# Australasian Hydrographer

July 2024

AUSTRALIAN HYDROGRAPHERS ASSOCIATION

**AHA**
**Australian Hydrographers Association**

**National Office**

services@aha.net.au

PO Box 3476
Weston Creek ACT 2611
Australia

**Editorial Team**

Zac Ward CPH (Editor-In-Chief)
publication.thinktank@aha.net.au

**Material Submitted**

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## 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.

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# From the Editor-In-Chief

## Zac Ward

Another financial year ticks over and another AHA AGM is held with many positive announcements to be noted. In this edition we were lucky enough to receive a write-up on the recent Annual General Meeting (AGM), President's Address, an insightful interview from industry Leader Linton Johnston (BoM) and some exciting milestone updates from the Flood Warning Infrastructure Network (FWIN) in Queensland (BoM). Great to see organisations contributing to information sharing in the hydrography field and I would callout on other members (and organisations) to do the same and get involved with the AHA as it continues to positively grow and develop.

As always please reachout:

publication.thinktank@aha.net.au
Zachariah.Ward@ewsaustralia.com

Many exciting training updates and events coming up that Arran will no doubt mention and even more exciting is the date/location announcement of Launceston for next year's 2025 AHA Conference! Thank you as always to all who are involved and participating in the huge workload going on in the background of the association and hope to hear (and see) everyone in the very near future across Australian water bodies and technical offices.

Cheers,

**Zac Ward** CPH

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# From the President

## Arran Corbett

Hello and welcome to the July 2024 edition of the Australasian Hydrographer. Firstly, we are thrilled to see the success of the initiatives spearheaded by our dedicated Editor-In-Chief, Zac. The quality content continues to flow (pun intended), thanks to Zac and those who have supported him. Keep up the excellent work!

In this edition, we've included an update and my President's Address from our recent online AGM, for those who couldn't attend. An important highlight from the AGM is our plan to hold the next AGM (November 2024) in person in Melbourne. This event will also mark the launch and celebration of our new website and user portal. We warmly invite you to join us for this exciting occasion—details to follow.

For those looking to expand your international networks, the next International Hydrometry Workshop will be held in Sweden from September 22nd to 27th. The provisional agenda is rich with sessions dedicated to training and capacity building, focusing on various hydrometric techniques and technologies. Attendees will gain hands-on experience and enhance their skills. More information is available at www.internationalhydrometrygroup.org – Website of the International Hydrometry Group

If you prefer your hydrometric training closer to home and in warmer conditions, register for our Darwin Technical Workshop! The 2024 Water Monitoring Skills Technical Workshop promises a growing agenda with a diverse range of topics. More details on these exciting opportunities will be shared as they are confirmed.

You can find more information and register at
2024 Water Monitoring Skills Technical Workshop - Australian Hydrographers Association (aha.net.au)

I will sign off with a reminder that while getting the gauging is important, coming home in one piece is more so. Stay safe and I look forward to seeing you in Darwin!

Best regards,

**Arran**

*(*AHA President, Arran Corbett, is an employee of Ninox)*

# AGM Meeting Minutes

## The following is a documented summary of the 43rd AHA AGM conducted online – 19th June 2024.

As communicated to Members in November 2023, the Australian Hydrographers Association Inc (AHA) applied for and received an extension from Fair Trade NSW to hold the 2023 Annual General Meeting (AGM) before 30th June 2024.

On 22nd May 2024, AHA called for nominations from Members for the following positions that were listed for election at the AGM for a two-year term, namely President, Treasurer, Secretary and three Committee Members.

AHA received one nomination each for the President, Treasurer and Secretary (office bearer roles) and four nominations for the three Committee Member positions which meant that an election had to be conducted at the AGM.

The 43rd AGM of AHA was held on Wednesday, 19th June 2024, during which the Members approved the minutes of the 2022, 42nd AGM held on 25th May 2023.

