smart Antenna was setup over a known survey marker using tripod and tribrach shown in Figure 1. The base station was configured based on survey marker coordinates (MGA94), elevation (AHD) and instrument height using SurvCE software.

The rover GNSS Smart Antenna was setup on either rQPOD or survey pole with the exact height of the GNSS antenna configured in the survey software.

Figure 1. Hemisphere S321 Smart Antenna.

Figure 2. CEESCOPE & M195 Dual Frequency Echo sounder.

Echo Sounder

CEESCOPE and M195 Dual Frequency echo sounder from CEE HydroSystems shown in Figure 2 was mounted on unmanned surface vehicle (USV) for the bathymetric component of the survey. The data was transmitted from the CEESCOPE to land based HYPACK® Hydrographic Survey software using CEE-LINK™ shore radio module.

USV

Autonomous rQPOD (USV) was used for the bathymetric component shown in Figure 3. A special mounting was designed for the M195 echo sounder to fit into the existing instrument wet-well.

The line plan developed in HYPACK® Hydrographic Survey software was uploaded onto the rQPOD. This enabled the rQPOD to track the lines autonomously during the bathymetric survey ensuring much higher efficiency in performing the surveys.

Figure 3. Autonomous rQPOD.

Figure 4. YSI EXO Sonde.

Water Quality

The YSI EXO Sonde shown in Figure 4 was used to capture real-time conductivity and temperature variations during the bathymetry survey.

Time series of conductivity and temperature measurements were recorded during the bathymetric survey for relevant sound speed corrections.

Survey Control

Survey Control Design

The horizontal and vertical survey control for the bathymetry survey was based on four survey markers shown in Figure 5. The position of the survey markers was selected based on Real Time Kinematic (RTK), Network RTK and Theodolite survey requirements.

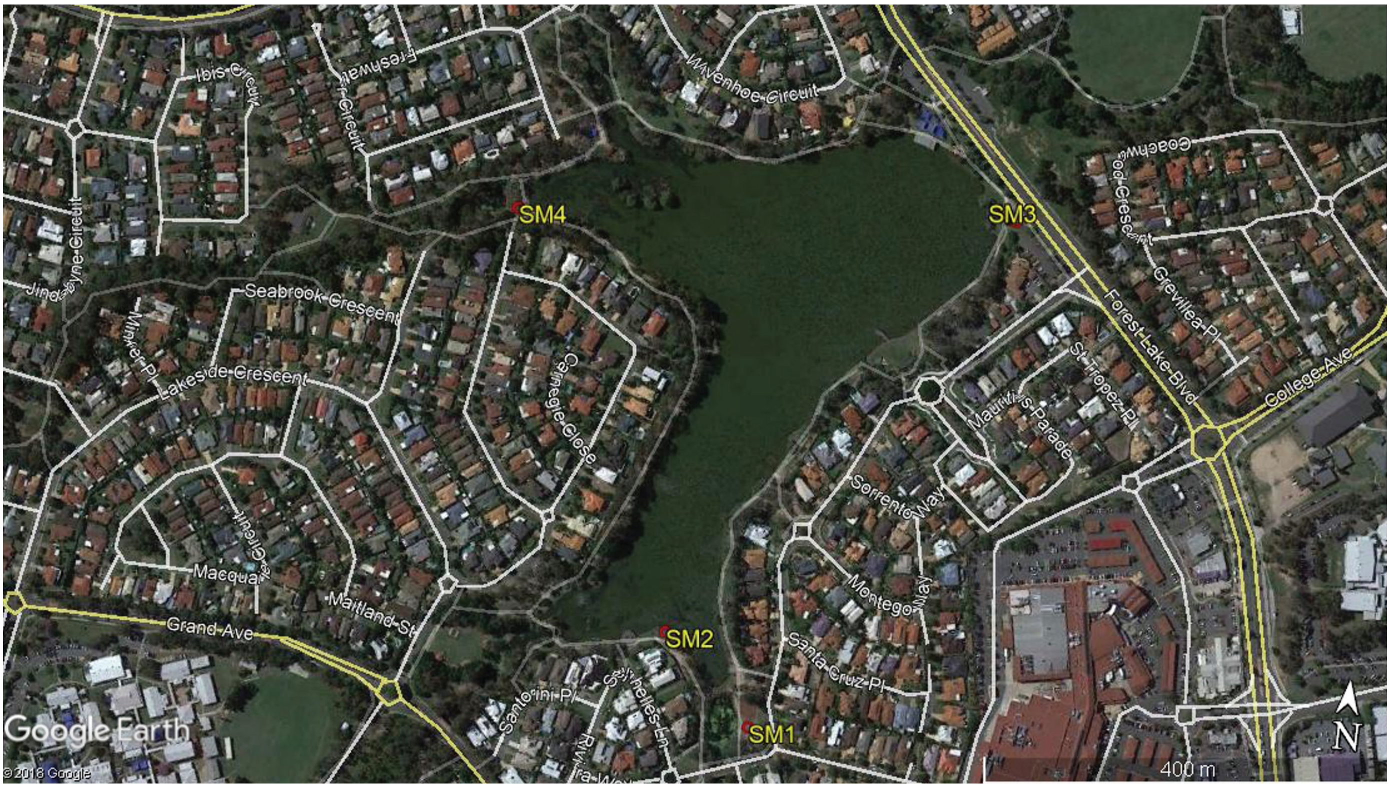


Figure 5. Location of Survey Markers.

