AUSTRALIAN HYDROGRAPHERS ASSOCIATION

Australasian Hydrographer

Snow Pack Survey, Snowy Mountains NSW
Photo. ©R. M. Clavton

November, 2003

The **Australasian Hydrographer is the Journal of the Australian Hydrographers' Association Incorporated. ISSN 0812-5090**

THIS ISSUE

EDITORIAL

"If you don't measure it, you can't manage it!"

Wasn't this our catch cry once upon a time? (or something very like it?) This morning I heard it in an ad on ABC radio for Bush Telegraph where they are have been running the "Water Challenge".

The Water Challenge invites consumers with water meters to monitor their consumption over a six week period. The more consumers that registered will enable an environmental entitlement of up to 1000 megalitres of water to be passed down the Murray River to be used in one of four options, flushing the Murray mouth, watering the Barmah Forest, watering a private wetland or a fourth option to trade the water in the market place as long as the funds from those sales are used for environmental works in the Murray Valley.

To us who measure it, we know that 1000 megalitres of water is not necessarily a lot of water so what's the hoo-ha anyway. What is significant about this is that people are being asked to *measure* water, albeit by reading their water meters, and then make some sort of informed decision as to how to use the water that will be available to be used for one of the options. Listeners to Bush Telegraph will be receiving information about flows in the river system and varying points of view as to the effectiveness of the options. The basis for the discussion and decision making will be how much water is there in the system and how does it vary over time. Maintaining accurate, continuous and long term monitoring of the flows in the system is the most important tool of this event. That data has been collected and maintained by us, Hydrographers, over the years.

While possibly not an earth shattering event (perhaps some of you weren't even aware of it!) it is just a small thing that emphasises the importance of the work we do – monitoring Australia's water resources.

To continue on the theme of media – one of our members, Paul Corbett, did a piece on South Eastern ABC radio a few weeks ago about river flows and the like. Well done Paul.

Our chairperson elect, Graham Armstrong, has 'volunteered' for 20 Questions in this issue and this issue sees the commencement of a paper on the South African monitoring network presented at the last conference.

Speaking of conferences the first call for papers for next years conference is now out. I encourage you all to consider contributing your wealth of information and experience to this event through papers and participation in the workshop.

Mic Clayton

(PS to find out more about the Water Challenge go to www.abc.net/water)

The **Australasian Hydrographer** is the Journal of the **Australian Hydrographers' Association Incorporated**. The Journal is distributed quarterly to Members. **ISSN 0812-5090**

Visit our **Web Site** at: **http://www.aha.net.au** to download a Membership application and to find contact details for your state representative.

Editorial and advertising enquiries should be directed to the association's **Publicity Officer**, Mic Clayton.

e - mail publicist@aha.net.au , or
PO Box 843, COOMA, NSW, 2630.

12th National Hydrographic Conference

The AHA is calling nominations for papers to be presented at the Australian Hydrographic Conference to be held at

ANA Hotel, Surfers Paradise
Gold Coast, Queensland.

28th to 30th July, 2004.

The conference theme is:

"The Science of Hydrography - Looking Forward, Looking Back"

Papers should be sent to:

The Convenors
12th Australian Hydrographic Conference, 2004
C/- Natural Resources & Mines Technical Centre
1345 Ipswich Rd
Rocklea. Qld. 4106.

And marked attention: Paul Martin or Ray Alford

Papers may also be emailed to:

Paul Martin - **Paul.Martin@nrm.qld.gov.au**
or
Ray Alford - **Ray.Alford@nrm.qld.gov.au**

The closing date for nominations/registrations of abstracts is
COB Friday 27th February, 2004.

Successful presenters should have papers submitted by
Friday 28th May, 2004.

Apologies

In the last issue of the Journal (August, 2003) the presenter of the paper from Manly Hydraulics Lab, Innovative Data Collection - The Next Step, was Bronson McPherson. Apologies to Bronson for omitting his name from the article.

12th National Hydrographic Conference

Queensland

28th - 29th July 2004

The 12th National Hydrographic Conference will be held in 2004 on the Gold Coast in Queensland. The event is being organised by the Department of Natural Resources and Mines and will be held over two days starting on Wednesday 28th July 2004.

The theme of the conference will be ***"The Science of Hydrography - Looking Forward, Looking Back"*** which should give scope for input from our members who perhaps are not on the cutting edge of Hydrographic technology.

In conjunction with the conference, it is intended to hold an Australian Hydrographic Association meeting on the 27^{h}, the evening preceding the event and a HYDSTRA group meeting on Friday 30th July. A field excursion will also be organised on that day for those not involved, or wishing to attend, the HYDSTRA group assembly.

Limited block accommodation has been booked at the ANA hotel, in Surfers Paradise, at very reasonable rates for those who wish to stay there.

Further details of this conference including attendance fees and cut-off dates for the submission of papers will be made available as soon as possible.

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Paul Martin Paul.Martin@nrm.qld.gov.au

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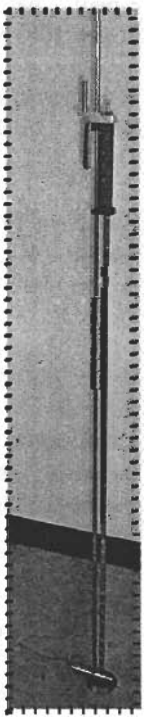
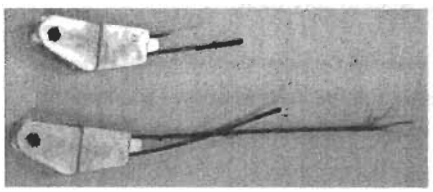


C1 CONNECTOR



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20 Questions with Graham Armstrong

I started in the hydrographic business as a trainee in 1976 with Sydney Water. Sydney Water provided an excellent level of training and experience because we had some very experienced people and operated all types of stations – clean and dirty water. It really gave me an excellent grounding in hydrography. Eventually I became the manager of the Hydrographic and Atmospheric business units of Australian Water Technologies (the commercial arm of Sydney Water) and when political pressure was applied to dismantle the AWT business I left and commenced working with ECOWISE Environmental in their Sydney Office. When I started with ECOWISE the Sydney Office consisted of just the two of us, we are currently at eight and hopefully can expand on that in the future.