In his President's Address, Arran Corbett welcomed the Members to the AGM and acknowledged Edna Coetzee (Secretary), Association Executive Services, the volunteer Executive Committee (including the President, Vice President Paul Sheahan and Treasurer Waldemar Varela), the AHA Committee and various subcommittees that have all been instrumental in making sure that AHA become a member focused organisation by setting and implementing strategy. The President extended a special word of thanks to James Mancey, outgoing Committee Member for his service to the AHA over the years, especially through challenges. The President stated that although James decided to step down this year, his legacy to others will inspire them to step up and take on the challenge in his place. The President also thanked Tara Matthews, for her repeated willingness to volunteer particularly in our new Water Quality Community of Practice.

The President provided updates on the following initiatives:

a. **AHA Website Member Portal Development.** AHA is currently building a new website member portal, Certified Practicing Hydrographer and Training Management Platform with partners DDSN Interactive. The project subcommittee has reviewed the current wireframe which captures the needs of our growing Association. We anticipate moving to user testing in the next few months and eagerly await the rollout by the end of 2024. This new platform promises a much-improved member experience.

b. **Water Quality Community of Practice.** Work continues on this important initiative. Tara Matthews along with Dr Ryan Turner, Michael Whiting and Mel Robinson are establishing the terms of reference, identifying the key goals and activities, and are engaging with relevant stakeholders.

c. **AHA Conference Launceston, 12th – 15th May 2025.** The conference subcommittee is currently building out the agenda, which will include practical demonstrations, insightful presentations, a trade exhibition, and entertaining social events.

d. **Training and Professional Development.** The training division is promoting excellent credit and empowering training for our Members and the broader water community that is a core activity for the AHA. Under John Skinner's leadership, the training division has grown, and we continue to see record enrolments in our diploma course and the provision of tailor training packages for specialised disciplines. This ensures that the AHA is seen as the peak body of water monitoring in Australia and that our Members are employees of choice by the industry.

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e. **Darwin Water Monitoring Skills Technical Workshop 16th – 19th September 2024.**
Based on feedback from AHA's last conference in Penrith, there was a strong desire for more face-to-face content and regional events.
In response, the workshop subcommittee has organised a week of training, create exhibition opportunities, interest group workshops, social events, and a field day at the Berry Springs National Park in Darwin.

In conclusion, the President called on Members to sign up, engage and participate in these initiatives as member involvement is vital to the collective success of AHA.

The Treasurer, Waldemar Varela, provided an overview of the 2023 annual financial statements and confirmed that AHA received an unqualified audit report. From a revenue perspective AHA made a profit of $183,089 as a result of the 2023 AHA Conference and training. The Balance Sheet is also looking healthy with total equity of $508,494.

The Treasurer concluded that healthy finances allow AHA to provide more for the membership and lobbying the government to increase AHA's standing within the industry and government. The Members adopted the Financial Statements for 2023 and the Committee's Report.

As mentioned before, only one nomination each was received for the office bearer positions and it was announced that for the following two years, Arran Corbett would remain as the President, Waldemar Varela as the Treasurer and Edna Coetzee as the Secretary of AHA.

An election was conducted, and Tom Candy, Colin Giddens and Tara Matthews were elected to fill the three ordinary Committee Member positions. The President congratulated the new Committee Members and invited all Members to work together to build a stronger and more vibrant Association.

This concluded the 2023 AGM with the announcement that the 2024 AGM is scheduled to be held on 27th November 2024 coupled with a face-to-face Committee meeting in Melbourne and the launch of AHA's new website.