Horizontal and Vertical Control

The four survey markers were established using Static GNSS survey technique, collecting more than 2 hours of raw satellite data at each survey marker. The raw satellite data was collected using Hemisphere S321 (multi-GNSS, multi frequency) Smart Antenna. The data collected during the static surveys was converted to RINEX format from where it was uploaded to the AUSPOS post processing facility on the Geoscience Australia website.

The Real Time Kinematic (RTK) and Network RTK surveys were verified against the established horizontal and vertical control during the survey to ensure that high level of accuracy is achieved.

Survey Localization

The results obtained from Geoscience Australia of the static surveys performed at the survey markers showed a higher accuracy in position and elevation at survey marker SM1. Based on the higher accuracy survey marker SM1 position and elevation was used to localize the entire survey.

Bathymetry Survey

Survey Procedure

The survey procedure comprised of two items, a topographic and bathymetric component.

The topographic survey consisted of surveying the lake boundary and the four inlets. The top and bottom bank elevation of the boundary was surveyed at an approximately 5m interval shown in Figure 6.

The inlets topographic survey comprised of surveying the surface elevation of the sediment and channel bed. A specially designed circular foot was mounted at the bottom of the survey rod to prevent the survey rod from penetrating the sediment during the sediment survey.

Figure 6. Top and Bottom Bank Survey.

Figure 7. rQPOD Platform.

The topographic and bathymetric surveys were based on RTK survey techniques, using Hemisphere S321 Smart Antenna's.

The bathymetric survey was performed using CEE HydroSystem with dual echo sounder and HYPACK® Hydrographic Survey software. The survey vessel consisted of rQPOD remote control platform with autonomous feature shown in Figure 7.

The bathymetric survey area was defined by a boundary based on actual measurements from where a line plan was developed at 10m intervals perpendicular to the channel topography. This is shown in Figure 8.

Figure 8. Border and Line Plan.

Data Collection

The line plan was then developed for the main water body of the lake. It was also uploaded on the autonomous rQPOD platform.

Individual measurement files containing all the raw data from the Hemisphere S321 and CEEHydroSystems echo sounder were created in HYPACK® for each of the planned lines.

The actual ship track of the autonomous rQPOD is shown in Figure 9.

Figure 9. Bathymetric Survey.

Position and elevation of each point during the topographic survey was recorded using the Hemisphere data collector and SurvCE software.

The individual points surveyed during the topographic survey at Inlet 1 are shown in Figure 10.

Figure 10. Topographic Survey.

Water Elevation

The water elevation was relatively constant during the bathymetric survey. Water elevation was surveyed each day before and after the completion of the bathymetric survey, summarised in Table 1.

A pressure sensor was also installed to monitor the water level trend during the bathymetric surveys.

Water elevation of 36.292 mAHD was used to translate the depth measurements from the echo sounder to elevation in mAHD. The elevation is based on the average surveyed water levels over the three days.

Date	Time	Elevation
1st Oct	14:39	36.287
2nd Oct	10:01	36.3266
	10:03	36.2977
	15:42	36.2932
	15:43	36.3106
3rd Oct	09:19	36.289
	09:20	36.271
	14:03	36.287
	14:04	36.283

Table 1. Water Elevation.

Water Quality

Conductivity and temperature timeseries data shown in Figure 11 were recorded during the bathymetric survey.

The real-time measurements from the EXO Sonde were used to perform speed of sound calculations for acoustic doppler measurements performed by the echosounder.

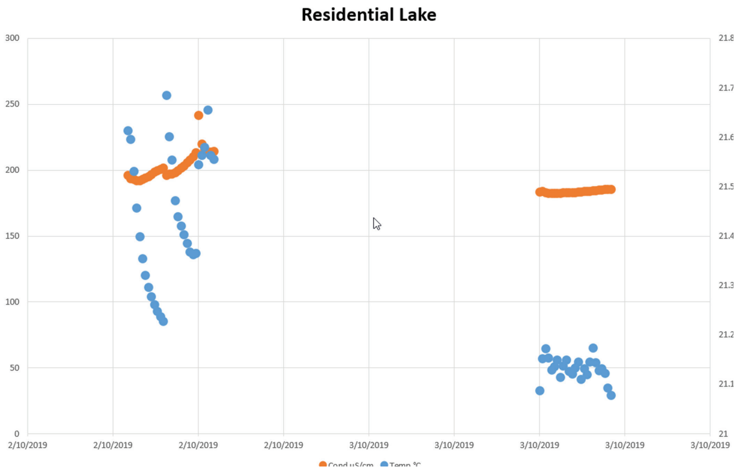


Figure 11. Water quality time series.

Survey Statistics

Survey statistics calculated from the raw data collected during both the bathymetric and topographic surveys preformed are summarised in Table 2.

Variable	Description	Value
Line Plan	Total number of survey lines	94
	Total length of survey lines	9,130m
Soundings	Number of soundings using echo sounder	141,612
	Number of soundings using survey pole	2,446
Perimeter	Distance of lake perimeter including four inlets	2,697.3m
	Area of lake perimeter including four inlets	108,318.1m2
Elevation	Highest surveyed elevation	38.45m AHD
	Lowest surveyed elevation	32.63m AHD

Table 2. Survey Statistics.

Model Development

TIN Model

A Triangular-Irregular Network (TIN) Model was developed based on the sediment surface and channel bed surface elevation in Hypack bathymetric software package illustrated in Figure 12. The models were developed from XYZ soundings of both the bathymetric (dual frequency echo sounder) and topographic surveys (survey rod).