What was your First Job? Factory demolitions with Zambezee Demolitions.

Why did you pick it? It payed good money and I was young (plus, I think in hindsight expendable given some of the tasks they made me do - where was Workcover back then!) Plus the owner was my next door neighbour so it was cheap to get to and from work.

What drew you to your present position? Outdoor activity (although you would be hard to pick that as a reason by looking at me today). What keeps me here is the knowledge that what I do has significant community value, even when performed on a commercial basis. The data we provide can often form the foundation for many critical decisions that, directly or indirectly, have a long term benefit to the community as a whole.

What is the favourite part of your current job? Making a contribution to whatever is at hand. It doesn't matter whether the problem is big or small, working together to solve it is always rewarding.

What is the strangest thing you have been asked to do for/at work? There have been lots of things but I remember once being sent on a job that took thirteen hours to replace a resistor in some monitoring equipment - the job took 5 minutes, the rest was travel time. It wasn't even essential to get it done quickly – it would not happen now days. I've also been doing a lot of auditing of Hydrographic Contracts that sometimes feels a little uncomfortable. I like to think any audit leads to improvements and there is significant value in reviewing projects/processes to detect deficiencies and create a continual improvement process.

Pastimes and hobbies? Boating and fishing – I don't even care if I catch anything - just being out on the water is great. In fact last weekend one of my six year old sons out-fished me with the biggest fish of the day using a $9.99 K-Mart rod! (He's currently looking for a new home).

What are you reading? An old Wilbur Smith novel - The Seventh Scroll.

Favourite Music? I like all types. It could be just about anything depending on the mood.

Favourite Website? http://www.fishnet.com.au/ and http://www.howstuffworks.com/

Where do you see our industry in 5 years from now? In decline, unless we start to get out there and demonstrate to policy makers the value of our industry. I see this as the biggest issue for the Association – we need to have a voice at the right levels in Government and Industry so there is a clear understanding of the benefits of good data and information.

How can participation of younger members be encouraged in our association? The industry has changed over the past few years and it is the younger members that will shape the association into what it needs to be for the future. We always need fresh input and enthusiasm. Maybe we should be encouraging them by offering free 12 months subscriptions as long as they provide one article for the newsletter.

If you could achieve one thing in your lifetime what would it be? I just want to be happy, like most people. Maybe I should have become a fisherman instead?

Name three people you would like to invite to dinner? John F Kennedy – who the hell shot you? God, because I want to know everything and Clive James because I love his humour.

Your Favourite beverage? Beer. I hear it's really good for controlling your waistline.

Your ideal weekend consists of.... on the water boating around. There is a great line by Toad in Wind in the Willows....."there's nothing in the world half as much fun as messing around in boats". I have to agree.

How do you balance your work and private life? It is difficult at times as I spend a lot of time between Sydney and Tuncurry (about 3 hrs north). I now work 4 days per week and although I get stuck with some work at home the overall balance is much better. I needed to

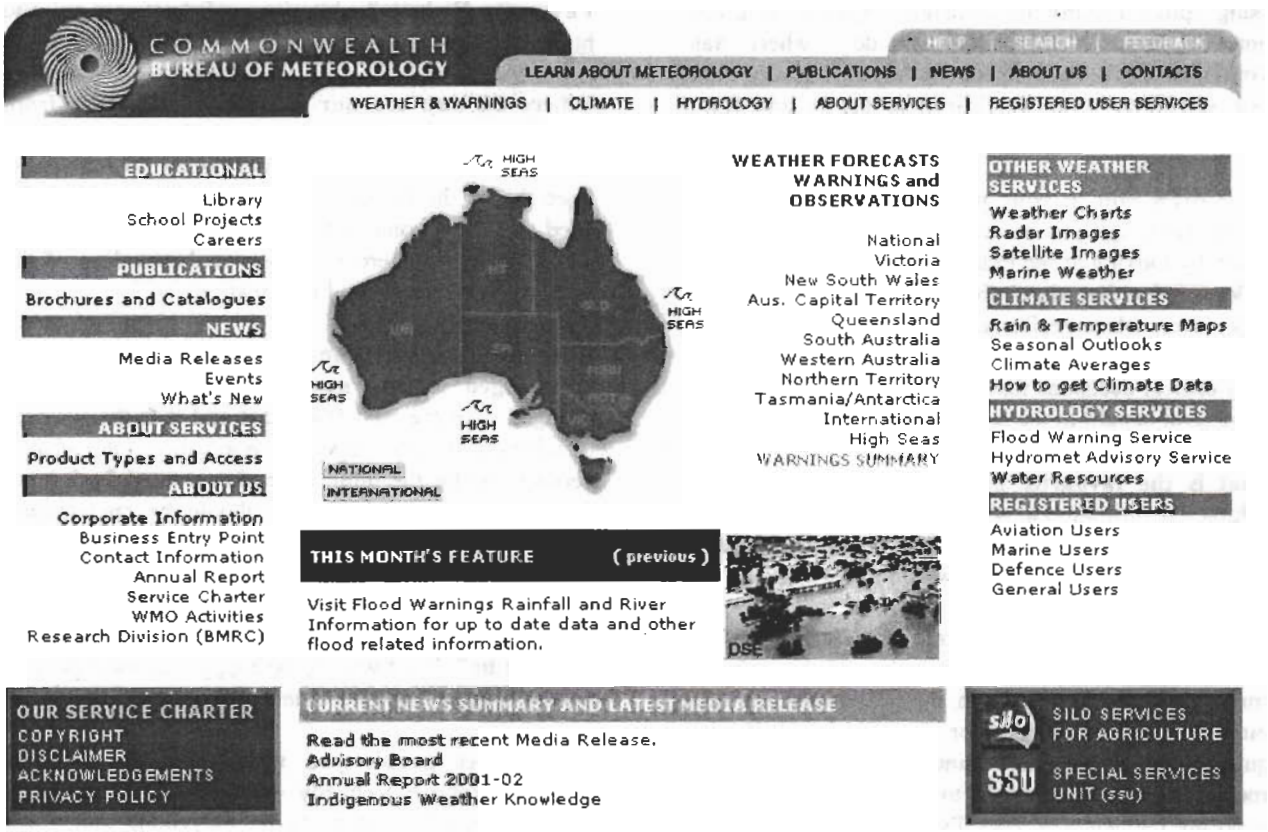
make an adjustment after my wife gave birth to twin boys after we had thought we were finished having more children. There's not many around in my situation with a 21 year old, a 20 year old and two 6 year olds!

