

Australasian Hydrographer

July 2023



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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Photo Information: (Cover) AHA Conference 2023 - Crowd. (Below) ADCP Field Day - AHA Conference 2023.

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.

Contents

From the Editor-In-Chief	3
From the President	5
AHA Conference, May 2023 – Resilient, Reliable & Robust	6
AHA Member Profile – Paul Blumer	14
After the AHA Conference, 2023	16
Beyond the Rating – Fitzroy/Martowarra River Floods 2023	22



From the Editor-In-Chief Zac Ward



Well, it finally happened!!! After +3 long years in waiting the return of the AHA Conference in freezing cold Penrith was the culmination of many hours of hard work & preparation for so, so many people. A huge thanks goes out to absolutely everyone who assisted, attended, participated and presented. Rubbing shoulders with fellow hydrographers and talking tech with everyone doing amazing things across varied subject-matters always provides invaluable experiences and I'd like to extend my own thanks to everyone who I saw, and who took the time to see myself (and the EWS Australia Team) across the fun-filled four days

I'm sure Arran will definitely have more to say on the event, award winners and pre-planning for the next big hydrography gathering which everyone will no doubt be eagerly anticipating already. 2025?!

Over the coming few editions of the Australasian Hydrographer you will see a bunch of AHA Conference presentations with the hope that sharing these interesting pieces will both inform, educate but also prompt/inspire others to submit

their own articles and presentations at both future conferences and in AHA publications. In addition to these technical presentations you will also see more 'light-hearted', social pieces with a view to broaden our wide ranging industry of dedicated, passionate individuals and continue the comradery and unity across the hydrography field in general.

This edition see's a monumental achievement with Paul Blumer (Murrumbidgee Irrigation) who was officially the first graduate of the newly configured Diploma of Hydrography through our RTO, Timber Training Creswick. Congratulations to Paul and can't wait to hear about more of the great drone/ADCP work you're bringing to MI. As always please send any articles, photo's, presentations, etc through to myself at publication.thinktank@aha.net.au and looking forward to seeing everyone at the next conference. Wherever that may be?!?!

Cheers,

Zac Ward CPH



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From the President

Arran Corbett



Fellow members of the Australian Hydrographers Association,

I would like to express my deepest gratitude for your incredible energy and enthusiasm at our recent Penrith conference. Thanks to your active participation, the event was a resounding success. The feedback we have received from attendees has been overwhelmingly positive and constructive. On behalf of the organizing committee, I extend our heartfelt appreciation for the valuable ideas, comments, and general feedback shared both verbally and through the event app. Your input will greatly contribute to our ongoing mission of providing exceptional value to our members and shaping future gatherings.

Let's take a moment to highlight some key statistics from the conference:

We welcomed 253 attendees, creating a vibrant and diverse community.

The conference boasted 19 trade stands, showcasing the latest innovations in the field.

An astounding 96.43% of respondents gave the conference a 4 or 5-star rating, demonstrating the high level of satisfaction among participants.

I am delighted to announce the winners of our conference prizes. The prestigious Alex Miller Award was presented to Robbie Heane from Water NSW for his outstanding presentation titled "Tools & Resources for a Low-Lands Hydrographer." Additionally, the Young Professional Award, which includes the opportunity to present at the upcoming NZHS conference in Queenstown next May, was awarded to Jaymee Woods from the WA Water Corporation. I extend my gratitude to Campbell Scientific for their generous sponsorship of the Young Professional Award.

A special acknowledgment goes to Agnes Zalan and the Blue Mountains Events & Conferences Team, whose tireless efforts ensured the success of our event.

Without their dedication, we would not have been able to deliver such an incredibly well-received conference.

Many of you have eagerly been awaiting news about our 2025 event. While I don't have any major announcements to share at this time, I can tell you that Hobart, the Sunshine Coast, and the Gold Coast emerged as strong favourites in the polls. Our committee will be convening in the coming weeks to discuss this, as well as other important matters.

I would like to extend a sincere thank you to the Bureau of Meteorology for serving as our Major Partner. Your invaluable support greatly contributed to the conference's success. I would also like to express gratitude to all our sponsors. Links to their websites can be found on our association's website.

In other association news, I would like to remind everyone that membership and CPH renewals will be sent out shortly. Keep an eye out for the email reminders, and please don't hesitate to reach out if you have any concerns.

Our dedicated committee and subcommittee members have been hard at work, tirelessly selecting a vendor to assist in the long-overdue upgrade of our Association's back-end system. This undertaking is no small task, and I want to personally thank Harry Schofield, Bill Steen, Paul Sheahan, Wally Varela, and John Skinner for their ongoing efforts. We are nearly there, team. Keep up the excellent work!

In conclusion, I urge you all to stay safe and take care. Your commitment and passion are vital to the success of our association and the hydrography community at large.

Sincerely,

Arran

AHA Conference, May 2023 Resilient, Reliable & Robust

Building better hydrographers, building better networks
– Panthers Penrith

The following selection of photographs were taken over the course of the AHA Conference 2023 (May 22nd – 25th). It includes presenters, vendors, attendees, demonstrations and the AHA Conference Dinner held at the Chairman's Lounge, BlueBet Stadium on Wednesday 24th May. All photo's courtesy of the Blue Mountains Events & Conferences Team.









AHA Conference, May 2023 Resilient, Reliable & Robust

Field Trip

The following selection of photo's were taken at the Offsite Regatta Wednesday 24th May. This was held Hawesbury/Grose and Nepean Rivers at Yarramundi. All photo's courtesy of the Blue Mountains Events & Conferences Team unless otherwise specified (all others provided by Daniel Wagenaar - Xylem). Note: No photo's were obtained of the Warragamba Dam Field Day. Please provide them to publication.thinktank@aha.net.au for possible inclusion in future editions.





Photo: D. Wagenaar



Photo: D. Wagenaar



Photo: D. Wagenaar

AHA Conference, May 2023 Resilient, Reliable & Robust

Awards

The following selection of photos were taken at the Awards Presentations on Thursday 25th May. Congratulations to both Robbie Heane (WaterNSW) and Jaymee Woods (Water Corporation, WA) for their prestigious awards. All photos courtesy of the Blue Mountains Events & Conferences Team.



Figure 1: Robbie Heane winner Alex Miller Award.



Figure 2: Jaymee Woods winner Young Professional Award.





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AHA Member Profile

– Paul Blumer

Describe your current role?

My current role is as a Field Hydrographer in the Asset Performance team at Murrumbidgee Irrigation (MI). I am responsible for all the hydrometric gauging's and surveys.

How did you find the Diploma of Water Industry Operations (Hydrometric Monitoring), did you have any favourite subjects/topics?

I was excited to be able to begin and complete the Diploma. I started while the AHA was still looking for a training provider before working with Timber Training Cheswick. Hence, I undertook a sort of hybrid Diploma, completing some of the older subjects from the past Diploma, and some with the new Diploma.

I enjoyed learning about a lot of the hydrometric principles. It explained why we do what we do.

Has the delivered learning helped your current role at Murrumbidgee Irrigation and if so, how?

The Diploma has given me a lot of the skills that I need to do my job. We don't have any other hydrographers working at MI, so it has given me a good base to grow from.

What hydrometric (or other) qualifications relevant to your role do you have?

I have a Bachelor of Environmental Science, majoring in Resource Management.

What do you consider some of your major career achievements to date?

Helping install and commission our hydrometric sites along Mirrool Creek and Main Drain J. I then developed ratings on these previously unmeasured sites.



We had just obtained enough gauging data to build the ratings which proved invaluable when our area was impacted by flooding last year. This data was used to inform management of water in conjunction with the local flood authorities to prevent impacts to the community.