The XYZ soundings from both the bathymetric and topographic surveys were combined with the bottom of bank surveys. A grid of 1m x 1m was developed from the XYZ soundings in HYPACK®. The top of bank soundings were combined with the 1m x 1m grid for the final TIN model.

Figure 12. TIN Model.

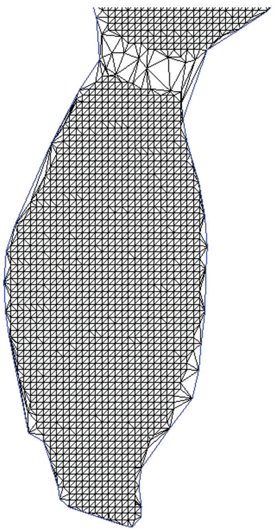


Figure 13. Inlet 1 TIN Model.

The final TIN model of Inlet 1 is illustrated in Figure 13. The TIN models developed for sediment surface and channel bed surface elevation was used for all outputs generated in HYPACK®.

Sediment Surface Elevation

Sediment surface elevation was developed from the developed TIN Model shown in Figure 14.

Elevation colour scheme range of 32.70 – 38.40m AHD was adopted for the survey. This clearly shows the change in elevation of the four inlets to the main water body.

3D Sediment surface elevation is shown in Figure 15. The surface elevation of the main water body does not change significantly across the lake.

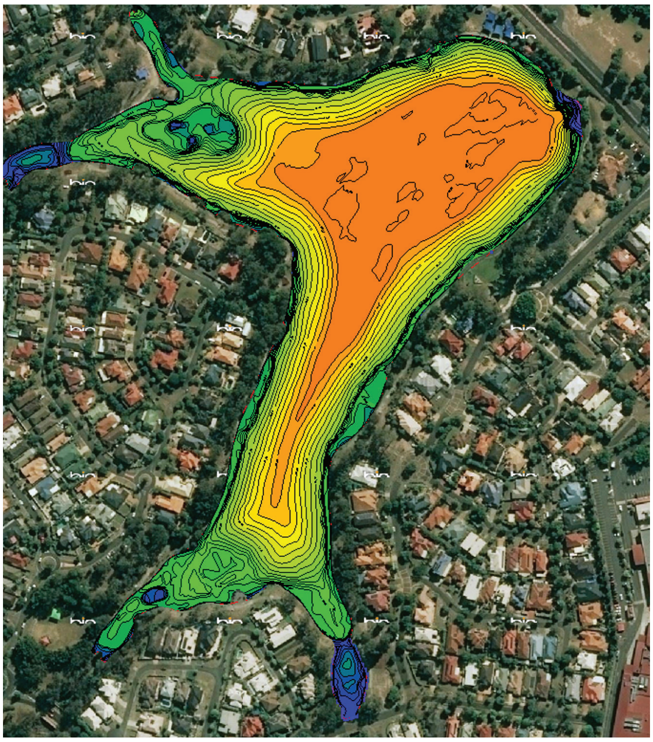


Figure 14. Sediment Surface Elevation.