Your greatest asset? Obviously my virility.

Your greatest liability? Obviously my virility

What is the best thing about your job? I have always enjoyed the hydrographic business and now that I've been around in it for a long time there's even bits I'm pretty good at. So I guess the bit I like the best is sharing some of that knowledge.

What is the worst thing about your job? The Hydrographic business has become highly competitive over the years and a lot of work is being done at such low dollar values the work simply is not being done to an appropriate standard. It's difficult to raise awareness of the value of our industry when some suppliers are out there damaging our credibility.



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SURFACE WATER MONITORING IN SOUTH AFRICA

CHRISTOFF LE GRANGE
Department of Water Affairs and Forestry,
Directorate: Hydrology, Pretoria, SOUTH AFRICA

INTRODUCTION:

The climate of South Africa varies from desert and semi-desert in the west (rainfall less than 200mm mean annual) to sub-humid along the eastern coastal areas (more than 1000mm mean annual) with an average annual rainfall of approximately 500mm. As a consequence of the topography and rainfall distribution, the natural availability of water across the country is very unevenly distributed, with more than 60% of the river flow arising from only 20% of the land area.

The Directorate Hydrology of the Department of Water Affairs and Forestry is responsible for the supply of all required information on the quantity and availability of surface water in the RSA. Hydrology maintains and operates the national hydrological network distributed throughout the country. Eight regional offices collect this data in the field and supply it to the Directorate Hydrology in Pretoria for final data processing, quality assurance and availability to all data users. Flow is measured on a continuous basis at more than 1000 stream-flow stations and at approximately 200 flow meters on pipes. Water levels are monitored at about 250 dams. Rainfall data is collected at more than 360 sites and evaporation at about 350 sites. The combined average run-off for South African rivers totals 53 500 million m^3 annually – less than half the run-off of the Zambezi River. Of this, large quantities are lost due to evaporation or wastage during floods, and only some 33 000 million m^3 can be economically used each year. Groundwater also delivers another 5 400 million m^3 annually. A total storage capacity of about 27 000 million m^3 has been created by the construction of large dams, holding more than half of the mean annual run-off of the country. City councils, irrigation and water boards also operate a small number of flow stations.

DISTRIBUTION AND WATER USE IN SOUTH AFRICA

Most of the main metropolitan and industrial growth centres, which have developed around mineral deposits and harbour sites, are remotely situated from major river courses. The main industrial and economic growth centre in South Africa includes the metropolitan areas of Johannesburg, Pretoria and Vereeniging that utilise the Vaal River for water supply. Various water resource development projects and inter-basin transfer schemes like the Tugela-Vaal, Usutu-Vaal and Lesotho Highlands Water have been developed to supplement the water supply to the Vaal River System. Some of the irrigation developments in the country are also located in sub-optimal regions with respect to water efficiency, having been established during times when water was relatively abundant. These factors aggravate the situation, with the result that in several river catchments the water requirements already far exceed the natural availability of water. Supply and demand have thus had to be balanced by large water resource development projects and the extensive inter-basin transfer of both raw and potable water from areas of surplus to areas of deficit.

The Department strives to supply a minimum of 25 litres of domestic water per person per day (South African population is 44 million). Urban and domestic amount approximately 10% of total water use. Agriculture is currently the largest user of water, approximately 55% of total water use. Industry 16%, the environment and eco-tourism use approximately 19% of the total use. By far the dominant growth in water requirements is foreseen in the domestic, urban and industrial sectors and is largely driven by population growth together with the concomitant urbanisation, increased standards of living and services as well as the supporting economic growth and industrialisation. In this respect it is estimated that, should current growth trends and usage patterns prevail, the total requirements for water in these sectors will approximately double over the next 30 years.

Based on current trends and utilisation patterns, projections are that the country's conventional water resources will likely be fully utilised before 2030, and that dramatic changes in water usage, with resultant large economic and social impacts, will then be forced upon the country over a relatively short period. Various water resource development projects and inter-basin transfer

...eed to be ... by the eight Regional offices [V
... (Belville); Eastern

d into 22 primary drainage
:) numbered alphabetically
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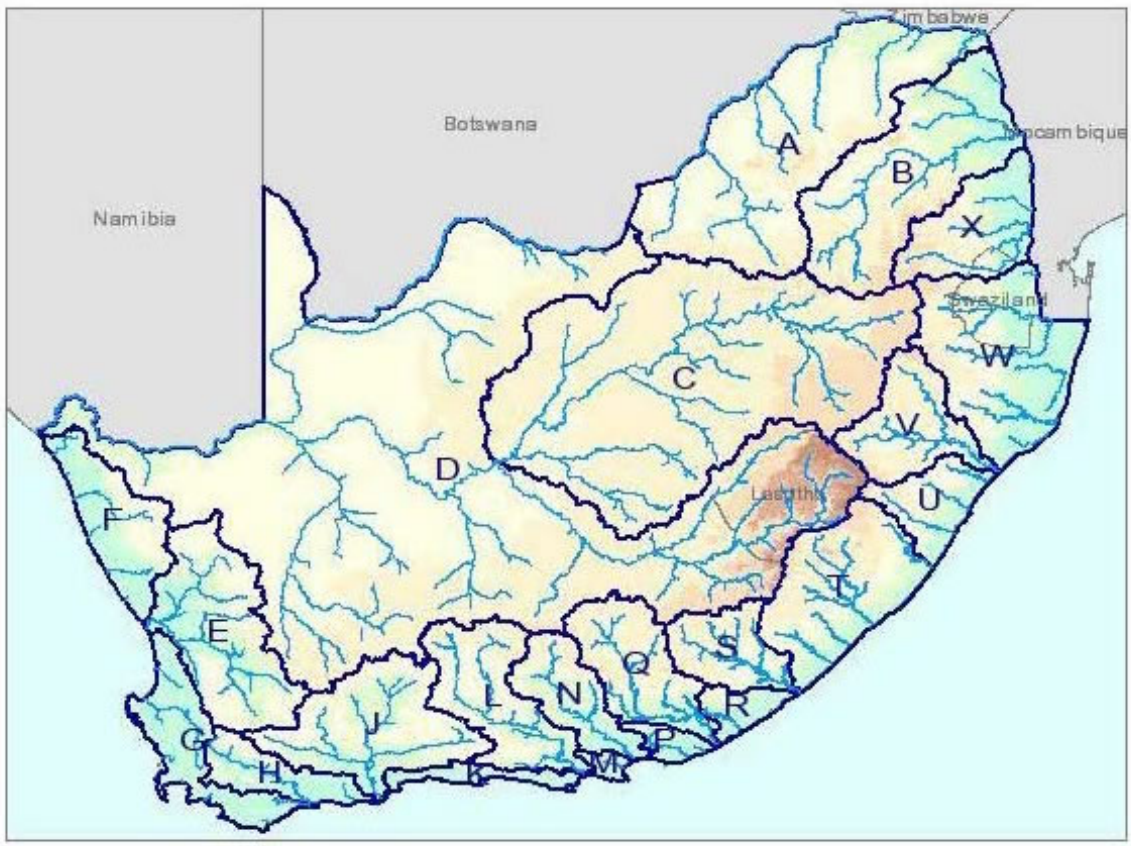
primary drainage regions, has been i
since 1899 and was revised in 1955 and
map is used for reference in all wat
management and planning
numbering of gauging struc