# AHA President's Address

## The following is a documented summary of the President's Address at the 43rd AHA AGM conducted online – 19th June 2024. (Arran Corbett – AHA President)

### Introduction

*Good afternoon, everyone. As the President of the Australian Hydrographers Association, it is my pleasure to welcome you to our Annual General Meeting. I am thrilled to see so many of you here today, demonstrating your commitment to our association and its mission.*

### Acknowledgements

*Firstly, I want to extend my heartfelt thanks to several individuals and groups who have been instrumental in our achievements this past year:*

1. **Edna:** Thank you for your exceptional work as our secretary. Your dedication has brought a new standard of reporting, organization, and governance to our association.
2. **AES:** We deeply appreciate your continued back-office support, which has been invaluable.
3. **Our Volunteer Executive Committee:** Your dedication to building a better, member-focused organization is truly commendable.
4. **Our Wider Committee and Subcommittees:** Thank you for setting the strategic agenda and enacting these strategies. Your efforts do not go unnoticed.
5. **James Mancy:** Your service to the AHA over the years, especially through challenging times, has been remarkable. Although you've decided to step down, your legacy will inspire others to step up to the challenge.
6. **Tara Matthews:** Your repeated willingness to volunteer, particularly in establishing our new Water Quality Community of Practice, is greatly appreciated. Thank you for your leadership and hard work.

### Updates and Initiatives

1. **Website and Member Portal Development:** I am excited to provide an update on our ongoing development work. We are currently building a new website, member portal, and CPH/Training management platform with Melbourne-based DDSN. The project subcommittee has reviewed the current wireframe, which captures the needs of our growing association well. We anticipate moving to user testing in the next few months and eagerly await the rollout by the end of 2024. This new platform promises a much-improved member experience.
2. **Water Quality Community of Practice:** Work continues on this important initiative. Tara, along with Ryan Turner, Michael Whiting, and Mal Robinson, are establishing the terms of reference, identifying key goals and activities, and engaging relevant stakeholders. We are ready to support this team and keenly watch their progress.
3. **2025 Conference in Launceston:** Our conference committee is making great strides in ensuring that our upcoming event in Launceston will be truly spectacular. With dates and venues locked in, they are now building out the agenda, which will include practical demonstrations, insightful presentations, a trade exhibition, and entertaining social events. All of this will be set against the beautiful backdrop of Northern Tasmania.
4. **Training and Professional Development:** Providing excellent, accredited, practical, and empowering training for our members and the broader water community is a core activity for the AHA. Under John Skinner's leadership, our training division has grown from strength to

strength. We continue to see record enrolments in our Diploma course and the provision of tailored training packages for specialized disciplines. This ensures that the AHA is seen as the peak body in water monitoring in Australia and that our members are employees of choice by the industry.

5. **Darwin Technical Workshop:** Based on feedback from our last conference in Penrith, there is a strong desire for more face-to-face contact and regional events. In response, a subcommittee has organized a week of training, trade exhibition, interest group workshops, social events, and a field day at Berry Springs Nature Park in Darwin. I encourage all of you to sign up and engage in this workshop. Your support is critical to our success and the success of future events.

## Conclusion

*My call to you, our members, is this: Sign up, engage, and participate in these initiatives. Your involvement is vital to our collective success. As a committee and as an association, we strive to provide real value to you, our members. We ask that you commit with us.*

*Thank you for your time and dedication. Let's continue to work together to build a stronger, more vibrant Australian Hydrographers Association.*

## Closing

*Thank you, everyone, for attending today's AGM. I look forward to another year of progress and collaboration. Have a great day.*

# AHA Member Insight – 20 Questions with a Leader in the Industry

Linton Johnston – Water Regulations & Standards Lead, Bureau of Meteorology (BoM). Interview by Tara Matthews (Water Quality Community of Practice and AHA contributor)

## 1/ What first piqued your interest to pursue a career in the water monitoring industry?

As a kid, I always really loved water and that attracted me to the field.

Water was always fascinating when you see a river flow and just seeing water and playing in the creek. I always had this attraction to water, but I think in terms of pursuing a career, it was really through that early experience at University where I studied civil engineering.

## 2/ Can you please provide a brief overview of your role at the Bureau and where it fits in within the industry?

My role is to enable the Bureau to fulfil its function of being a national water information agency under the Water Act which came through in 2007. The Bureau received these functions requiring us to provide a nationally standardised data view of water information around Australia including water availability, water quality and water use.