We have also used gauging's to help improve the accuracy of many of our regulators by incorporating updated discharge co-efficients into the SCADA controller. I have also done a lot of bathymetric surveys and seepage investigation work which allows us to pinpoint the root cause of failures and ultimately adds values to our customers.

How did you end up in the hydrometric/irrigation profession?

I was working in the Environmental Team at MI for two and half years when I was approached by my first boss in this field, Paul Hutchinson. He was interested to know if I wanted a new challenge and career path.

Paul started a Hydrological Engineering team with Waleed Ali (data scientist) along with me. It was all

unknown territory, and we had some great wins early, which set up the success of our team for the future.

Was there anyone who had a major influence?

My current manager, Sam Yenamandra has been a great mentor. He is always looking to improve our processes and accuracy in the asset performance space.

Our team has grown over time and now includes more data scientists, field operators, and systems engineers. I am still the only hydrographer.

What has been the most memorable experience (good or bad) in your career?

Making the switch from the Environmental Team to my current role was great. It presented me with a new challenge where I had to start from scratch and carve my own path. It changed my career trajectory. It has been a great experience learning new skills. I am always looking for ways to improve.

What makes our profession interesting?

In my role, I use a lot of different instruments and tools to obtain accurate data. I love that the technology is moving at a rapid pace, especially in the surveying field.

For instance, we are currently using a Mavik 3 E drone with PPK ground control points for photogrammetry on drained channels this winter. This is giving us highly accurate AHD levels and bathymetry of our channel network which we can use for: channel design overlay with accurate cut and fill, finding silt bars, channel contraction, and weed obstruction.

In the seepage space we have an EM31, which allows us to pinpoint the problematic sections of channel instead of patching up entire reaches.

What do you do when you're not at work?

Spending quality time with my wife and two kids. I always free up time each weekend to have a beer with mates and watch the footy.

I swim before work to try and stay fit now that I don't play rugby anymore.



Figure 1: Drone Survey AHD Levels.



Figure 2: Paul Collecting an ADCP Measurement.

How do you think hydrometric monitoring will change into the future?

The use of drones and AI is going to be prevalent. I've seen footage of a large Matrice Drone in Canada, dragging around an ADCP collecting a bathymetric survey of a river.

Even the use of technology such as Surfbee boards for ADCP gauging's is eliminating the need for timely cableway installations. This can speed up our workflow allowing us to get to many more sites in a day.

The large datasets that are collected as part of automation, can also be used to create useful tools and dashboards to help inform decisions for operation and maintenance of waterways.

I think we will continue to innovate and stay ahead of the game, which will lead us to work smarter, not harder.

After the AHA Conference, 2023

Mic Clayton FAHA CPH

Introduction

Following the Australian Hydrographers conference in Penrith, a group of young presenters from New Zealand partook in a short tour around the more remote areas of the Sydney Water Catchment.

Amber (Weir Are All the Fish), Georgia (Auckland Groundwater), Michael (I got cheap cameras from IT) and Tane (Jetskis - Cool!) wandered off on a trip into the Upper Blue Mountains west of Penrith with Mic Clayton as a guide (???)

Given that many real hydrometric sites in the Sydney Catchment are 'off limits' to general public visits, the trip was tailored to give the Kiwis an idea of:

- How the Sydney Water Catchments interact
- Get a perspective of the scale of the Sydney Water Supply System (particularly in relation to the Warragamba Dam Catchment). The combined Sydney Water Catchments provide drinking water to over 4 million people, approximately 60% of the population of New South Wales!

- See the edge of the Murray Darling Catchment (at least from a long distance from the edge of a sheer sandstone cliff in the Cox's River catchment)
- The effects of the 2019/2020 bushfire events ...amongst many other random discussion topics!

The Short Tour

Departing Penrith after the conference the Kiwis had to endure a quick trip to the Nepean River where Mic grew up as a kid (and look at his childhood home). Taking in the views from the Yandii Bridge across the Nepean River, a discussion on the impacts of the Penrith Weir on the river channel, the way the upstream geology and hydrology have interacted in relation to the Lapstone Monocline (entrenched meander activity over millions of years) and other bits of info about the river were all discussed.



Figure 1: Nepean River Upstream of Yandii Bridge. The river is held back by the Penrith Weir elevating its 'natural' level. The edge of the Lapstone Monocline is in the distance. (Photo: M McDonald)

Up to the far west of the Blue Mountains the crew headed, but not before a short detour just up the first rise for a visit to Australia's oldest (mainland) bridge near Blaxland – Lennox Bridge. Learning that the creek flowing underneath the bridge was once sustained by the Glenbrook Sewerage Treatment Plant outflow prior to it being diverted to the more appropriate sewage disposal systems within Sydney Water systems in the 80's. Additionally it is now receiving more natural drainage regimes from the catchment.

Time to make for our destination in the far upper Blue Mountains – but there were a few stops along the way before dinner.

Michael was desperately trying to get photos of views as we headed up the mountains so a random side road off the Great Western Highway was explored to see if there was a view. The view was marginal but the local flora, sandstone formations and so on made for a good local environment discussion to start.

Further up the 'Blueys' the gang stopped off at Gordon Falls Lookout near Leura. From here the



Figure 2: Lennox Bridge – Australia's oldest mainland bridge. (Photo: M McDonald)

viewer can look down into the Kedumba Valley and in the distance the upper arms of the Warragamba Storage (Sydney's primary water supply) could be seen. The scale of Sydney's Water Supply Catchment was being absorbed.



Figure 3: Gordon Falls Lookout. Lake Burragarang reaches are just visible in the distance. Other features in the image are Mt Solitary and Kings Tableland. Oh yes – and 4 Kiwis! (Photo: M McDonald)

Just on sunset the tour mob stopped at Echo Point to take in the Three Sisters vista at Echo Point as dusk set in. Two 'stories' exist as to the dreamtime origin of the Three Sisters, the more accepted version is:

'The tale begins with Tyawan, a witchdoctor who had three daughters; Meenhi, Wimlah and Gunnedoo. Whenever Tyawan had to pass by a hole to get food, he would leave his three daughters behind a rocky wall on a cliff. He did this because down this deep, dark hole there lived a Bunyip who was the most feared creature on the land.

One day as Tyawan passed by the hole off to get food, a large centipede crawled next to the girls and scared Meenhi so much that she threw a rock at it. The rock then fell down into the valley and angered the Bunyip. He came up to face the girls, and Tyawan who saw this from a distance turned his daughters into stones to protect them from the Bunyip with his magic bone. After he had done this, the Bunyip began chasing him so he turned himself into a lyre bird. All was well and everyone safe, however in the scuffle Tyawan had dropped his magic bone somewhere, leaving him a bird and his three daughters into the rock formations we see today. It's said that you can still hear the call of the lyre bird around the rocks even till now; Tyawan in search of the magic bone.'

Still more to do – like dinner before the overnight digs were reached. Mountain Culture Brewery was the dinner venue where the group met up with Matt, the host for our overnight stay even further into the depths of Upper Blue Mountains.

The location for the night stay sits on the Darling Causeway, a sandstone ridge formation that separates the upper Cox's River Catchment (Part of Lake Burrogaorang/Warragamba Catchment) from the Grose River Catchment (the Grose lower confluence with the Nepean River is located just a couple of hundred meters downstream of the field day of the conference at Yarramamundi Bridge). The fall from the Darling Causeway catchment edge to the confluence with the Nepean River is 1100 metres to just 15 metres over a river length of 54 km (average channel fall of 2%).