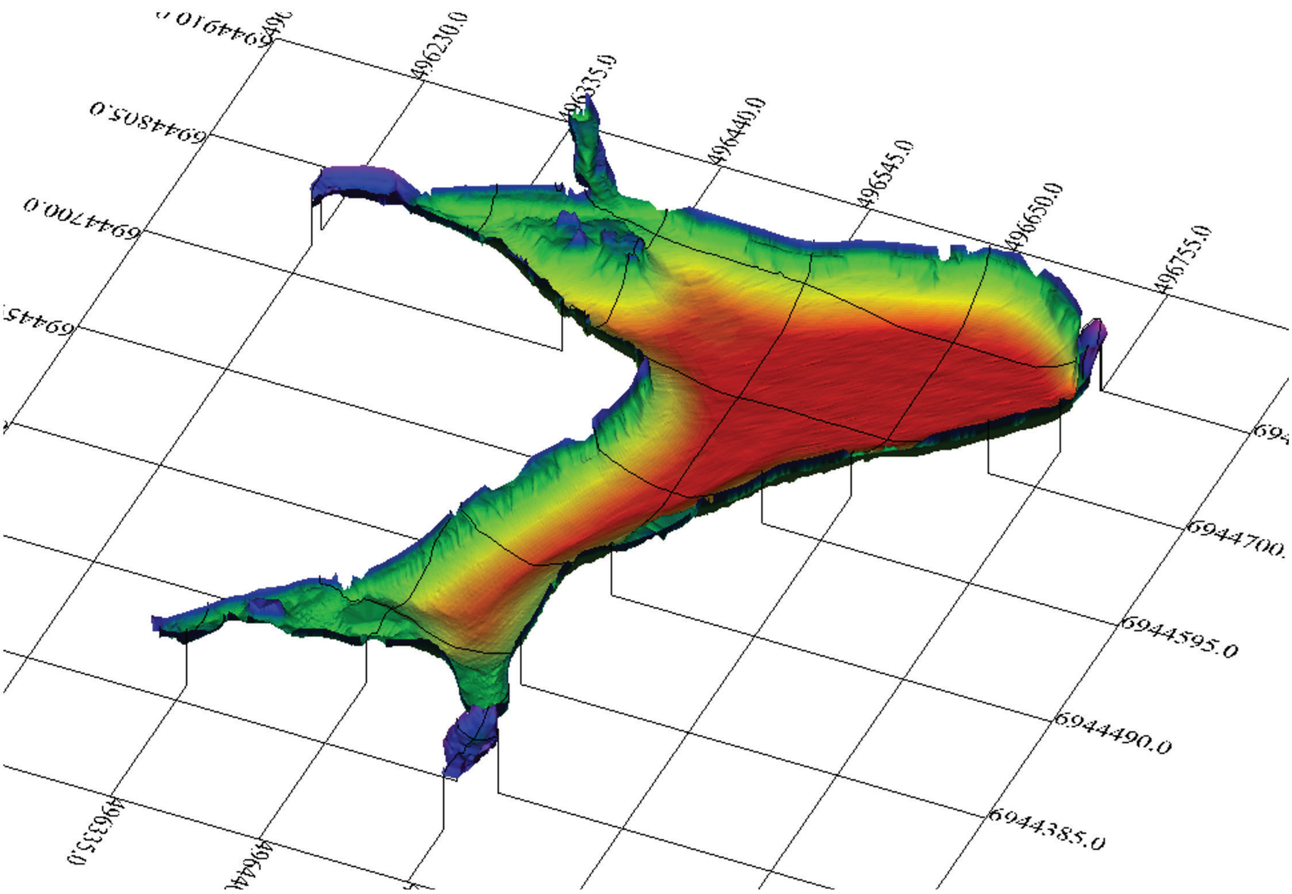


Figure 15. 3D Sludge Surface Elevation.

Channel Bed Surface Elevation

Channel Bed surface elevation was developed from the developed TIN Model shown in Figure 16.

Elevation colour scheme range of 32.70 – 38.40m AHD was adopted for the survey. This clearly shows the change in elevation of the four inlets to the main water body.

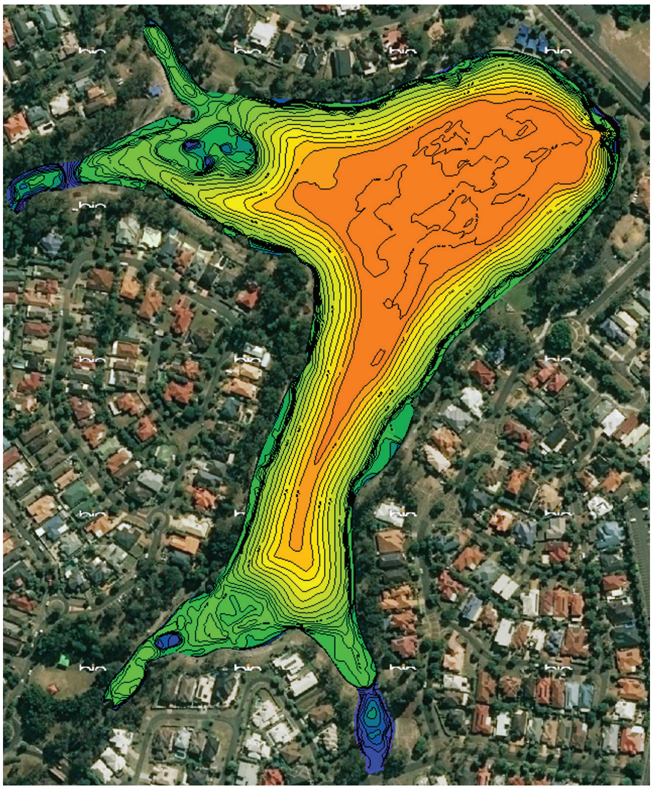


Figure 16. Channel Bed Surface Elevation.

Figure 17. Sediment Thickness.

Sediment Thickness

The sediment thickness was determined by developing a surface elevation model for Sediment Surface and the Channel Bed.

The difference in elevation between the two models resulted in the total thickness of the sediment within the lake shown in Figure 17.

Sludge Volume

Volume and area calculation was performed between the difference of the Sediment and Channel Bed Surface Elevation models. The 'Volume' and 'Area' of total sediment calculated in the Lake is summarised in Table 3.

Volume Above (m^3)	Area Above (m^2)	Volume Below (m^3)	Area Below (m^2)
3435.2	106361.7	113.3	26365.4

Table 3. Sediment Volume and Area Calculation.

The 'Volume' and 'Area Above' equate to the total amount of sediment above the channel bed supplied in Table 5. The 'Volume' and 'Area Below' equate to the total volume below the channel bed.

Conclusion

The survey approach and data processing is unique to each project even though the survey equipment and procedures are similar. There are aspects that are similar between projects, but it is unlikely that you could apply the same approach entirely on a new project.

What I have found over the years is if you comply with the following key principles, the probability in achieving accurate survey results is very high:

1. Segmentation of survey - This is a key component in overall survey design and depending on the size of the project, it is difficult to perform the entire survey in one operation. The following process was followed;
   a. Establish horizontal and vertical control
      i. Visibility to sky is crucial for GPS surveying.
      ii. Line of sight is essential for Theodolite (Total Station) surveying. Areas with dense vegetation and or buildings will need a different survey technique.
   b. Topographic survey component comprising of top and bottom of bank of entire lake.
   c. Topographic survey of each individual inlet.
   d. Bathymetric survey of main lake.
2. Systematic approach with both the survey and data processing.
3. Establishing control for surveying and water elevation measurements. Existing survey markers and water level instrumentation can be used, but operator must verify the accuracy.
4. Verification process for surveying and water level measurements. It is important to verify the position, elevation, and water level accuracy during the entire survey against a reference (survey markers, water level sensor, staff gauge, etc.). This process must be performed at the start and end of each survey.
5. Segmentation of data processing. Depending on the size of the project, it is impossible to process all the raw data at once. In certain cases, only a part of the data can be processed at a time from where the different segments are combined. The following process was followed;
   a. Echo sounder data was processed separately.
   b. Combine bottom of bank with echo sounder measurements.
   c. Generate 1m x 1m XYZ grid.
   d. Clip XYZ file (1m x 1m grid) with top of bank border file.
   e. Combine XYZ (top of bank) with clipped XYZ (1m x 1m grid) file.
   f. Develop TIN model.