We pull that together from all the various agencies and organisations that monitor and collect water data, as well as understanding that national view and how it changes over time.

My role has essentially been working with all the different players that are involved in water monitoring and water data. My role is very much dependent on really good quality data collection at the coalface by hydrographers and others.

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## 3/ How did you come to be in your current role as Water Regulations and Standards Lead for the Bureau of Meteorology?

I started at the Bureau in 2000 in flood warning with a small flood warning unit in South Australia.

My work was end-to-end involvement of what was needed to predict floods and put out flood warnings starting at the monitoring of your river levels and your rainfalls throughout the catchments.

I was also involved in telemetry systems, data management systems, hydrological models, real-time forecasting and was tasked with promotion of education for people to take protective action when flood warnings are issued.

## 4/ What is the favourite part of your role?

I learned the importance of having reliable data that you could depend on when you really needed it. In 2007 the Commonwealth Water Act came through and that's what set the Bureau these new functions in water information where I moved into that space. I've been working in that area ever since.

The Regulations under the Act say who needs to give data to the Bureau and my initial work in that area was working with each of the state and territory government agencies and to understand what information was held and how we were going to bring it all together in the Bureau system.

My role today is a slight extension where I'm looking at water markets information, so this is water trade, buying and selling water in the Murray Darling Basin- which is another facet of water information and water data.

## 5/ Since you started what would you say is the biggest changes to come through with the biggest impact on the industry today?

From when I began data was largely inaccessible, it would sit in a database somewhere and you would get on the phone as ask for a copy that would be on a floppy disk, hard disk or a USB – these hard storage devices were rapidly getting superseded and became obsolete by other technologies. Fast forward, cloud-based computing is now the norm where we have an explosion of data and data portals. The issue has now shifted from 'where can I get data' to 'where do I start? What data source is trusted?'

## 6/ Are there any emerging trends or technologies that you are currently interested in following closely?

Surface velocimetry which is using video imagery to derive flow measurements really interests me. It is a relatively simple concept, but we are able to modernise it with advanced camera technologies like drones and combining that with clever processing techniques.

It opens a whole world of possibilities for lower cost monitoring and it's only going to explode and be more prevalent as different technologies and computer processing keep advancing and potentially enabling better coverage.

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## 7/ The present state of the industry is rapidly progressing, for example in real-time monitoring and telemetry. Where do you hope to see the industry in 5-10 years?

Ultimately, we want to have the best information available for what we need to do to have sustainable water systems and water available for the various needs and uses in Australia.

I hope we can continue to invest in monitoring and look at advancing those technologies that are going to give us the best bang for buck as budgetary pressures aren't going away.

## 8/ How has technology advanced the industry since the beginning of your career, and what impact has it had on improving the quality of data and environmental impact and the ability to predict extreme weather events?

An example of this is the CSIRO lead AquaWatch which is combining observations from spectral imaging (data from satellites) and interconnected with ground-based sensor networks. This is giving us a comprehensive dataset of water quality in rivers and lakes Australia wide and enhancing our ability for predictive forecasting of events such as algal blooms or blackwater events.

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## 9/ What advice do you have for the next generation of up and comers in our field?

Be curious about your environment. Take an interest in what you're doing, and I think whatever opportunities present to get out in the field, get that good grounding and hands on experience.

It's important in your early career as it gives you that real depth of understanding about what you are doing and helps foster that real love of what you're doing as that's where your inspiration comes from.

## 10/ What do you see as the biggest challenge for the next generation and what advice would you give should they want to pursue a similar pathway to yourself?

It's always hard to get that confidence when you're starting off in a career, so you need to back yourself as you've probably got your own ideas and are probably just as good as the next person.

I would recommend finding a few mentors in the industry and really make the most of the opportunities that you can get to learn from them because I've learned so much from different colleagues.

A colleague who was in the hydrometric field said to me when you are faced with a career decision, take the path that's going to lead to the greatest adventure as you want to enjoy what you are doing.

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## 11/ How do you stay updated in current affairs involved within the industry?