Arriving in the dark in the upper reaches of the Grose Valley for the overnight stay there was not much of a chance for everyone to appreciate where they actually were in the Australian Wilderness! The following map sort of gives some perspective to where the gang had been in previous days and where they would be staying for the night.



Figure 4: The Three Sisters at dusk from Echo Point (Photo: M McDonald)

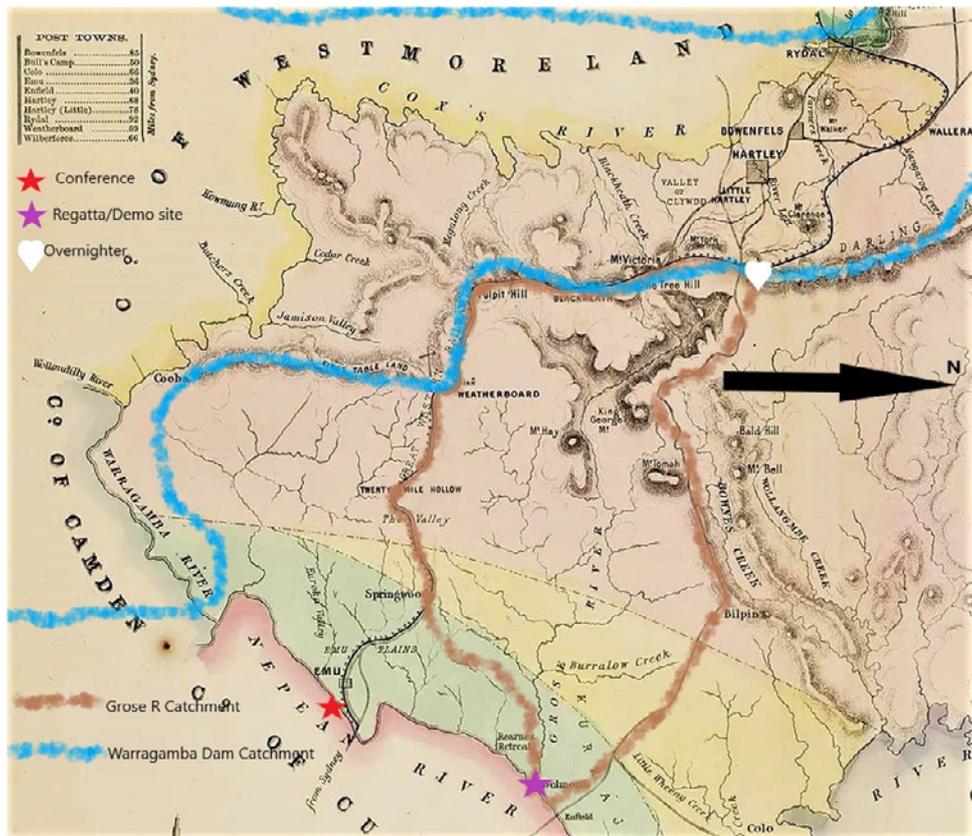


Figure 5: Concept map of the Grose River and Upper Cox's River/Warragamba Catchments explored on the post AHA conference trip. (Adapted from County of Cook lithograph section, Bishop, C1879)

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Friday was spent exploring this little nook of the Cox's River Catchment before taking in some more of the Upper mountains/Sydney catchment areas, but not before a bit of sampling upper catchment cold water and sunrise yoga. Followed by an invigorating outdoor shower, what a way to start the day!

A morning tour through the bushland of our host's property took in a small area of the Upper Cox's River Catchment recovering from the failed back burn attempt to halt the Gosper's Mountain megafire in late 2019. The catchment vegetation is recovering slowly in the area as a consequence of the severity of the fires in the catchment during that time.



Figure 6: Sunrise Yoga on the catchment boundary between the Grose and Upper Cox's River Catchments! (Photo: M McDonald)



Figure 7: Vegetation regeneration following the 2019 bushfires (June 2023), looking into the Upper Cox's catchment. The furthest ridgeline is the boundary for catchments flowing west into the Murray/Darling system. (Photo: M McDonald)



Figure 8: Comparison image of fire impacts in the Upper Cox's catchment, March 2020. (Photo: M Clayton)

From our cliff top vantage point above this Upper Cox's Catchment tributary the group could also discern the far ridge that separates the eastern flowing Cox's catchment from the western flowing catchments. Both these contribute to the Murray Darling Basin that eventually drains out through South Australia.

It was soon time to start making our way down through the Upper Mountain villages of Medlow Bath (historic health resort town and home of the Hydro Majestic Hotel), Blackheath (starting point for many adventure walks into the Grose River Catchment) and Katoomba. Taking in more cliff top vantage points of these outer Sydney catchment areas the crew then parted ways at Katoomba Railway Station, where they set off on some further adventures in the big smoke of Sydney before departing back across the ditch!

Conclusion

While this was only a brief glimpse of life away from the bustling urban location of the AHA conference in Western Sydney, being able to spend some time post conference with this 'Kiwi Krew' was very enjoyable from my own perspective. Enabling these sorts of activities, such as informal catchment tours or opportunities to spend a few days with a hosting organisation doing the 'stuff they do' enhances the hydrological experiences of those involved who have attended a conference or workshop beyond the immediate confines of the organised event. Conversations and ideas flow much more easily in these situations. There is always something to learn amongst everyone involved with new ideas and old ideas cross fertilising.

Conferences and workshops shouldn't be just about the programme you have paid for. Look for additional opportunities either side of an event to be a host or search out chances to learn more about the



Figure 9: On the lookout for Evan (from NIWA) above a misted in Grose Valley! (Photo A. Taylor)



Figure 10: Along the way homeward another Kiwi was located! (West Katoomba Water Supply Reservoir)(Photo A. Taylor)



Figure 11: Final parting photoshoot, 4 Kiwis with the Three Sisters. (Photo A. Taylor)

Beyond the Rating – Fitzroy/Martuwarra River Floods 2023

Robert Lawry, WA Decision Support Services
Senior Hydrologist – BoM

(PowerPoint Presentation with comments – taken from the AHA Conference 2023).

G'day, my name's Rob and I'm a Senior Hydrologist with the North-West Decision Support team within the Bureau of Meteorology (BoM)

I've worked with the Bureau for 20 years and I've seen a lot over that time.

But today I want to tell you a story. It's a story about the importance of data and its a story about the challenge of flood forecasting when you lose river gauges during a flood.

January 2023 Fitzroy River Floods

...so a quick overview of the story I'll tell today

For today I really want to mainly focus on the hydrology and hydrography with less focus on the emergency response and other impacts of the flood.

I'll just go through:

- Where the flood happened and a bit about the catchment
- Tropical cyclone Ellie and the rain it brought
- The massive flows that resulted from that rain
- The river gauges and what happened to them during the flood
- The challenges of forecasting without quality data
- And finally.... some thoughts for the future



- Impacted the Fitzroy River catchment in the far north of Western Australia
- Caused by heavy rain from Ex-TC Ellie
- Triggered peak flows beyond anything recorded before in Western Australia....and possibly Australia?
- Destroyed four river height sites
- Gauges offline and flows beyond rating curves challenged our ability to provide accurate forecasts and advise emergency services
- Consider how we can measure better, leading to forecasting better into the future

The Mighty Martuwarra/Fitzroy

Firstly the Martuwarra/ Fitzroy River Catchment, its around 30% bigger than Tasmania, at 95,000km in total area. It's a totally wild river, no dams, very little water extraction and an average discharge of around 8,000 gigalitres per annum.

This is really variable with some years seeing almost no flows and some years, like this year, seeing much more than average.