Vale - David 'Buck' McPhee

David 'Buck' McPhee was part of the Victorian Department of Environment Water Land and Planning's (DELWP) water monitoring and data team for 10 years. David was the regional co-ordinator for the Regional Water Monitoring Partnership (RWMP) and was mostly based in Tatura (and more recently in Geelong). The RWMP is a voluntary collection of 52 organisations that come together to share the cost of surface water monitoring in Victoria.

As one of the RWMP coordinators, David spent a lot of time in the field at surface water monitoring sites talking to RWMP partner representatives to understand their needs and offer suggestions and solutions to their issues in conjunction with our service providers (ALS and Ventia). David was very much at home with all the technology used to capture and transmit water monitoring data.

David made a major contribution to documenting all the assets at the 850 monitoring sites in the RWMP network and working on a database that would track and predict when assets would need to be replaced. David also championed the use of bulk purchases of monitoring equipment, which resulted in lower costs to RWMP partners.

David attended many the flood plain management annual conferences, where he could indulge his two loves, talking and red wine. He also did a lot of networking with local councils with flood management responsibilities to smooth their way into the RWMP. Local councils now represent one third of all RWMP partners.

David was the Victorian representative on WaMSTeC (Water Monitoring Standardisation Technical Committee), which during his time on the Committee was spent reviewing and further developing Australia's National Industry Guidelines for hydrometric monitoring.

In recognition of David's work, gauging site 405200 (Goulburn River @ Murchison) has been renamed Goulburn River @ Murchison (McPhee's Rest) and a memorial plaque has been installed at the site recognising David's contribution to the Victoria water industry. David passed away in September 2020 after a short battle with cancer.

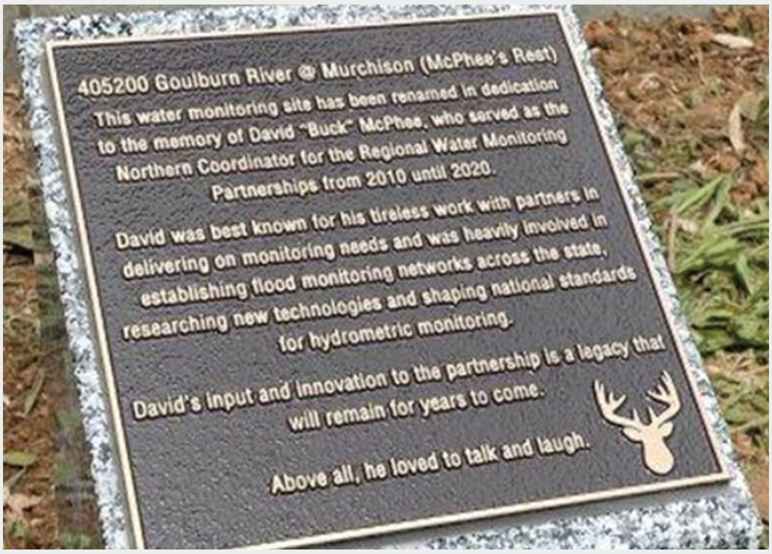


Image 1. Memorial plaque for David 'Buck' McPhee installed at Goulburn River @ Murchison (McPhee's Rest).

Vale - Keith Barrett

Western Australia is a state blessed with an abundance of natural resources but, as for the rest of Australia, the most precious is water. The more we know about this resource the better chance we have of managing the various competing demands for what we know is not inexhaustible.

Keith Barrett, a Hydrologist, and leader in the development of hydrography as a profession, within Western Australia during the period of the Public Works Department, Water Authority, and current Water Corporation, understood this well.

Keith considered Hydrometry and Hydrology to be companion disciplines, Hydrographers traditionally measuring the flow and content of our streams and groundwater while the hydrologists analysed and modelled with the data that the hydrographers collected. Keith also understood that without hydrographers and the hydrometric data they collected hydrologists would struggle to influence decisions about water related infrastructure.

Image 1. Keith Barrett
13.02.1939 to 24.11.2021

Keith started as an engineering hydrologist with the Public Works Department in 1961. Initially it wasn't the career he had thought of taking up, having seen himself primarily as an Engineer, but it was one he showed a great aptitude for. This was not surprising given Keith had always shown an interest in water as a young child.

Keith later went on to a leadership role as an engineer in the Water Resources Section of the Public Works Department (PWD). When the PWD folded in 1985 he became a Hydrology Manager within the Water Authority of Western Australia and later Infrastructure Planning Manager within the Water Corporation of WA.

During Keith's early career the formation of the Australian Water Resources Council (AWRC) and later passing of the Commonwealth Parliament of the States Grants (Water Resources Measurement) Act 1964, provided a springboard for significant developments in the measurement of WA's water Resources.

The scope of hydrometric work in the state widened to include the measurement of water quality and the installation of more gauging stations on previously less-well-understood rivers.