Just having those conversations with your colleagues and peers, it's through those discussions that you learn about what other people are doing.

I am in a privileged position at the Bureau because I get to talk to people all over the country. You're hearing what people are doing e.g. in Queensland and Tasmania, different states and territories, so there is general awareness of what's happening. The professional relationships that you build up are extremely important. AHA is a good example of developing professional relationships and a great way to expand your network and keep abreast of what is happening.

## 12/ I note your heavy involvement in the formation of the National Industry Guidelines for Hydrometric Monitoring (NIGLs) and so I have a few questions around this if that's okay. Firstly, what has been your involvement over the years?

From 2007 when the Water Act was introduced one of the first things that the Bureau did was set up the then Water Information Standards Business Forum (which is now known as WaMSTeC) where we got representatives from 25 many of the major water monitoring organisations, and we saw the value in a consistent approach. Our focal point would be discussing and developing standards and where the priorities were. It became the catalyst for getting things done and working collaboratively.

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## 13/ As we have just closed 10 years since the NIGL's implementation, can you briefly describe the practice of hydrometric monitoring prior to 2013? Also, your thoughts on electronic data collection and starting to replace some of the lab-based costs as technology improves and accuracy increases?

I think the impact of technology improvements on hydrometric practices has been one of those constants that hydrographers have to keep up with over there over their careers.

Whereas once you measured water level with a shaft encoder in a stilling well with a mechanical data logger all sitting upstream of a very expensive concrete weir. When I started you measured water and flow via water level and there was expensive infrastructure upstream.

Now there is electronic data monitoring with pressure transducers, water quality probes and acoustic doppler technology which has been a huge advancement.

Now we are pushing into velocimetry which opens the possibility of getting flow gauging using videos taken from satellites.

## 14/ And to follow on from that, what is the impact that the NIGLs and standardisation have brought to the industry?

The guidelines have brought a consistent practice, and I would hope that has resulted in more confidence in the data that has been outputted.

That was one of the primary reasons for having the structure and processes that WaMSTeC had set up.

In areas like legal cases and challenges it really helps that we have a benchmark of a national standard to point to.


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## 15/ What do you think the disadvantages of technology advancements have been?

There is risk with people picking up the latest piece of technology and thinking they can deploy it in the field without understanding the fundamentals. It's easy for the instrument to spit out a number but you can get into trouble with poor quality data.

## 16/ What are your thoughts in terms of the future of productivity improvements from data that the Bureau collates? For example, understanding weather impacts including extreme climate events, however also in terms of agricultural benefits, and the collection of alternate energy sources such as wind turbines, or tidal energy.

The Bureau's strategy is about doing things that can increase the value and impact that we provide to the community through data and services.

It's not just about having more data and services, but how do we target different sectors and have better value and impact as a result.

It's about understanding the business of different sectors like agriculture, the energy sector or emergency services and understanding what they do and what they require.

## 17/ In the face of a warming climate and the extreme weather events that are rapidly evolving as time goes on, including floods, fires and extreme temperatures how is the Bureau preparing for this and what insight can you provide us?

It's about tailoring services and how we package them up and present data in ways that they want to use for their purposes. An example of this is in agriculture where the Bureau has been doing work with CSIRO and it's called 'My Climate View'. Farmers can go in and look at specific climate projections and how they change over time for commodities like rice, wheat and dairy as well as wine growers. It's an advancement that the Bureau has contributed to improving efficiencies and productivity.

## 18/ How do you think we can collaborate with other stakeholders, such as government agencies, research institutions and community organisations to address water related challenges, but also centralise information exchange?

It's about looking at ways that we can have shared water information and national investments so that we are not doubling up on the same things and collaboration.

We could avoid the same investments happening in every state and territory and potentially have an opportunity for a national investment that meet our needs with unified standards and systems.

## 19/ What do you see as the biggest challenge (other than funding) in the industry today?

From a water information perspective, a big challenge will be less about access to data and more about how to use the data to help make decisions – big data technologies will make it easier to share and access data – the challenge will be what do we do with an explosion of accessible data – that is where AI is likely to be a game changer.