From the upper parts of the catchment the first major town is Fitzroy Crossing, there's around 1,300 people living there. Further downstream there's a handful of other towns and communities of a few hundred people each including Noonkanbah, Christmas Creek and Looma. From a hydrology

point of view the Margaret and Fitzroy Rivers are the two big tributaries coming together about 5km upstream of the crossing. At Fitzroy Crossing, as you might guess we've got the Great Northern Highway crossing the Fitzroy River. That highway crossing is the only all-year, northern link from WA to NT. The only other west to east link is ~2000km south.

- Total catchment size 94,000 km²
- Around 45,000 km² upstream of Fitzroy Crossing
- Two major tributaries, the Fitzroy and the Margaret, which meet just upstream of Fitzroy Crossing
- High variability in annual discharge



The Monitoring Network

- In terms of river monitoring upstream of Fitzroy Crossing:
- The catchment has a good rain gauge network with about 20 gauges, although if you do the sums that's only one gauge per 5,000km² (that's a dense rain network for us in WA)
- 5 river height sites covering both the Margaret and Fitzroy River tributaries. The 2 gauges circled, Dimond Gorge on the Fitzroy and Mt Krauss on the Margaret are critical to predicting the timing and height of the river in Fitzroy Crossing.
- From a flood forecasting aspect once we've got the Fitzroy Crossing forecast in hand it's pretty straight forward to route those flows downstream and provide accurate forecasts further down the catchment.



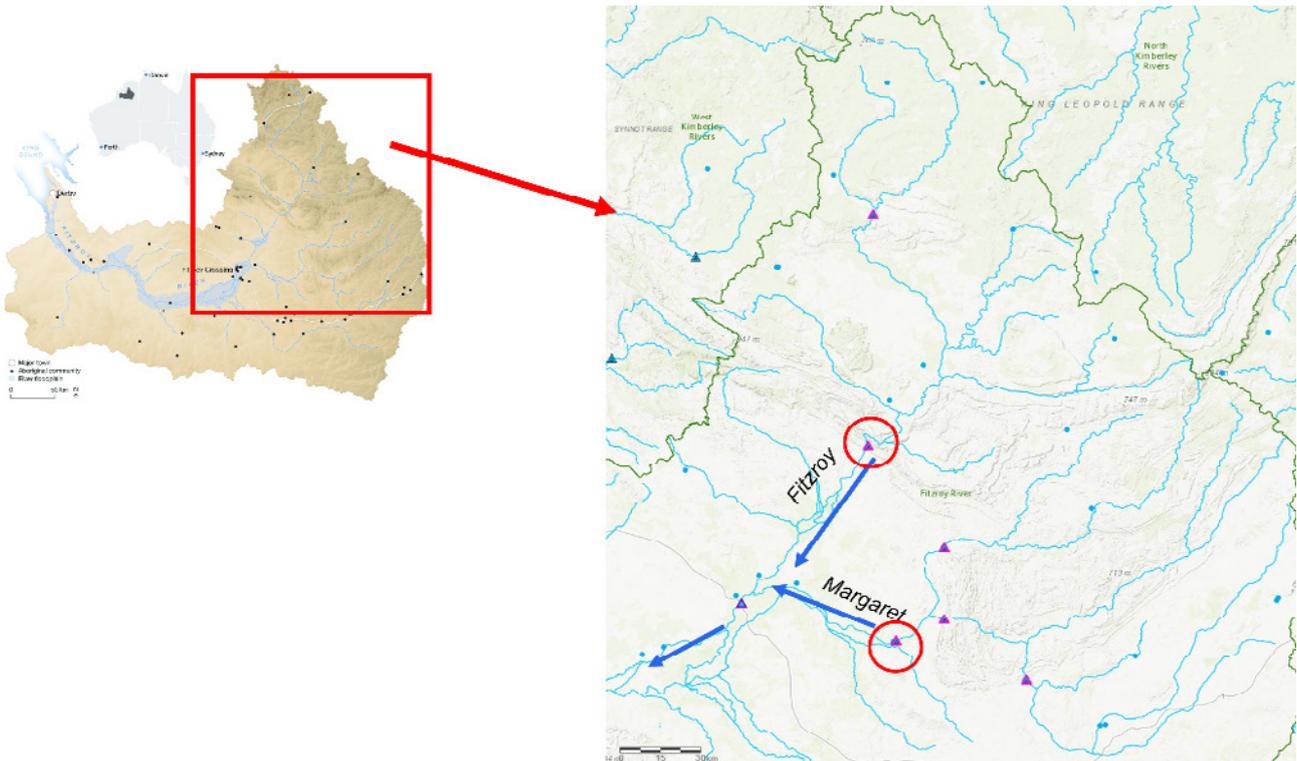
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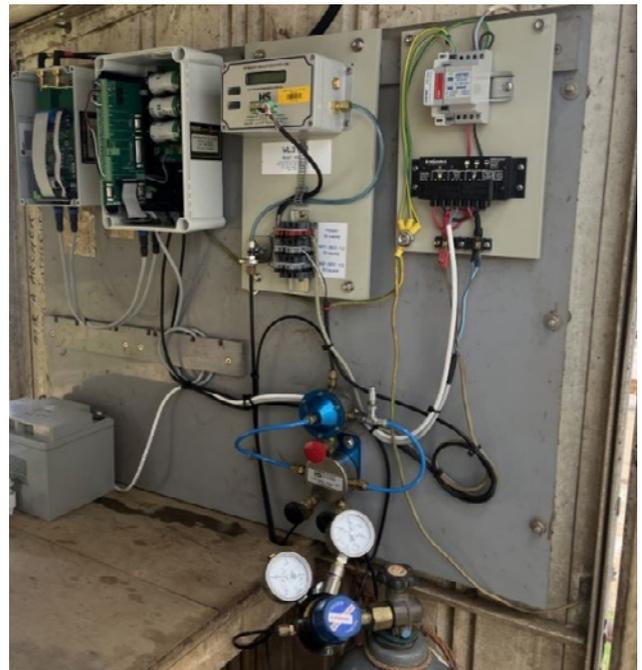


The Technology

When it comes to technology used across the Fitzroy - data collection sites mostly use solar power and satellite comms.

We use 0.2mm tipping bucket rain gauges, with a rim height up at 1m. We do that to stop the gauges becoming blocked with grass and dust.

River height sites are gas line bubblers with dry pressure transducers.



Ex-Tropical Cyclone Ellie

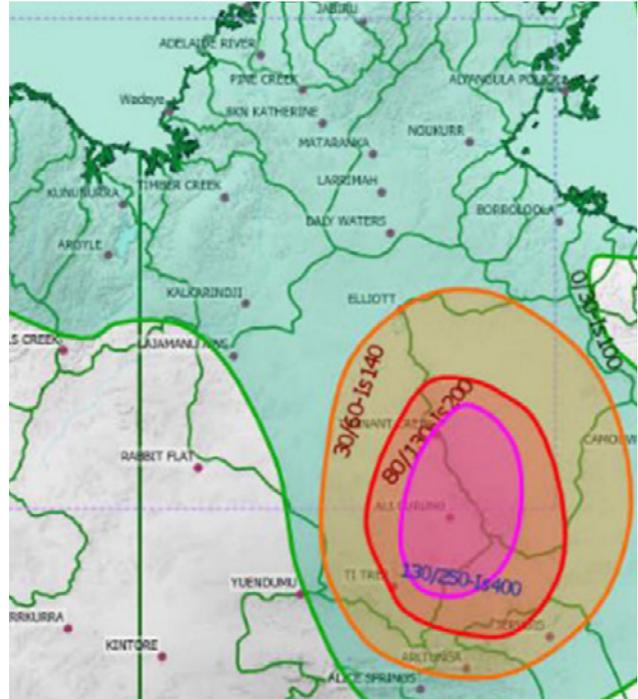
So you now know the Fitzroy River Catchment, you also know the network and you now the tech. Let's get onto the flood event itself.