GAUGING POINT	DESCRIPTION OF GAUGING POINT	OPEN STATIONS
H- GAUGING STATIONS IN FLOWING WATER: 1181		
A	Upstream gauge plate	1 015
B	Submergence plate	452
C	Crest tapping	3
H	Gates	8
K	Valves	4
M	Meters	207
Q	Sampling points	1 509
R	Untreated water	26
S	Treated water	24
U	Slope surveys	5
V	Current Gaugings	132
W	Float measuring site	13
X	Composite Flow	100
Z	Combination flow	5
R- GAUGING STATIONS IN STORED WATER: 251		
A	Gauge plate	274
B	Submergence plate	1
H	Gates	324
K	Valves	52
M	Meters	21
Q	Sampling points	480
Y	Calculated heights	4
Z	Combination flow	9
E- METEOROLOGICAL STATIONS: 375		
A	Class A evaporation pan	230
P	Rain gauge	361
S	Symons evaporation tank	244
T	Temperature	1

Table 1: Summary of gauging points in South Africa

Hydrological Information System (HIS)

The Hydrological Information System (HIS) consists of several interconnected databases on the UNISYS A19 Clearpath Mainframe. It uses the DMSII database engine, occupies about 15Gb of disc space on the mainframe, consists of 600 000 line of LINC code (6 mil in COBOL) and another 600 000 of ALGOL code for numeric processing. It contains about 40 million items of information and has been designed to serve at least 100 users simultaneously.

The present system was originally initiated in 1983 and has been redesigned and updated over the last few years. It is accessible to all users in the Department,

including regional offices. The only system directly linked to it is HYDAC 5, which is a chart digitising system. Other systems can download data via FTP onto the system. Limited success has been achieved in facilitating access to users outside government services and in using a GIS front-end to access data.

HIS serves as the main national archive for surface-flow data, processing of flows and producing data products for users. It consists of several systems:
Refer: for user registration and access control.
Staskat: the flow gauging point catalogue providing a common index.
FLO: flow calculations and the observed water level-, ratings- and calculated flow- archive.
Verdamp: the evaporation and rainfall archive for reservoirs.
VVI: a system to calculate and archive reservoir records.
Intyds: the archive for unedited real time records from telemetry systems.
Dokreg: a system to manage 1,5 million source documents.

A wide range of utility programmes was developed over the years by hydrologists and engineers in the Directorate Hydrology to cater for various needs in the preparation of data for analysis, simple interpretation and bulletins. Examples of these utility programmes are:
Rawdata: a customised system written in Dephi, which provides graphic facilities to support data evaluation investigations.
OTT-Hydrus 3: a commercial system supplied with the standard OTT data loggers in use in DWAF, to extract, edit and process data from the OTT-loggers and to transmit it with FTP to HIS.
Prolog: an electronic data processing system, also customised and developed in Delphi, to import data from other electronic systems and prepare files for transmission with FTP to HIS on Mainframe.
Calib: collection of calibration programmes written in Delphi, which is maintained to calculate flow ratings for gauging stations.
Osiris: a customised DBXL database used by regions to manage their monitoring networks.
Rainfall database: a copy of the Weather Bureau Rainfall Database.
Flood Control and telemetry: systems providing functionality for Flood Control purposes.

The present mix of separate systems, requires much manpower in inter-system file management, indices updating as well as a great deal of time in data preparation from different systems for analysis. This has resulted into a serious limitation to the development of both Hydrometry and Analytical Hydrology in South Africa. The present mixture of architectures does not support the decentralisation of functions to small business units, like the proposed 19 Catchment management areas. The Directorate is currently revising and adapting its strategy regarding data collection and processing systems to make hydrological data available on a real/near real time basis. The most important goal is that the present systems are integrated into a single, highly accessible system and the inadequacies regarding access and added value functions be addressed in the shortest possible timeframe.

The second part of Christoffs presentation will appear in the next edition of the Journal where the structures and hardware of the network are discussed and the future directions for the South African network will be discussed.

STIL Gauging Logger

(Advertisement)

"Twelve hydrometric teams within the NSW Department of Sustainable Natural Resources are routinely using Stil GLoggers to log and process streamflow measurements. There are other types in use and some hydrographers are using handheld PC's for gauging input and processing. Users find the GLogger easy to set up and simple to use. It has proved very robust in the field. The initial problems with data loss and 'scrambling' on downloading have been overcome. We are now using the gLogger universally for all gauging and have found it utterly reliable in recent times. There are considerable time savings over manual methods and we're finding the consistency checks that the software provides (both yours and HYGAUGE) of immense benefit."

Paul Corbett
NSW Department of Sustainable Natural Resources.