You say, 'other than funding', but I think 'as always' is the case. Funding will always go where the need is demonstrated to be! So, a challenge for us will then be to continue to demonstrate the value of good water data. We need to keep hammering home the message that you can't buy data when you need it, and that data's value multiplies with reuse. We need to concentrate on how we describe and record data quality to enable fit for purpose use and extend the utility of the data beyond the primary reason it was collected.

## 20/ Last, and some might say most importantly for our Victorian readers: Are you an Adelaide Crows or Port Adelaide supporter?

I've got to disappoint everyone and own up to supporting St Kilda! Or whoever is playing Collingwood!

# Anomaly Detection in Real-Time Water Quality Monitoring

Presentation from the AHA Conference 2023.
*Cameron Roberts – Data Analyst*
*(Queensland Department of Environment & Science)*

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## All RTWQ Probe Location(s)

The broader network has a combination of probes depending on:

- Interest
- Funding at the time

## Micro-Site Location(s)

High density RT monitoring:

- Lower Burdekin Catchment (~21 sites)
- Herbert Catchment (~17 sites)

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## Mechanisms of Anomalous Data

Specific mechanism for data errors varies:

**External Influences**

- Lens obstructions
- Erosion/deposition issues
- Wildlife/pest interference with equipment
- Fouling
- Saltwater interference (Bromide ~ Nitrate)
- Dry reads
- Physical damage to probe measurement medium (e.g. scratched lens')

**Internal Influences**

- Conditions outside of manufactures specifications (turbidity limits)
- Calibration drift
- Repeated values (probe reading unsuccessful and reports previous value in the internal memory slot)
- Analogue signal noise
- Firmware issues

## Anomaly Detection in RTWQ

WQI data pipeline able to detect and categorise:

- **Impossible Values**
- Values outside of specified **manufacturers ranges**
- **Constant Values** / very low variability
- **Data Spikes**

## Variety of Sites and Installation Setups

WQI data pipeline able to detect and categorise:

- Not all real-time monitoring sites are created equal
- Generalise a ruleset that is going to encompass the network
- Take note of considerations such as:
  - Path length dependant measurement ranges
  - Change to equipment
  - Different expected variability between estuarine and freshwater systems
- Develop a 'lookup table' for site specific considerations/probe information
- Try and avoid OVERLY specific rules.

## Reportable WQ Parameter Processing

## Manual Quality Coding

WQI utilise different codes for auto and manual coded data

- Manual codes won't be overwritten by the machine
- Auto codes will be overwritten should any updates to the algorithm occur