Tropical Cyclone Ellie rolled into the Northern Territory as a fairly normal Category 1 system just before Christmas. However, the system brought heavier rain than usual, triggering flooding everywhere it passed.

This included both of the Territories major highways for a number of days and triggered evacuations at places like Timber Creek and a number of other communities

We generally find ex-tropical cyclones across the top end normally drop 2-300mm over a few days, however Ellie was a lot wetter than that with totals over a few days of 3-400 or even 500mm being recorded.

You can see from the image (left) the pink area shows falls of 250 - 400mm and that's just for a 24 hour period!



ALERT2 Evolution

Aquamonix & ELPRO have been busy working on the new ALERT2 products and were recently awarded the Bureau of Meteorology National Flood Warning Network Installation.

The ALERT2 hardware sets a new benchmark for remote monitoring. The rollout has begun with a number of councils and utilities starting to future-proof their networks.

Features At A Glance:

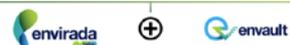
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A woman wearing a yellow high-visibility jacket, a blue wide-brimmed hat, safety glasses, and green gloves is kneeling in a grassy field. She is holding a rope attached to a white measuring pole. In the background, there is a river with a blue boat and another person sitting on a tall pole. The scene is outdoors with tall grass and trees in the distance.

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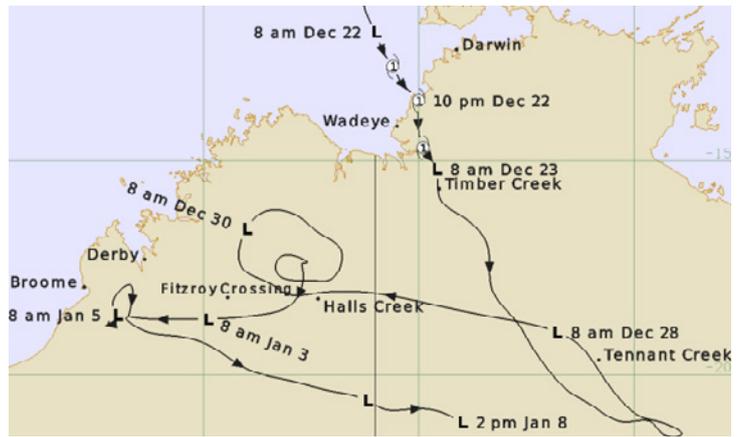
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- Crossed the NT coast December 22nd
- Major flooding for Timber Creek (NT) involving evacuations and closure of the Victoria Highway and Stuart Highway
- Notable were the forecasts of exceptional rainfall amounts > 500mm per day
- Heavy rain risk flagged for WA as early as 22nd of December due to extended model outlooks suggesting an eventual shift to WA a week before flooding in the Fitzroy River

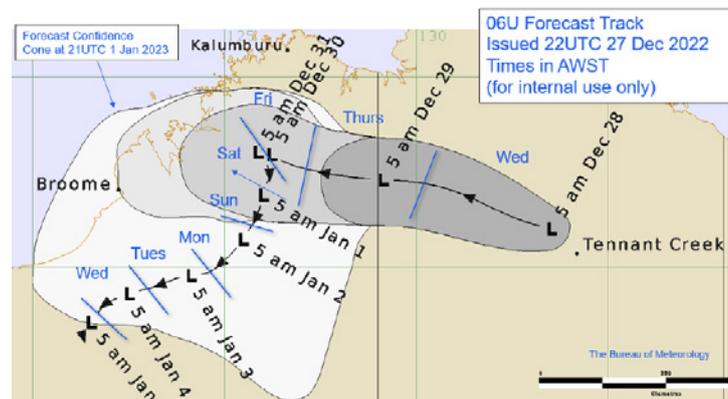
From early on it looked like Ex-Tropical Cyclone Ellie was looking like heading West, not only west but across the central Kimberley. Most of our Kimberley rivers are very remote with almost no flood risk to communities. The Fitzroy River Catchment is different however, its populated, it is prone to flooding and has flood risks.

In flood forecasting the best scenario is having a system pass quickly across the land or a catchment. It means we don't see big accumulations of falls in any one spot and as a result less or no flooding. The worst case is slow system movement or a system that stalls. When a system dwells over an area it just rains and rains in one area. For Ex-Tropical Cyclone Ellie what happened was even worse than that, the system stalled and then looped not once, but twice! Effectively parking itself over the Fitzroy River Catchment for 3-4 days, something that really never happens.

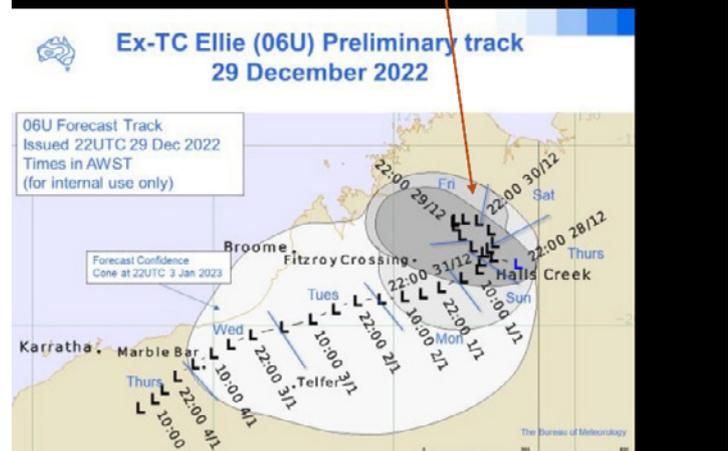
As each day progressed Ex-Tropical Cyclone Ellie became less likely to pass across the land quickly and more likely to 'linger' around a single area which means a greater risk to exceptional rainfall and exceptional flood impacts.



Ex-TC Ellie (06U) Preliminary track 28 December 2022



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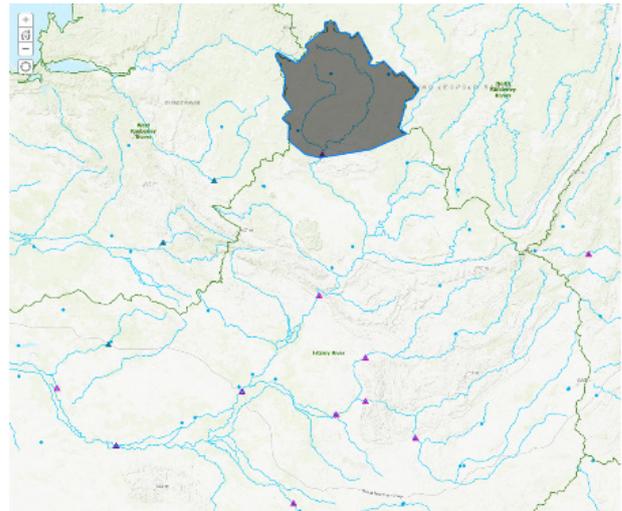
Phillips Range (Hann R) – it begins...

While the system lingered the rain that fell was extreme and focussed on the Fitzroy River part of the catchment more than the Margaret River area.