The Taranaki Regional Council has recently purchased a second Gauging Logger (known affectionately as a Glogger) to add to its arsenal of gauging equipment. We have found, after the initial and almost inevitable teething problems with new products and software, the Glogger has made the 1-person gauging exercise very efficient and due to the enhancements of the latest software version arguably more accurate. The on-board software is plain and user-friendly and the end results can be easily transferred into most hydrological databases, eliminating the need for double handling. The Glogger being fully water-proof (we have recently done deep wade gaugings with the Glogger under about 400mm of water!) we have no hesitation in recommending it as another item for the Hydrologist's field tool box."
Grant Best,
Taranaki Regional Counci Hydrologist

... And finally some praise for the loggers filtration abilities in high conductivity geothermal streams around Rotorua. I actually carried out a successful gauging with the min/max values on the contact set at 93 and 95 respectively for a wiping contact Pygmy. It didn't miss any of the counts. Normally we would have had to do this gauging by visually timing the rotations.

Cheers
Glenn Ellery
Team Leader Environmental Data Services
Environment B O P

Good afternoon

I'm a hydrographer with DLWC and based in Dubbo NSW. I have heard nothing but good reports from the Armidale office who having been using your instrument. As I would like to put a submission to my management for one of the counters, could you please indicate the price per unit and freight charges. Thanking you for you time on this matter

Andrew Pearce

Natural Resource Officer (Hydrographer)
Hydrometrics Group - Resource Information Unit
Dept. Land & Water Cons. - Central West Region

And again:

Owen

Good morning. Have just spent the last couple of weeks in the field using our new GLOGGER for gauging. It is very versatile, robust easy and efficient in it's design and keystrokes. I have recommended to my supervisor that enough units be purchased that each team can have one for use. It is a great piece of gear and a must in every hydrometric vehicle.

Andrew Pearce

STIL have a couple of GLoggers available for loan to hydrographers in Australia.

A Comparison of Turbidity Sensors for Continuous Field Deployment

The second and final part of a paper presented by Mic Clayton, previously Senior Water Information Officer, Department of Primary Industries, Water and Environment, Hobart, Tasmania Presented at The 11th Australasian Hydrographic Conference Homebush, July, 2002

4. DISCUSSION

The data collected from the sensors indicated that they generally performed well within the 0-250 NTU range during the period except for a period from August 12 to August 17 when a relay circuit powering the sensors remained on and flattened the batteries and the BTG unit failing on October 17 when the 4-20 mA output circuitry appeared to fail. Another system power failure occurred close to the completion of the test.

The following plot tracks sensor values recorded coincident with field spot readings recorded in Table 2.

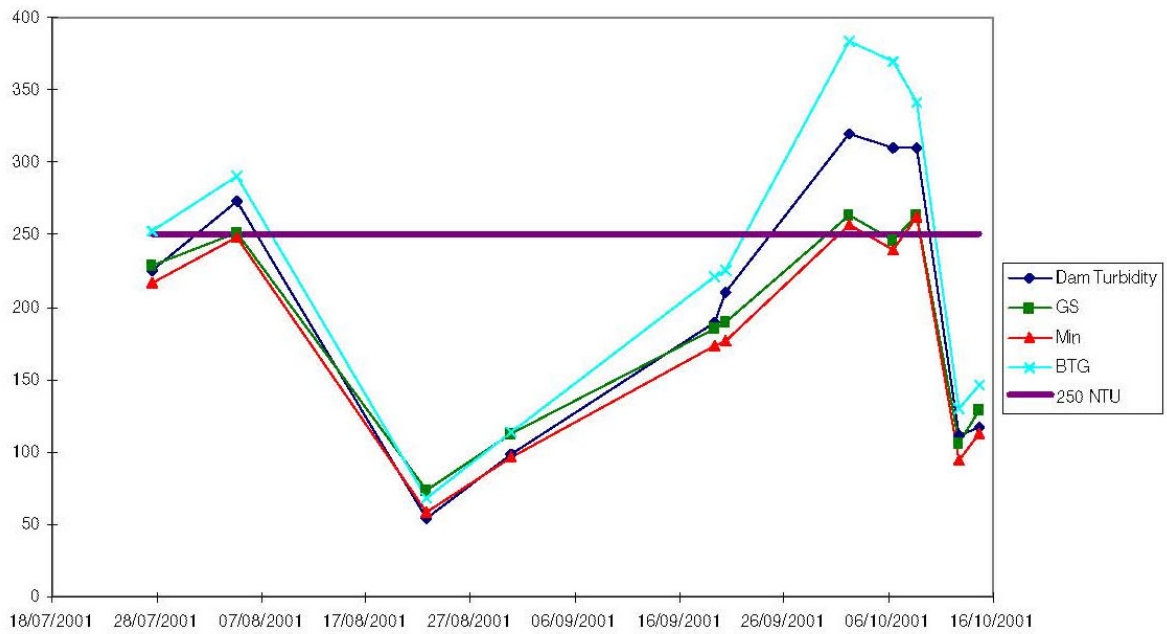


Figure 4. Comparison Plot of turbidity data from field readings and values recorded by sensor at time of field readings.

Deviations away from the Hach readings tended to be in the order of +/- 5% (Full Scale Deflection) for the Mindata and Greenspan sensors while the BTG presented deviations of up to +/- 10 % FSD.

When considering these deviations though, the following issues in regards to comparing recorded data with the spot readings should be considered:

- Possible errors in the Hach readings eg. representative water sample, clean test bottle, Hach accuracy.
- Cumulative logging system errors eg. performance of signal conditioning modules and components throughout the comparison under a wide variety of environmental conditions.
- In the case of the BTG there may have been the beginning of final deterioration of the unit, the unit being 7 years old. BTGs deployed in the field by DPIWE have generally performed better than this.

Given that these considerations above are what will be typically experienced in the field situation, including others such as operator experience in taking readings and maintaining the logging systems as well as understanding data collected, these deviations are considered quite acceptable and probably more

reflective of real life deployment situations in hydrometric networks.

All the units performed reasonably well in the 250 NTU range. When the dam turbidity passed 250 NTU the Greenspan and Mindata units did not present values much above 250 NTU. This would be expected as this was the specified range of the sensors.

The performance of the BTG above 250 NTU tended to overestimate the turbidity compared against the Hach readings. This would have been mainly due to the re-scaling of the BTG to 500 NTU maximum range after it had been initially two point tested only in the 0-250 NTU range. In defence of the BTG this re-scaling after calibration is not the preferred method of setting up the unit. In fact if the scaling had initially been set at 500 NTU then the two point test at 2 NTU and 226 NTU had been performed the unit would have 'refused' to accept the calibration as the high value would have been considered insufficient for the total range the sensor was being expected to be measured by the unit.