## Code Pipeline and R-Package

- The data processing pipeline is all written in the R language
- An internal R-package has been developed with functions for:
  - Data egress
    - > Eagle.IO API's
    - > WMIP HTTP web calls
    - > OpenWeather API's
  - Probe specific data processing
    - > YSI EXO sonde
    - > Trios Opus/NICO
    - > Generic water level sensors
- Not yet available for public consumption

```r
WaterCheck <- function(df, OVERWRITE, WLmax) {

  df <- df %>%
    mutate (`Quality` = case_when(
      `Quality` > 0 & !(`Quality` %in% OVERWRITE) ~ as.character(`Quality`), # if a quality code exists and it is not listed as an OVERWRITEABL
      `Value` < 0 ~ '3201',                                                   # bad - impossible value
      `Value` > WLmax ~ '3201',                                               # bad - exceed sensor limits
      `Wlevel_centerSD` == 0 ~ '3214',                                        # bad - repeating values
      `Wlevel_leftSD` == 0 ~ '3214',                                          # bad - repeating values
      `Wlevel_rightSD` == 0 ~ '3214',                                         # bad - repeating values
      log(`Value`) > (3* `Wlevel_sd` + `Wlevel_median`) ~ '2211',             # uncertain - possible spike
      log(`Value`) < -(3* `Wlevel_sd`) + `Wlevel_median` ~ '2212',            # uncertain - possible spike
      TRUE ~ '1220' ))                                                        #Q - Good - Auto QC

  return(df)
}


OPUSCheck <- function(df, OVERWRITE, probeType, pathLength, InstallType) {

  #generate a 'limits' file per probe and pathlength to list the upper and lower thresholds for the OPUS and NICO probes
  Limits <- WQI::PathFinder(ProbeType = probeType,
                            PathLength = pathLength)

  df <- df %>%
    mutate ('TSSeq_Qual' = case_when(
      `TSSeq_Qual` > 0 & !(`TSSeq_Qual` %in% OVERWRITE)  ~ as.character(`TSSeq_Qual`), # if a quality code exists and it is not listed as an OV
      `SQI` < 0.8 ~ '3061',                                          # WQ - Bad - Auto (Poor spectral quality)
      `abs360` >= 0.8 ~ '3062',                                      # WQ - Bad - Auto (Above probe limits)
      `TSS_centerSD` == 0 ~ '3068',                                  # bad - repeating values
      `TSS_leftSD` == 0 ~ '3068',                                    # bad - repeating values
      `TSS_rightSD` == 0 ~ '3068',                                   # bad - repeating values
      log(`TSSeq`) > (4* `TSS_sd` + `TSS_median`) ~ '2030',          # uncertain - possible spike
      log(`TSSeq`) < -(4* `TSS_sd`) + `TSS_median` ~ '2030',         # uncertain - possible spike
      `TSSeq`> Limits$TSSUpperLim ~ '2011',                          # WQ - Uncertain - Auto (Above Parameter Limits)
      `TSSeq`< Limits$TSSLowerLim ~ '2012',                          # WQ - Uncertain - Auto (Below Parameter Limits)
      TRUE ~ '1020' ),                                               # WQ - Good - Auto QC
      'N-NO3_Qual' = case_when(
        `N-NO3_Qual` > 0 & !(`N-NO3_Qual`%in% OVERWRITE) ~ as.character(`N-NO3_Qual`), # if a quality code exists and it is not listed as an OV
        `SQI` < 0.8 ~ '3061',                                        # WQ - Bad - Auto (Poor spectral quality)
        `abs360` >= 0.8 ~ '3062',                                    # WQ - Bad - Auto (Above probe limits)
        `abs210` > 3 ~ '3062',                                       # WQ - Bad - Auto (Above probe limits)
        InstallType == "ExSitu" & `abs210`<= 0.15 ~ '2035',          # WQ - Uncertain - Possible Dry Read
        `NO3_centerSD` == 0 ~ '3068',                                # bad - repeating values
        `NO3_leftSD` == 0 ~ '3068',                                  # bad - repeating values
        `NO3_rightSD` == 0 ~ '3068',                                 # bad - repeating values
        log(`N-NO3`) > (4* `NO3_sd` + `NO3_median`) ~ '2030',        # uncertain - possible spike
        log(`N-NO3`) < -(4* `NO3_sd`) + `NO3_median` ~ '2030',       # uncertain - possible spike
        `N-NO3`> Limits$NO3UpperLim ~ '2011',                        # WQ - Uncertain - Auto (Above Parameter Limits)
```

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## Next Steps: *Validation against grab samples*

- Anomaly detection processes **clean these data-streams** to a reasonable standard
- Some **manual oversight** is still required
- Methods currently under development to achieve the following:
  - Streamline regression models between real time and discrete grab sample datasets
  - Aid in the identification of outliers from harder to delineate things like drift or step changes
  - Use these models to adjust data to better estimate target variables (TSS/NOx)

```
Call:
lm(formula = VALUE ~ interp2, data = join)

Residuals:
     Min       1Q   Median       3Q      Max 
-131.094  -16.282    1.248   15.905  119.850 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept) -36.87144    3.95011  -9.334   <2e-16 ***
interp2       1.33156    0.02984  44.619   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 35.02 on 183 degrees of freedom
  (34017 observations deleted due to missingness)
Multiple R-squared:  0.9158,	Adjusted R-squared:  0.9154 
F-statistic:  1991 on 1 and 183 DF,  p-value: < 2.2e-16
```