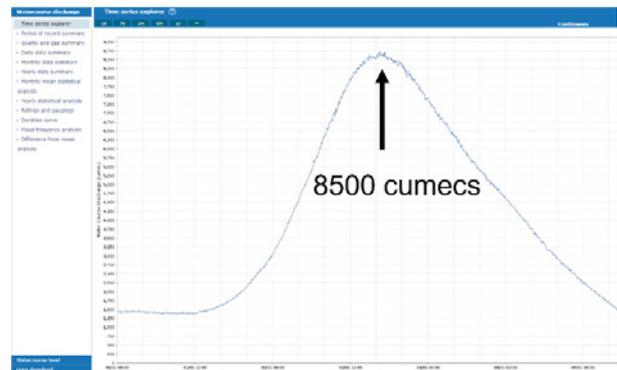
Most falls we saw over a 2-4 day period exceeded 1% AEP's or 1 in 100 year rainfall amounts 3-400mm. Dimond Gorge took the cake recording 830mm in a week

Within 24hr of heavy falls the Philips Range River gauge took off. The gauge has a catchment area of about 5,000km² and is high in the Fitzroy River Catchment

Phillips Range doubled its previous record peak flow and exceeded its previous record river height of 14m by over 3m!



Hann River - Phillips Range



Heavy Rain Upstream

24 hr

- 356mm Dimond Gorge 2nd January (>0.2% AEP or 1 in 500 year)
- Numerous falls > 200mm (1-2% AEP)

72 hr

- 525mm Dimond Gorge (0.2% AEP)
- 440mm Windjana Gorge (0.5% AEP)
- Numerous falls 300-350mm (1-2% AEP)



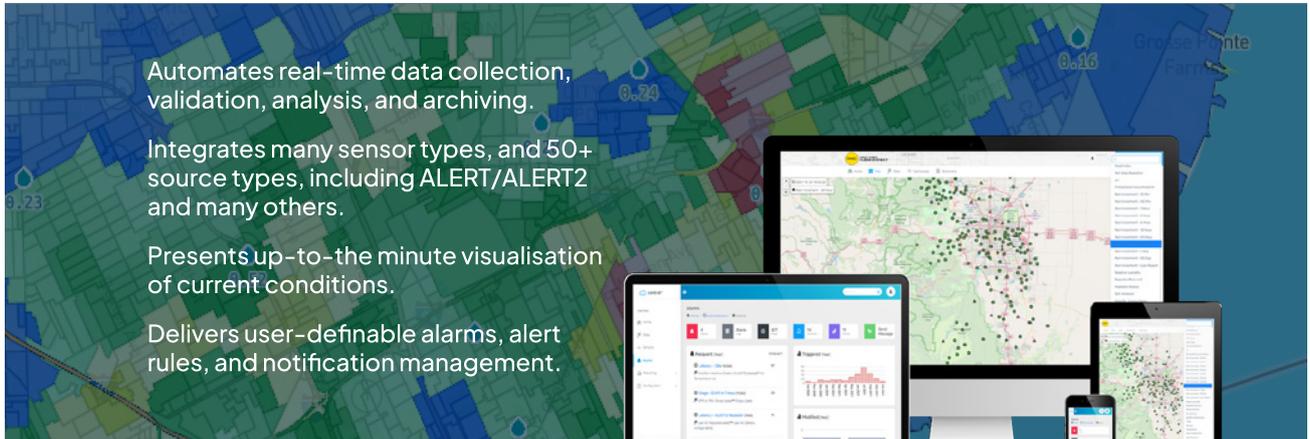
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Looking Forward

VEGA

Dimond Gorge (Fitzroy R) – *The first to fall*

Downstream from Philips Range with a catchment area four times the size we've got Dimond Gorge.

All the water in the Fitzroy River has to pass through this narrow passage.



Usually the gorge is a beautiful, peaceful location for canoeing and birdwatching. However the gorge

turned into a torrent with water backing up almost 10km from the gorge entrance.



Measuring this flow is the Dimond Gorge river height site situated where the gorge exits onto the flat country.

The gauge is located well above the 1 in 100 year flood level and positioned atop a 4m platform.

From the rainfall recorded we already knew this would be a big flood however getting the Dimond

Gorge peak reading would allow us to get an accurate picture on the flow coming down the Fitzroy River. This combined with the Margaret River flow would allow us to provide an accurate forecast of the level and therefore the impacts at Fitzroy Crossing and further downstream.



Unfortunately we never got that reading.

The gauge rose half a metre above its previous highest level set 20 years ago and then stopped reporting.

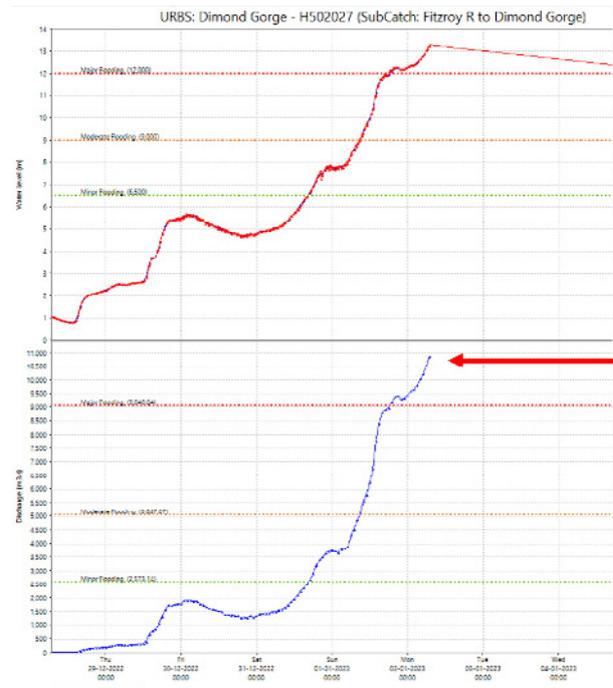
With data offline at Dimond Gorge and a flood barreling towards Fitzroy Crossing urgent questions suddenly became harder and harder to answer.

- How high will the peak be down at Fitzroy Crossing?
- What areas will get inundated?
- Could it impact homes?
- Will it impact the highway?

A couple of months later our Department of Water colleagues (DWER) found out why the gauge stopped reporting.

Not only was the gauge and platform destroyed, but trees, vegetation and even the soil had be scoured from the entire area!

- Data stopped at 13.5m and 11,000m³/s.
- What actually was peak flow?
- Without peak flow how do we provide river forecasts for downstream locations?



Data ceased during event @ approx. 11,000 cumecs



The Fitzroy Crossing Forecast – at least 13.2m??