However, with these developments came significantly more hydrometric data which required analysis. For Keith, who along with his co-workers relied on this information, questions began to arise regarding the data coming back from the field. Eventually, keenly aware of the need for more accurate information, Keith, and his co-worker Brian Sadler felt compelled to review the process.

The review findings, delivered in May 1963, resulted in the formation of the Water Resources Branch within the Public Works Department, and proved to be a significant catalyst for the development of expertise in hydrometric data collection and assessment in WA. One of the primary developments the introduction of the trainee hydrographer scheme, a formal pattern of recruitment training and development of expertise, creating long-term careers for many notable Western Australian hydrographers for years to come.

The following 1960's and 1970's offered the chance for WA, a late starter, to become a driving force in Australian Hydrographic Development. Staff at every level were encouraged to contribute ideas -

> *"That was the joy of it. We had no tradition holding us back in everything we did it was like exploring the future. We were inventing a newer future all the time. We never looked back, never had to worry about the past, never had to check with everybody if we could do something, we just concentrated on doing it."* Keith Barrett[1]

Hence whilst Keith was an extremely talented Engineering Hydrologist, it is widely agreed within the WA Hydrographic fraternity that his ultimate contribution, to the management of our valuable water resources, was his unerring skill in developing, guiding, and encouraging effective multi-disciplinary teams. The more challenging the 'project', the more multi-disciplined the teams.

Additionally, whether they knew it or not, Keith also passed this skill on too many WA hydrographers, some staying in the profession for their whole careers, others branching out to related professions. Some even went on to pass their skill and knowledge to other family members.

Overall WA benefitted from this skill and understanding of the value of 'quality' water information. During his career, in addition to igniting the formation of a Water Resources Branch and Hydrographic Trainee program, Keith also contributed to;

- The 1964 Pilbara Aerial Survey, the basis for a comprehensive streamflow gauging network across the Pilbara region.
- The Kimberly Ord Project which eventually resulted in the construction of Australia's second largest dam (by capacity) the Ord River Dam, in 1972.
- WA's 'Salinity Assessment and applied Catchment Research Programs' (1985 -1995).
- A range of water resource assessments that at the time illustrated the impacts of declining rainfall, since the 1970's, on the efficiency of WA's South-West Surface Water Catchments and eventually lead to the construction of Perth's first Desalination plant.
- Wungong Catchment Forest Management Trial (2007 – 2014).

Keith will long be remembered both for his energetic, creative, and innovative work managing WA's water resources and the enduring culture of teamwork and innovation he fostered within Hydrographers, Hydrologists, Hydrogeologists, Engineers and Environmental practitioners alike.

For anyone interested in knowing more about Keith's input into WA's Hydrographic fraternity and the hydrographers it produced *Till the Stream Runs Dry* is a wonderful book by Bill Bunbury that provides a valuable historical record of Hydrography within Western Australia, as seen through the passionate eyes of the long-term Hydrographers who lived it including Keith.

Keith passed away from mesothelioma on the 24th November 2021 at the age of 82.

[1] Bill Bunbury, Till the Stream Runs Dry, A history of Hydrography in Western Australia, Government of Western Australia, September 2010.

Harnessing the Power of Data to Solve Global Water Challenges - Four key water data management milestones to ensure the sustainability of water

Rich Prinster, Strategic Development for Aquatic Informatics

With the global population expected to hit 8.5 billion[2] in the next 10 years, the demand for water is rising inexorably.

Many areas of the world are already facing either water shortages or water that's unsafe for human consumption.

When it comes to water scarcity:

- Four billion people[3] live in water-scarce and stressed regions — one billion of whom have no access to safe drinking water.
- Two-thirds of the world population faces water scarcity for at least one month every year[4].
- The over-pumping of underground aquifers is depleting water tables[5] in many parts of the world, including America, India, and China.
- Dams and lakes across America are drying up from drought and overuse.
- Droughts and natural disasters cut off access to potable and sanitary water anywhere in the world - Haiti is still known as a "pipe less" nation, after the catastrophic earthquake in 2010.

When it comes to water pollution:

- Globally, there are almost 1 million deaths[6] per year from waterborne diseases.
- 21 million[7] Americans are getting water from systems that violate health standards.
- 33 major US cities[8] have skirted water quality testing, the worst among them being Flint, Michigan; Toledo, Ohio; Charleston, West Virginia; and the Colorado River basin.

[2] https://www.un.org/sustainabledevelopment/blog/2015/07/un-projects-world-population-to-reach-8-5-billion-by-2030-driven-by growth-in-developing-countries/
[3] https://waterfm.com/water-utility-digital-world/
[4] http://www.endwaterpoverty.org/
[5] http://www.earth-policy.org/books/pb2/pb2ch3_ss2
[6] https://waterfm.com/water-utility-digital-world/
[7] https://www.sciencemag.org/news/2018/02/millions-americans-drink-potentially-unsafe-tap-water-how-does-your-county-stack
[8] https://www.theguardian.com/environment/2016/jun/02/lead-water-testing-cheats-chicago-boston-philadelphia

The bottom line: if we remain on the same path, the world is facing a 40 percent shortfall[9] in freshwater resources by 2030. So, it's no surprise that the World Economic Forum ranked the water crisis in the top 5 of global risks for the eighth consecutive year.

While the supply of water cannot be increased — e.g. we can't control how much rain falls — there are ways we can manage it better to reduce waste and contamination.

The UN General Assembly launched the Water Action Decade 2018-2028[10] to create urgency and encourage action in transforming how we manage our water. Each of the four workstreams outlined in the Action Plan Resolution rely on data quality, data management and knowledge sharing to address water challenges.