## Next Steps: *Integration of more complex methods*

- Current pipeline is fairly simple
  - It does filter out the majority of data errors
- QUT ARC linkage project on anomaly detection
- Spatial temporal stream network models
  - Leveraging data from nearby sites to infer water quality
- Artificial neural networks
- In-filling of data gaps

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- DES Water Quality and Investigations Team
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# National FWIM Program Reaches Important Milestone

Learn about progress in the Bureau's National Flood Warning Infrastructure Network (FWIN) Program. *Submitted by Kim Daniels – Stakeholder Engagement Manager (BoM)*

## Introduction

The first capital works in the Bureau of Meteorology's (BoM) national Flood Warning Infrastructure Network (FWIN) Program have begun in Queensland.

This important milestone was achieved on schedule, 6-months after the FWIN team began engaging with Queensland councils about flood warning sites that the Bureau will acquire and upgrade.

Nationally, the Bureau owns around one-third of the gauges it relies on to deliver flood forecasts and warnings. The 10-year national FWIN Program is simplifying ownership and improving maintenance of the network across Australia. On-going maintenance costs will be shared 50/50 between the Bureau and State and Territory Governments.

FWIN's work began in Queensland, where almost half of the nation's rain and river gauges the Bureau relies on for flood forecasting are located. There are more than 70 owners of the sites in Queensland, mostly local government councils. FWIN will relieve councils of the requirement to own and maintain selected flood warning infrastructure.

## Commencement

Two pilot projects have been designed to test FWIN's processes. The first pilot tests the acquisition and remediation processes, and the second tests the program's end-to-end processes.

The river level gauge at Kamerunga Bridge in Cairns was identified as the site for the first pilot. The site suffered extensive damage during TC Jasper in December 2023 and is an important forecast location that impacts Cairns Airport. Capital works began on 3rd July following the Bureau's acquisition of the equipment from Cairns Regional Council and gaining permits from the site owner. The upgrade involves replacing water instrumentation and communications equipment and installing gauge boards to meet the flood warning infrastructure standards.

Kamurenga Bridge Remediation, July 2024

Kamurenga Bridge Remediation, July 2024

The second pilot location is the Burrum Cherwell catchment southwest of Bundaberg. This pilot will test the end-to-end processes and transition into the Bureau's business as usual work. Site investigations are complete, and capital works are expected to start later this year.

FWIN General Manager Ella Harrison said: "The FWIN Program has a unique structure, bringing people together across the Bureau. FWIN relies on the expertise of hydrologists, technicians, and flood forecasters to plan and implement the program. This collaboration has been critical to the program's early momentum and will continue to be important to FWIN's progress across the country."

In the first half of 2024, FWIN's stakeholder engagement team spoke to each of the 64 Queensland councils that own and maintain flood warning infrastructure in FWIN's scope to build understanding of the flood warning network and communities' needs. Regional workshops with councils followed across the state, resulting in a list of sites to be acquired under the program.

FWIN's core program of works in Queensland will be announced by September 2024, identifying about 750 of the 1,000 assets to be acquired and remediated in Queensland by 2028/29. In 2024/25, 200 of these sites are scheduled for upgrade.

## What's Next for the FWIM Program?

The FWIN Program will be rolled out in stages: remediation work in New South Wales and the Australian Capital Territory will start in 2025/26, in Victoria in 2026/27 and in Western Australia, the Northern Territory, South Australia and Tasmania in 2027/28. All remediation work is planned to be completed by 2030.

In New South Wales, detailed planning has begun. FWIN is working with the Department of Climate Change, Energy, the Environment and Water (DCCEEW) to align FWIN activities with other flood infrastructure upgrades occurring in the state.

*For more Information*

Contact the team at:
floodinfrastructure@bom.gov.au

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