This point is an important aspect for anyone involved in the calibration of any sensors, not just turbidity sensors - that calibration should always try and span the full range of the sensor, it cannot be assumed that the calibration relationship will hold past the top calibrated point.

The following plot (Figure 5) shows the behaviours of the sensors for a period of the test starting after a rain event on 22/8/01 had dropped the dam turbidity to 54 NTU through to another rain event on 12/10/01. The data recorded by the Greenspan and Mindata sensors flattens out as the top of the range is reached and the 're-scaled' BTG continuing past the 250 NTU limit of the other two sensors though, as stated previously, not accurately.

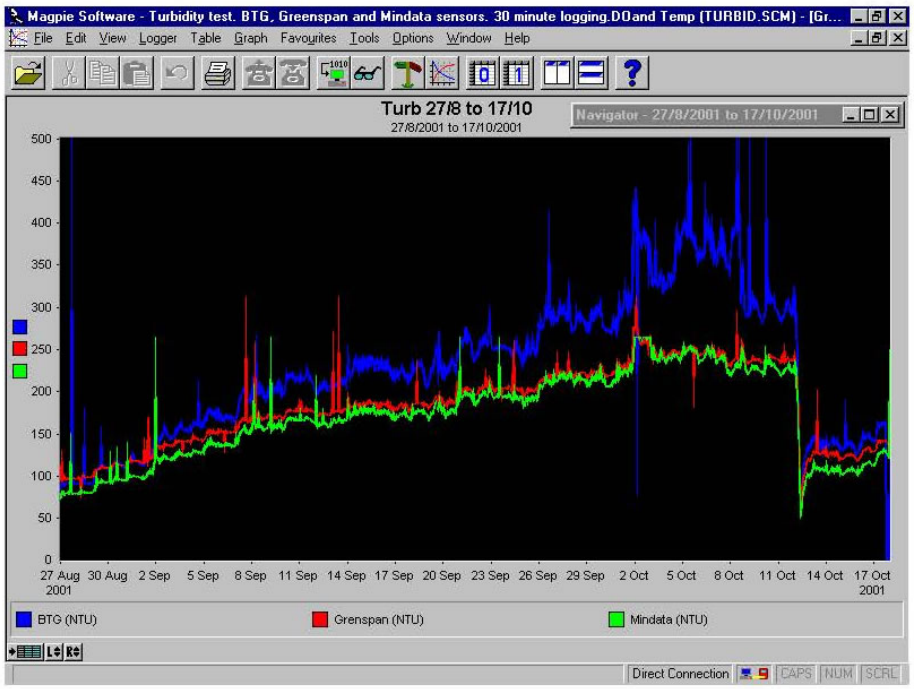


Figure 5: Trace of data recorded for a sub period of study

From the trace there are spikes evident in the data as well. Water fowl were often observed on the dam stirring the dam sediments while bottom feeding in the dam and many of these may be attributed to them stirring up these sediments. Wind did not seem to have much of an impact on stirring up bottom sediments during this comparison so was generally not considered responsible for any spikes.

The dam environment was expected to provide a 'hostile' environment to the sensors with quite high turbidity and active microscopic populations within the dam. For much of the test turbidity was in the high end of the 0 - 250 NTU range and it was only during significant rain events that the turbidity dropped as clean waters of the surrounding grassed paddocks entered the dam. Turbidity of the dam then climbed, apparently not as a result of suspended sediments but

more as a result of the types of microscopic organisms present in the dam (pers comm C. Bobbi, 1998). This point is important to remember for those who measure turbidity, it is not just suspended sediments that the sensors pick up but a wide variety of objects that move about in the water body.

A surprising result of this comparison study was the lack of algal build up on the sensors, even though the sensors had not been maintained during the 5 month period of the test. Even the Greenspan sensor, without a lens cleaning pump in this test, remained quite clean. It is believed that algae did not build up on the sensors because of the high turbidity of the water preventing sunlight penetrating the water to promote algal production at the depth the sensors were located at. This is in contrast to actual field installations where turbidity sensors are deployed in water bodies where turbidities are in the low ranges (0-10 NTU) for a majority of the time and much more sunlight is available in the water body to encourage algal growth on the sensors and their support structures.

The following figure (Figure 6) shows the condition of the sensor heads after deployment for the study period and all show reasonably clean optical surfaces.

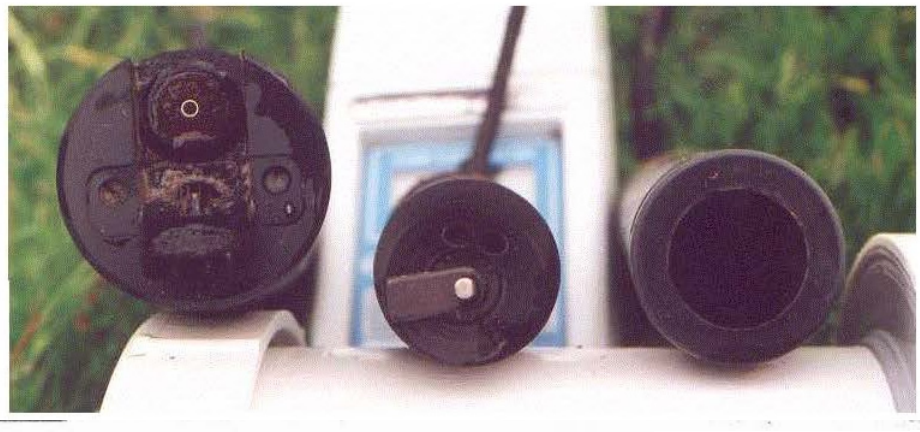


Figure 6: Condition of sensor faces following deployment for study period.(L to R, Mindata, BTG, Greenspan)

Figure 6 also shows the LPD on the Mindata in the open position and the wiper assembly on the BTG.

In respect to the high turbidities encountered during this comparison and the reason for the high turbidity, that is the type of microscopic organisms living in the dam, it should also be considered that there may have been a different impact on the optics of the sensors if the turbidity was a result of fine suspended solids that might feasibly have adhered to or settled on the sensors possibly having adverse effects on the readings.