9 https://www.un.org/sustainabledevelopment/water-action-decade/
10 http://www.wateractiondecade.org/

UN's Water Action Plan Resolution

1. Facilitating **access to knowledge** and the exchange of good practices
2. Improving **knowledge generation and dissemination**, including new information relevant to water-related SDGs
3. Pursuing **advocacy, networking, and promoting partnerships and action**
4. Strengthening **communication actions** for implementation of the water-related goals

Source: United Nations[11]

While the action plan is straightforward, the sheer magnitude of our water problems can be daunting. To avoid analysis paralysis and apply the UN's action plan to real-world problems, governments, utilities, and industries that manage and use water should strive towards four water data milestones:

1. Water data consolidation to break down data silos
2. Water data analysis to turn raw data into actionable insights
3. Internal knowledge sharing across organisations, government departments, and international bodies
4. External knowledge sharing with industry and the public to educate, inform, and encourage respect for our most important resource

Water Data Consolidation

The first milestone is to breakdown some of the data silos that currently exist. Many government agencies are entrenched in legacy systems which can hinder progress. While many have been automating data collection in several areas for some time, few are examining the data sources alongside one another to connect the dots and uncover real insights.

Understanding the relationships between the consolidated water data sources is powerful. It can unveil insights we would never have found otherwise and offer correlations that we can use to test new hypotheses about the cause and effect of different water activity.

For example, we might detect a spike in water temperature from one set of data and an increased level of chlorophyll in another set. Alone, these trends may not raise an alarm but when read together, they indicate signs of agricultural runoff pollution that can cause harmful algal blooms.

When it comes to data consolidation, organisations can start small and chip away at the problem, breaking down data silos one by one to showcase the benefits in real-world scenarios.

[11] https://www.un.org/sustainabledevelopment/water-action-decade/

Case in Point:

Sanitation District No. 1 (SD1) manages wastewater and stormwater and has kept its rivers clean for over 70 years. Various departments work together to clean 37 million gallons of water per day. They conduct an average of 40,000 analyses, oversee inspections of 55 industrial users and 200 food service establishments, that also require collection of FOG data and permitting.

SD1 breaks down silos with Linko, a software tool that consolidates data across all teams to create efficiencies and ensure better water management across the region. For example, daily lab results sync with compliance data to alert SD1 of possible compliance issues; when regulations update, they can automatically change them across their consolidated system; and state reporting across all events easily.

“At the end of the day, if you aren’t familiar with pre-treatment, you would think that it’s just comparing a number against the limit. If that were the case, Excel would work. But, regulations change, interpretations change, and having a software platform that keeps up with that saves time and improves compliance,” says Sarah Griffith Laboratory and Industrial Pre-treatment Manager at Sanitation District No. 1.

SD1 allows different teams to gain value from consolidated data. For even greater benefits, data consolidation should occur not just cross-functionally, but also at a state, national level, and international level. This would involve alignment in the procurement of water data analysis platform tools and the collaboration between various IT and data science teams to build out the sufficient teams and processes.

Image 1. Aquatic Informatics portfolio of software solutions drive the efficient management of water information across the water cycle to protect human health and reduce environmental impact.

Water Data Analysis

Water utilities can struggle to get real value from the data at their disposal. IT teams often lack insight into the use cases that would help them justify the allocation of resources to water data projects and departments and teams don't know what they don't know.

So where can organisations start? Firstly, IT teams should collaborate with managers across the organisation who can ask the right questions of the data. These questions should map back to the goals of the organisation:

- Water utilities may ask questions to ensure safe drinking water for citizens
- Water purveyors may ask questions to understand water loss within the system
- Environmental agencies may ask questions to find solutions in extreme weather scenarios

Good data creates demand for good information. In other words, once you know what you *can* know, you will want to know more.

Case in Point:

The City of Riverside is a perfect example of a utility provider that maximized their use of data to gain powerful insights and subsequent operational efficiencies. Riverside Public Utilities (RPU) has been providing water and electricity to 70,000 customers since 1895. The utility is proactive in tackling challenges head on and data plays a central role in how it meets those challenges.

RPU implemented WaterTrax to consolidate and automate water quality sample data transfers from the laboratories. Today, the system integrates with their internal business intelligence tool, OSISoft PI System (a vehicle used for centralising data sourced from other business units including SCADA), Esri GIS, and Asset Management/Work Order System (UWAM).

The integration enables RPU to view current data from systems that were previously siloed and isolated. This integration has provided the utility with a more holistic view of their distribution system samples, treatment plant process control samples and groundwater well samples. Data is visualized in team dashboards and has had a significant impact on the operations team, helping them improve the efficiency of water quality management.

"The API integration has really improved our ability to quickly make decisions based on real time data. The advantage of combining information from SCADA, UWAM, and WaterTrax gives us the big picture in one place and allows us to improve performance and operational efficiency, said" Robin Glenney, Water Quality Administrator at Riverside Public Utilities.

Internal Knowledge Sharing

Data consolidation and analysis will bring an era of water transformation. Today, the biggest water users are power plants, farmers, and water utilities. Sharing data will help us identify the industries and communities that use water well, and those that don't. This knowledge sharing can go a long way to establishing best practices and forming helpful water regulations.

Case in Point:

The State of Wyoming has great insight into how their water is being used. They use this data to make smart decisions about conservation, about permit approval or revocation, and about innovation. They monitor continuous recording devices in over 400 streams, reservoirs, and canals, and operate numerous other continuous recording stations in cooperation with the USGS, the National Weather Service, and other federal and state agencies.