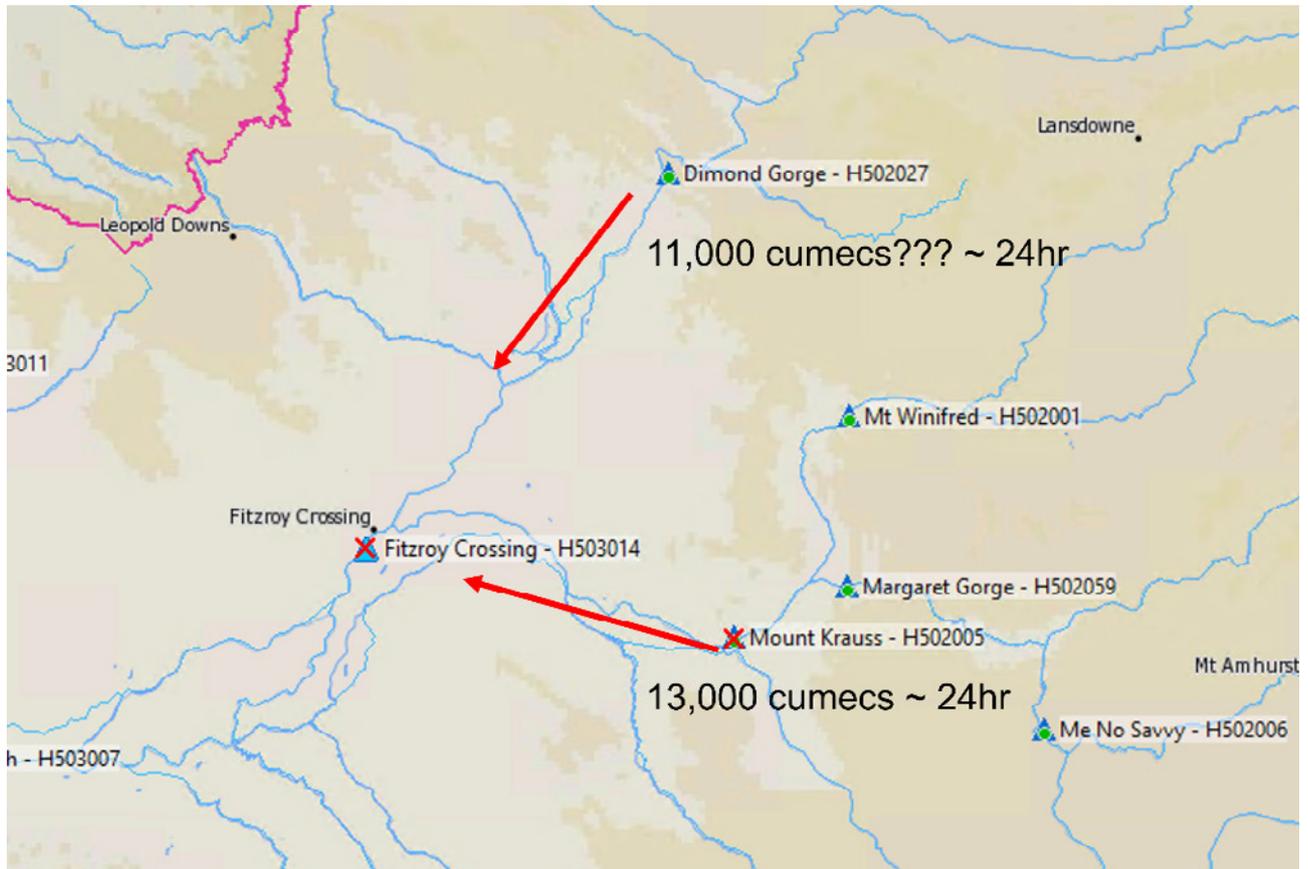
From a forecasting point of view we got the peak flow from Margaret River at 13,000m³/s. That was a top 5 peak flow (with a 60 year record) and at least 11,000m³/s coming down from Dimond Gorge. The previous highest recorded flow at Fitzroy Crossing was 28,000m³/s which was calculated to be a 1-80 year flood.

So in ~ 24hrs from these upstream peaks we should expect to see at least 24,000m³/s around the

previous record flood height from 2002 - or possibly even beyond?

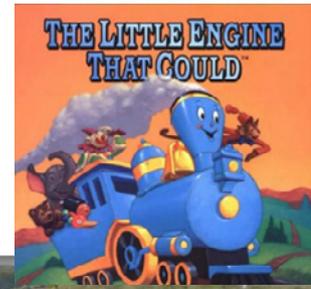
The answer came about a day or so later, from:

- Fitzroy Crossing
- Town of 1,200 people
- National Highway One Crossing
- Multiple smaller communities nearby



The Little Gauge That Could

The Fitzroy Crossing gauge, we called it "The Little Gauge That Could" is high on the banks of the Fitzroy River at Fitzroy Crossing



This gauge was our opportunity to get the full combined Margaret and Fitzroy River flows and give us an accurate picture of what we were dealing with to predict downstream flood levels. The gauge started to rise and was reporting perfectly however, as the river level went past the MAJOR height we started to see issues.

Firstly, you'll notice a half metre jump in river height in just an hour (see below)

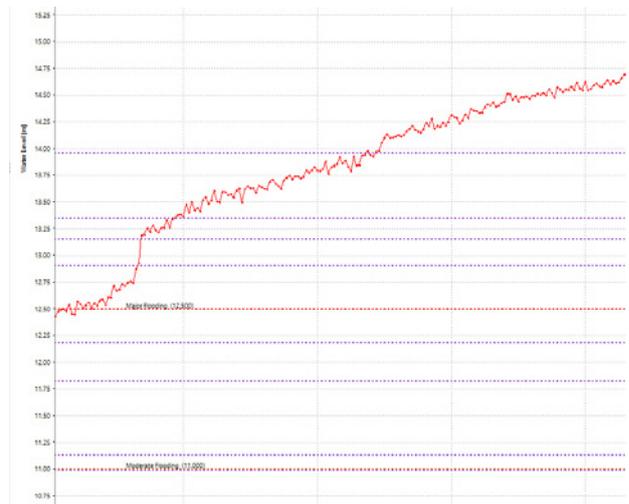
That equals a flow increase of about 10,000m³/s. Correct data or faulty data, what could cause a jump like that?

However despite our concerns the gauge was somehow struggling, it kept reporting

...and reporting. When water reached the base of the instrument hut we weren't sure how much longer the gauge would last, but it just kept reporting!

The bridge started to collapse but "The Little Gauge That Could" still kept reporting.

Would we record the peak to help forecast further downstream?



As the concrete hut started to get a lean we got very worried but we still hadn't reached the peak! When would this river stop rising?!?



By the next morning "The Little Gauge That Could" could not anymore, the gauge was gone.

But not before it recorded a peak height of 15.8m?

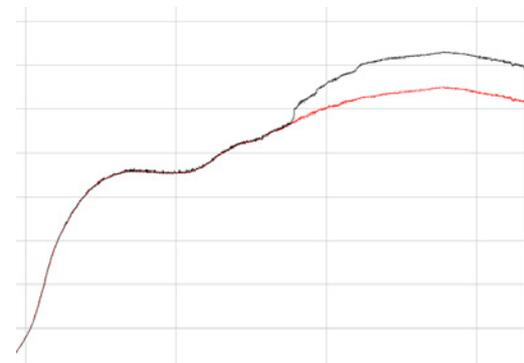
Using the peak height which might be questionable combined with on-the-ground inundation extent compared to the past highest flood we could confidently say we were looking at beyond a 1 in 100 year event

From a hydrology point of view well over the previous peak discharge record of 28,000m³/s.

Despite the height being reduced after survey results, it was indeed well above the previous record

We wondered what was actual peak flow?... 40, 50, +60,000m³/s

Easily a new WA peak flow record, maybe a national record?



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Fitzroy River Floods - Unprecedented

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Community Messaging

- Unprecedented
- 1 in 100 year
- Worse than 2002, seek even higher ground
- Life threatening
- Daily press conferences
- Every single location downstream will see flooding exceed all previous records

Emergency Services Mapping

- What inundation maps were applicable
- River height to AHD conversion to assist on the ground responders
- Once mapped, evacuate and act on impacts expected – PLUS a little extra (uncertainty factor)

Now that we actually had the peak height messaging became much easier - this flood wasn't just bigger than the previous record flood, it was a LOT bigger!

To community our message was simple, this flood would exceed EVERY single previous record as it moves downstream. If you've ever seen an area get flooded before it WILL get flooded in coming days - move to higher ground NOW.