As stated earlier the sensors performed reasonably well but some issues were experienced with all the sensors as outlined below.

BTG

As stated, this unit was not new but a refurbished unit and the subsequent re-scaling of the sensor after calibration was not the appropriate method of setting up this instrument. Its performance though was still considered good for the intended purpose until the failure of the 4-20 mA output from the transmitter. Performance in the wider DPWE network has been generally as good or better than this.

Greenspan.

As stated earlier the Greenspan at the time of deployment for the comparison did not appear to be within specifications and this was corrected for through re-scaling the Unidata logger signal offset and gains via the Magpie software. Following the comparison the unit was returned to Greenspan for evaluation of the suspected problem. Greenspan were unable to fault the unit and on return to DPIWE the unit appeared to be behaving itself. The reason for the anomaly is still not known. Other than this issue its performance was good.

Mindata

The sensor seemed to go out of calibration after the second power failure in the final days of the test outputting less than expected (approx -20% FSD). This unit was returned to Mindata for evaluation and they could not find a specific fault but agreed that it did appear to have gone out of specification and re-calibrated the unit. The unit has since been deployed in the field and has not had any further problems.

It was also found that the sponge pad on the Mindata LPD had compressed somewhat due to the closing action of the LPD. During the comparison Mindata advised of this slight problem and that a harder pad was now being used in its place. The performance of the softer pad during this comparison though did not appear to be a problem with the pad moulding to the shape of the sensor face possibly affording better protection but over longer in-situ deployments the harder pad should prove to be an advantage.

Performance of the sensor was good in spite of these issues.

4.1 Sensor cleaning mechanisms

The three units offer systems with which to maintain the optical surfaces in a good condition between maintenance visits either as integral (BTG and Mindata) or as an optional add on (Greenspan).

From experience of these units in the DPIWE network all systems work reasonably well in maintaining sensor optics IF failure doesn't occur . Ignoring faiures or problems with each system, and from a DPIWE perspective, the BTG wiper system appears to keep the lens the most clean while the Greenspan system is not as powerful at dislodging build ups on the optical surfaces. The Mindata units' LPD mechanism to date have demonstrated excellent ability to protect the optical surface and keep them clean in this study and in the field, though this statement should be couched in terms that currently deployed units are yet to be subjected to the full onslaught of real winter floods having been subjected to a Tasmanian drought over the last year.

Problems that have been experienced with the mechanisms include:

- BTG - wiper blade dislodging from wiper arm, internal grub screws loosening on driving shaft and wiper not turning, failure of optical units inside the sensor head controlling final location of wiper at end of wiping cycle, gradual grinding and striation of lens surface caused by grit caught on wiper blade.
- Greenspan - pump failure has been the main problem, occasional failure of water proofness of earlier version power cable connectors, gradual blocking of pump filtering cover.
- Mindata - to date no known problems have been experienced with the LPD in the field, but a potential problem might be a suspected fragility of the LPD flap as it is extended into the flow, particularly at higher stream velocities. Given that with 15 minute data logging the LPD is open for only 10 seconds (under DPIWE operational protocol) this equates to extension into the flow for less than a minute every hour.

A review of faults at sites with these self cleaning mechanisms has shown that the failure rate over time for the Greenspan pumps has been relatively higher than for the BTG wiper mechanisms. Outright failure of the pump itself has been the main culprit and this is possibly due to the use of a lower cost (hence lower quality) in line pump. Failure of any Mindata LPDs has not yet been experienced to date.

Repair cost per unit for the replacement of the in-line pumps is cheaper than repair costs for the BTG wiper mechanism (and probably for the repair of the Mindata LPD mechanism) and does not require replacement of a sensor and its cable, but the frequency of failure and the need to produce waterproof cable joins in the field have created an irritation with this type of system.

4.2 Sensor Calibration Checks

Calibration checks of sensors can be problematic, more so with attempts at in field calibration checks. One method is to use a pre-mix of a number of Formazin solutions of required values, checked against a secondary standard immediately prior to use in the field particularly if it is not 'fresh'.

An 'in air value' being equal to 0 NTU is possible with the BTG and Mindata sensors but the Greenspan can indicate a value of 20 - 30 NTU in air, though when in water of close to 0 NTU the Greenspan measures the appropriate value so an in air cal check is not possible with Greenspan sensors. With all sensors though it is advisable that low value standard solutions be used for calibration checks wherever possible.

The configuration of the BTG sensor lenses (90 degree orientation) enable smaller samples of Formazin standards to be used for secondary standard recalibration checks but the Greenspan and Mindata sensors require larger volumes of solutions to prevent interference from the container bottom particularly at lower turbidity values. (Refer to Forward Interference results previously tabled). Greenspan now supply a 'calibration cap', matched to an individual sensor to enable a one off value check of the sensor.

Working on calibration checks through the range in the field situation has been found to be more user friendly with the BTG than the other two units by virtue of smaller volumes of standard solutions being required.

Of the units currently deployed by DPIWE the BTG units are the only truly operator re-rangeable and re-calibratable units used and this has been a valuable tool for DPIWE as it has been found that optics in all the

sensors tend to deteriorate over time but the BTG enables the user to correct easily for this. The Greenspan and Mindata units require replacement with new units or repair/recalibration by the supplier if found to be out of calibration.

If the performance of the latter two has deteriorated or developed a fault such as an inexplicable offset, but the resulting turbidity/output signal maintains a straight line relationship the versatility of the Magpie software used by DPIWE enables another level of calibration adjustment to occur to compensate for this problem by treating the units as a pseudo re-scaled unit until resources and time permit replacement/repair of the faulty unit thus minimising data loss even though data may be at a lower quality than with a new sensor. In regards to this last statement there is no reason why the pseudo re-scaled sensor connected to the data logger cannot be recording as accurately as a new unit if check calibrated properly and continuing deterioration is not dramatic.

4.3 Data Representativeness and Use

As mentioned earlier the turbidity data collected in the DPIWE network is being used for State of River reporting along with assessing general water body conditions.

The general process of using the data for these studies to date has been:

1. Comparison of the continuous turbidity data recorded against actual flood samples collected for a number of flood events,
2. Examine correlations of Total Suspended Solids (TSS), transported phosphorous and nitrogen against recorded turbidity values.
3. Calculate loadings using stream flow data for events and then synthesise TSS, and associated values from these turbidity and flow records.