All water data is collected, reduced, and compiled using AQUARIUS software to consolidate all the disparate data so they can process, visualise, and manage their water data in one dashboard.

The state can now ask questions of the data like:

- How much water is available?
- How much is being used and by whom?
- How much additional water is being used for agriculture?
- How much additional water could be taken out of the system?

This helps them make better decisions about current water permits. “We are now sharing data with our users in real-time, helping them as well as us make better management decisions. Before we implemented AQUARIUS, that was not possible,” said Loren Smith, Water Division Superintendent at Wyoming State Engineer’s Office.

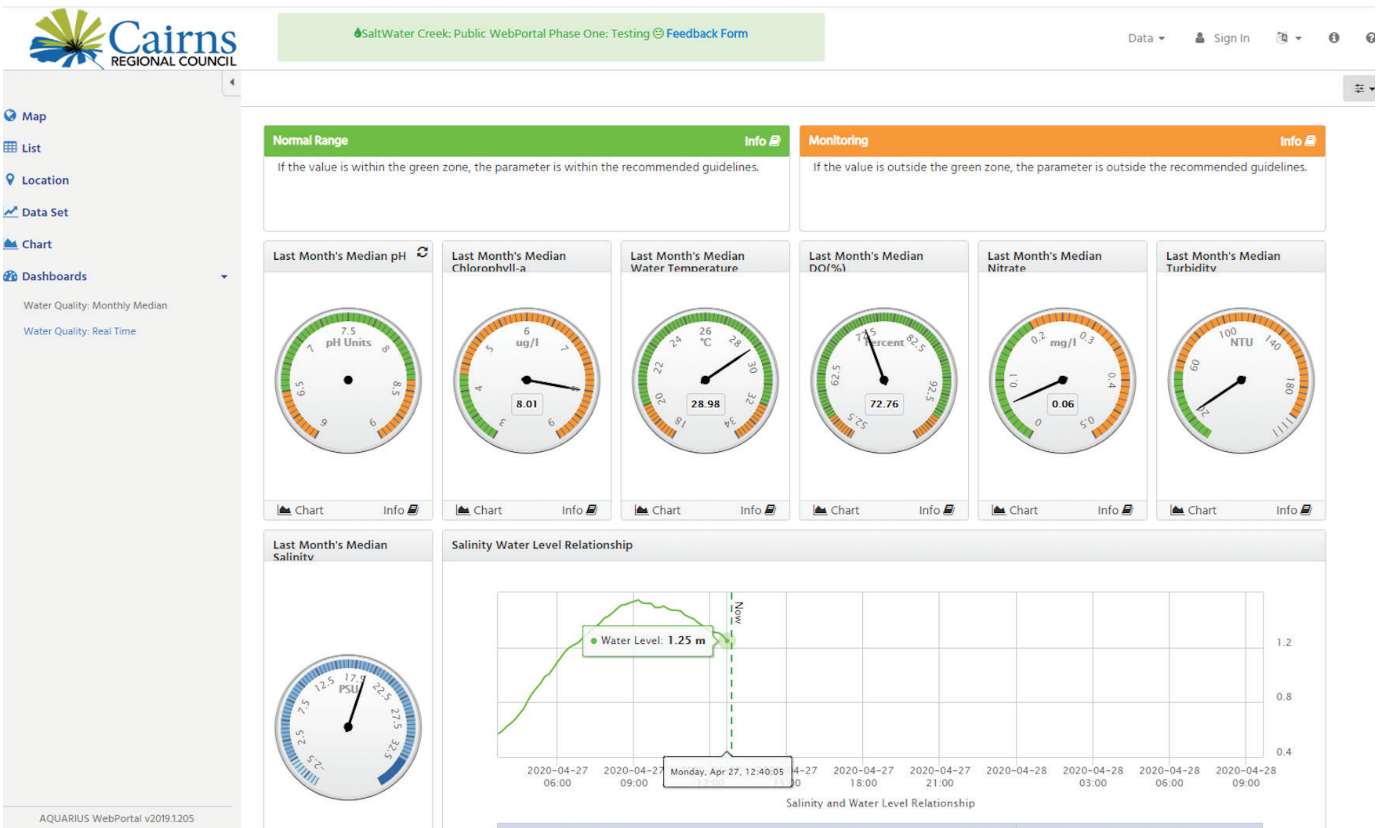


Image 2. Cairns Dashboard is driven by Aquarius software to acquire, process, model, and publish water information in real time.

External Knowledge Sharing

According to a World Bank study[12], the projected economic impact of water scarcity is estimated to be as much as 6 percent negative GDP in certain regions by 2050. To solve a global problem, we need global collaboration.

The only way we can solve our water problems and avoid these shockwaves is by harnessing our data. Today, however, only 45 percent of government data is clean, accurate, and in a usable format to glean real insights. If organisations can't get a handle on the data soon, they run the risk of falling further and further behind as the rate of technological change increases.

"If we can connect all water data, we can proactively predict issues, and ultimately protect life. By sharing this data with the public, with regulators, and with international bodies, we can raise awareness and drive real change," says Aquatic Informatics CEO, Edward Quilty.

Image 3. Modern data management tools, streamline field collection and make it easy to share real time information with stakeholders through online portals.

[12] https://www.worldbank.org/en/topic/water/publication/high-and-dry-climate-change-water-and-the-economy

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