However, the messaging for our SES friends was more challenging. How could we accurately predict a useful downstream river height when we were so far beyond any level recorded ever before and so far beyond any rating curve? Levels get pretty dicey beyond verified flow readings. We did however know what level it would exceed (the previous record level) and then we added a margin for safety.

Flowing your way...

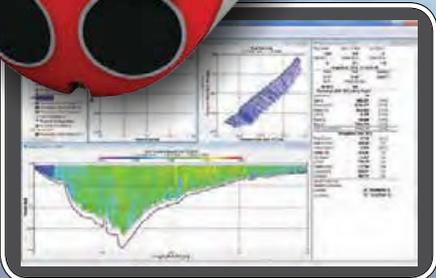
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Fitzroy Crossing – Warning Downstream

And sure enough every single location downstream from ‘the crossing’ did exceed all previous records and as we expected assumptions about rating curves were wrong.

One location called Noonkanbah, despite having around four times the previous highest recorded flow, the peak height was not even 1m above the previous record. Yet further downstream the peak height was 2.5m higher than the previous record!

As the peak moved downstream we had two more river sites stop reporting at the Fitzroy Barrage and at Looma.

However with that Fitzroy Crossing, which was verified at Noonkanbah, we could still provide a good forecast

- New records set at every downstream location
- Two further gauges went offline, total of four water level sites damaged



Image: Destroyed 12 m high gauge at Dimond Gorge Dpt Water

NEWS UPDATE

**4 FITZROY RIVER LEVEL STATIONS
DESTROYED IN FLOOD TO BE
REBUILT**

Fitzroy River Floods - Peak Flow Analysis

Since the flood DWER, our state river agency, has completed a surveyed review of the flow at Willare down at lowest section of the river.

Their report puts the peak discharge at around 40,000m³/s (+/- 30%)

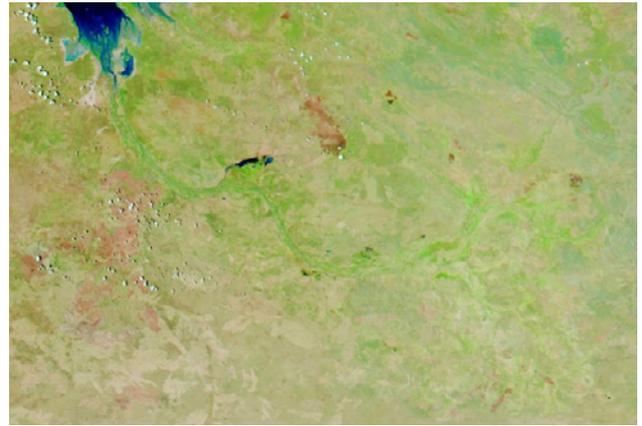
A review of peak discharge at Fitzroy Crossing is currently underway.

Questions:

What's the highest peak flow you have ever seen recorded?

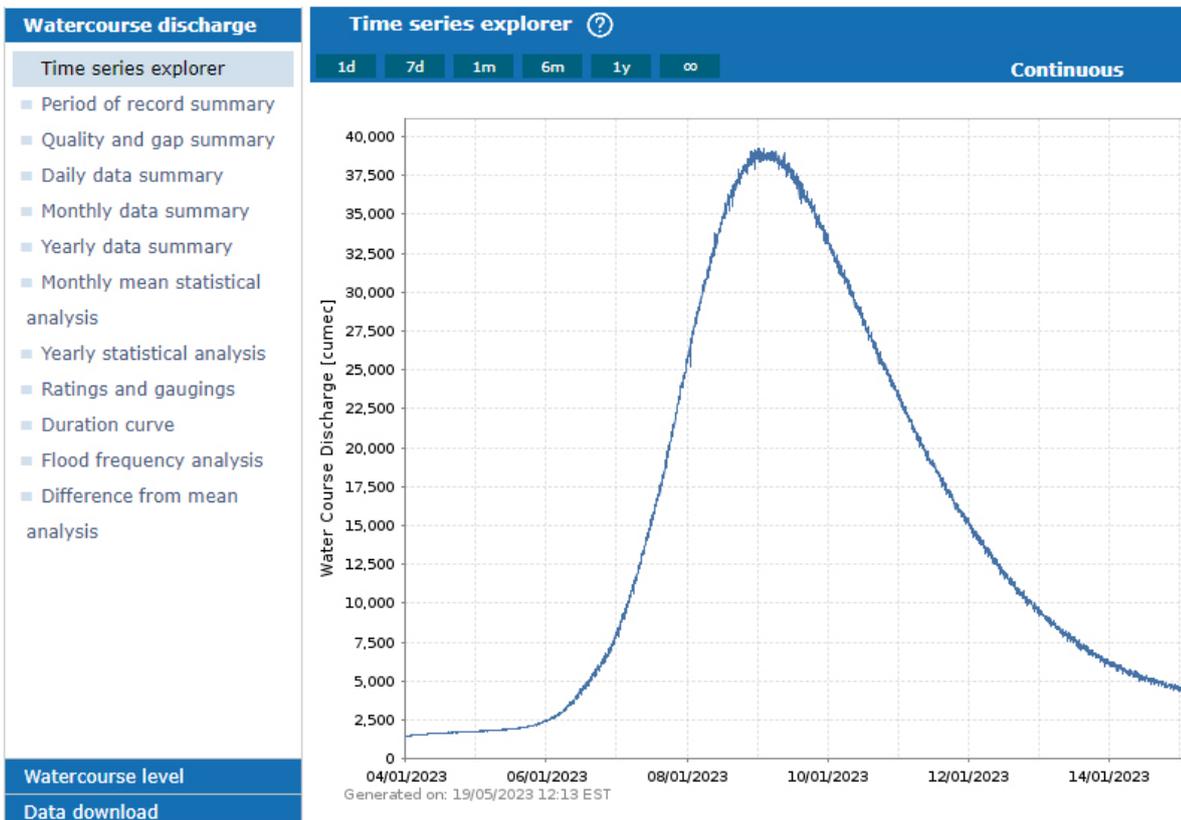
Do we have a list of top Australian flows?

- At Willare where the flood peak is most attenuated, DWER has recently estimated a peak flow of 40,000m³/s (+/- 30%)
- Highest peak flow in Australia?



Fitzroy River - Willare

Station number 802008
 Latitude -17.74
 Longitude 123.65
 Data owner WA - Depart
 Environment



Lessons for the Future?

- Big floods happen and a proportion will exceed levels thought impossible
- Climate change suggests extreme rainfall is becoming more common and the atmosphere can hold more precipitable water than ever
- When records break, there is no more critical time for accurate forecasts for safety and the protection of property
- **Without hydrographic data there is NO FORECAST!**
- How do we ensure that gauges survive and keep reporting during extreme floods?
- Accurate flood level gauging's are critical to having good rating curves



In closing:

- So, we had a big flood! Despite our state river agency (DWER) having top quality river gauges, well above 1 in 100 year flood levels we still lost a lot of gauges. This left me wondering what if we hadn't recorded the peak height and flow up at Fitzroy Crossing?
- Having that peak height gave us an insight into the magnitude of this flood, e.g. what could be expected downstream and when it would arrive. We know there will be more floods across Australia and some of those will exceed all previous expectations and even redefine return intervals. E.g. what was 1 in 100 year may become 1 in 20 year.
- My closing question to the audience is;
- How do we locate, build and design river recording sites to be more resilient?
- To survive floods of the future?
- ...and to keep reporting when it really counts for forecasting?
- The 2023 Fitzroy floods were some of the worst flooding in Western Australian history. We had six communities evacuated and over 500 homes damaged, however despite this we didn't have a single fatality during the flood.
- The story is simple – quality data... saves lives....
thanks



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