Gippel (1989) reported that particle size is 'potentially the most important variable confounding the relationship between turbidity and M_{SPM} (suspended sediment concentration)'. Gippel investigated the variability of turbidity against particle size as well as the absorption and attenuance properties of various mediums in respect to differing wavelength properties of the sensor and showed that turbidity values recorded by different turbidity units could vary for the same medium even though they had been calibrated with the same Formazin solution. He also suggested that multi wavelength sensors with complex processing could possibly cater for the varying properties of the sediments but to date these do not appear to have made it to mainstream hydrometric monitoring applications

DPIWE deploys single wavelength sensors in its network calibrated to the generally accepted Formazin standard method. What must be noted is that this method employs calibration of the sensors relative to turbidity caused by spherical polymer molecules of regular size, shape and absorption/attenuance properties - this does not occur in the real world.

Relative turbidities vary dependent on a variety of items suspended in the water column such as suspended material such as clay, silt, finely divided organic and inorganic matter, soluble coloured compounds and plankton and microscopic organisms. These items do not necessarily possess the optical qualities of your laboratory standard Formazin solution! Gippel highlighted this stating that 'the turbidity of a fine dispersion can be twice that of a coarse dispersion of the same mass concentration'. What this statement infers is that a turbidity value double that of another may not necessarily correspond to it having twice the mass concentration of TSS or whatever compounds are being investigated.

Following on from this, and given that the properties of sediments and organic matter in the stream, as well as the proportions of materials, in the stream can quite feasibly vary from catchment to catchment due to geology, organic loads and land use and over time, it is thus important that actual co-ordinated sampling programs compliment the monitoring of in situ sensors to determine more appropriate correlations of TSS and the like.

It is important that these programs also take into account catchment conditions over time, eg. is the data from a fresh after a prolonged dry or wet period, has fertiliser been recently applied in the catchment and so on.

As with many other measurements undertaken in water catchments, it is vitally important that the user of the data, as well as the data collector, have a good understanding and knowledge of the catchment processes affecting the streams being monitored to ensure that the data is understood and used suitably and effectively for the purposes it is intended.

5. CONCLUSION

This comparison study and experience with the turbidity sensors used in the DPIWE network over the last few years have indicated that the sensors currently in use perform reasonably well considering the high expectations that are often placed on the sensors deployed in the field for extended in situ monitoring purposes.

While the comparison test in the dam did not show any problems in regards to algal build up, even with a lack of a lens cleaning mechanism on the Greenspan unit, it has been found from field experience in lower turbidity stream flows that it is still advisable to deploy sensors with a lens cleaning mechanism if integral to the sensor or as an external 'add on' such as the Greenspan pump assembly or an in house solution.

Ability to keep the optical surfaces free from algal or fine silt deposition is the most important factor, after sensor accuracy and reliability, when considering the design and deployment of the sensor. Each of the systems available for the sensors has its pros and cons and the effectiveness of each may also be affected by the properties of the particles suspended in the water body.

The use of these so called self cleaning mechanisms on turbidity sensors should not be viewed as a reason for not undertaking maintenance of these sensors at regular intervals. Rather, it should be recognised that these devices are intended to **assist in maintaining accuracy and performance** of the sensors and hence confidence in the data being collected from them between maintenance and calibration visits.

Turbidity can be a reasonably accurate indicator of sediment concentrations if particle size and the optical properties of the particles remain constant but in reality this is not so. Catchment properties, land use and seasonal changes in these factors can quite feasibly alter what the turbidity values 'mean' and may well vary from catchment to catchment so an understanding of the catchment conditions at the time the turbidity data was collected is also essential for the end user of the data. It is thus important that the use of turbidity data in catchment studies should be coupled with well planned and executed sampling programs to enable more accurate correlations and extrapolations of inferences from the turbidity data sets such as estimation of Total Suspended Solids.

While this study does not advocate one sensor brand over another it is hoped that it will provide some initial comparative information by which intending users of such sensors may make decisions to suit the needs of their networks and clients. At the end of the day final sensor selection by a user would also be governed by other issues such as:

- relative costs and budget available for purchase
- site limitations in regards to installation and distance of stream bed or other features from the sensor face
- OH&S issues in regards the required installation to enable safe ongoing access to the sensor face for inspection and cleaning.

It is also important that users of these sensors understand the vagaries of turbidity, its measurement and how data might be interpreted or extrapolated in catchment studies and be prepared to provide interpretation of the data collected to clients as well as being ready to educate the end user of the data and not just act as a collector of this data.

BIBLIOGRAPHY

Bobbi, C (et al) (1999), *State of River Report for the Brid River Catchment*, DPIWE WRA report 99/19-22, Tasmania.

Bobbi, C (et al) (1999), *State of River Report for the Pipers River Catchment*, DPIWE WRA report 00/09,99/16-18, Tasmania.

Gippel, C.J., (1989) *The use of Turbidity Instruments to Measure Stream Water Suspended Sediment Concentration*, Monograph Series No. 4, Department of Geography and Oceanography, University College/The University of New South Wales, Australian Defence Force Academy, Canberra.

Greenspan Technology, *Turbidity Sensor - User Manual Edition 1.6*, Greenspan Technology, Warwick, Queensland

Mindata (2001), *2600 Turbidity Sensor - User Manual Version 2.0*, Mindata Pty Ltd, Seaford, Victoria

Zellweger Analytics *User Manual, TxPro-T Turbidity Transmitter,* Document ID 712-2014-71E, BTG Inc, Decatur Georgia, USA

Contributions to the Journal and Newsletter

Member contributions to the Journal and newsletters are most welcome. You are the Association and hence it is helpful if you provide input into it.

At present the Editor is limited to steam driven Word 6.0 so if you have a contribution could you please submit in that format.

Advertisers could also assist by providing TIF, GIF or JPG images or similar of their ads - while PDF format is handy it means cut and paste has to be done - literally!

I look forward to getting summaries of papers from the conference from those who have indicated that they are willing to provide them. Summaries of the summaries are also welcome as I can use them as a precursor in the newsletters for items appearing in the next Quarterly Journal.

Photographs are also welcome for the cover of the newsletter - final use of a submitted photo will depend on how well the image transposes onto the cover of the Journal, so the clearer the better.

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