AUSTRALIAN HYDROGRAPHERS ASSOCIATION

Australasian Hydrographer

2 Person Gauging Team, Indonesia
Photo courtesy Mark Wolfe

August 2003

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

THIS ISSUE

EDITORIAL

Hello everyone and welcome to our quarterly Journal of Australasian Hydrographer.

This edition has been held over till this month so as to allow the opportunity to report of on Association's Annual General meeting in late August.

The Annual General meeting was held on August 26, in Hobart in conjunction with the National Hydstra Users Group Conference. The Committee extends thanks to Hydstra for continuing to support the combined format to occur.

At the AGM the Association saw the election of Graham Armstrong to the position of Chairperson of our Association following the resignation of Les Marshall earlier this year. I am sure that I can speak for everyone in thanking Graham for taking on this mantle.

The minutes of the AGM and Committee Officer reports for the last year are contained in this edition of the Journal.

This edition sees presentation of papers from the 2002 conference on Innovative Data Collection and how it is used and the first part of a paper comparing turbidity sensors currently used at Tasmanian hydrometric installations.

As most would be aware there has been a first announcement for the 12th Australian Hydrographers Association Conference to be held in July 2004 on the Gold Coast, Queensland. Ray Alford has commenced work behind the scenes in getting this one up and going and announcements and calls for papers will soon be made. The theme of the conference is "***The Science of Hydrography - Looking Forward, Looking Back***"

Ray has advised of a tentative time line for the conference and some details are contained in the Annual General Meeting minutes contained in this Journal. Start thinking about those presentations now!

There appears to have been a great response to the new Hydrographic Certificate IV Course provided through OTEN with apparently 53 enrolments from across Australia this year. It is great to see organisations again realising the need to employ new staff and them (and maybe older staff) to undertake suitable technical training and education in the field of Hydrography.

Thanks to Mark Wolfe for his contribution to the cover photo, very interesting to see this concept of the two man gauging party in action!

Mic Clayton

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.

Australian Hydrographers Association
Annual General Meeting Hobart, August 26, 2003

Convened 16:50
Attendees:
Acting Chair / Publicity Officer: Mic Clayton.
Secretary: Scott Walker.
Treasurer: Max Hayes.
Jason Venables, Mick Yemm, Alex Springall, Stephen Buckland, Brian Chester, Wayne Soutter, Ben Martin, Andrew Smith, John Hollis, Andy Cumming, Garry Newton, Bill Steen, Paul Sheahan, Michael Whiting, Marc Schmidt, Simon Cruickshank, Tom Riley, Andrew Kaar.

Apologies:
Denis Burt, Jim Tilley, Mick Lysaght, Graham Armstrong, Faye Edden & Ray Alford.

Minutes from the last meeting:
Minutes from the 22nd AGM Read by Mic Clayton.
There were no matters arising from the minutes.

Treasurer's report for calendar year 2002-3
Statement of Receipts and Expenditure 01/01/2002 to 31/12/2002 presented by Max Hayes, Treasurer.

Receipts

Subs	$14100
Interest	$24.01
Conference	$15000
Total	$29124.01

Expenditure

Publications	$6554.58
Misc	$3343.40
Bank Charges	$22.70
Total	$9920.68

Bank Of Melbourne Account Opening Balance 01/01/02	$7933.68
Income	$29124.01
	$37057.69
Expenditure	$9920.68
Closing Balance 31/12/02	**$27137.01**

Reconciliation:

Closing Balance, 31/12/02	$27137.01
Plus Receipts not Credited	$0.00
Less Unpresented Cheques	$0.00
Closing Balance, 31/12/02	$27137.01

Accepted by Bill Steen / Seconded by Michael Whiting.

Matters arising from treasurer's report:
AHA will use a substantial proportion of their funds to help establish the next AHA workshop in QLD 2004

SECRETARY'S REPORT FOR 2002-3 (Scott Walker)
Well I have had the secretary job for a year now and have enjoyed the privilege immensely.

When I was elected, I made a speech off the cuff that indicated that I would push for some reforms within the Association. I know most of us in the public service shudder when we hear the word reform, but I wasn't intending on downsizing the organisation.
However, the down sizing did occur. Les, who was elected Chairman, decided to step down, citing some personal issues that negated him from fulfilling his duties.
Mic Clayton, our publicity officer, and I have shared the role to date but now look forward to the election of a new chairman to share the duties.

This year I aimed primarily to establish a web-site. This was achieved and we've had over 200 hits since its launch at the start of the year. Hey it's no bigbrother.optus.com.au, but it's a start. I wanted the AHA to have a 24/7 presence not just an annual meeting and a few newsletters with private jokes that nobody gets.
That is why we have forums and surveys so we can discuss the issues anytime.
We have had feed back from a lot of students looking for careers and we also provide free advertising for jobs within the industry.

This year we also provided credit card facilities and established an interest group association with the AWA. Here we maintain our independence but we receive a copy of the WATER magazine and receive exposure in the magazine its self. We were offered ½ a page every issue and presently this has only been utilised the once. It was a shameless self-promotion of the AHA and its member's talents. Next year the AWA indicated they were happy to continue the present arrangement but indicated that ½ a page exposure every issue would come under review. They look to be offering less. One full page a year, ½ a page biannually, ¼ a page quarterly. It will be negotiated once members endorse its continuance.

Most correspondence to and from the secretary's desk is via e-mail so the following is a summary
Copies of e-mails are available upon request.

Correspondence In:

Establishment of web-site issues.	19/08/02
Corporate membership issues.	19/08/02
Offer from AWA that needed negotiation.	06/11/02
Invitation to represent at Ozwater Perth April 2004	22/11/02
Invitation to attend Hydrology Symposium	17/12/02
Credit Card Offer	20/12/02
Les' resignation	09/05/03
Hydrography Cert. Available from OTEN	25/07/03
Writer needed for Instrumentation Subject	25/07/03
Danger of OTEN being wound up	08/08/03

Correspondence Out:

Corporate membership benefits	18/08/02
Call for Workshop papers to be distributed	19/08/02
Application for Web-site	28/10/02
AWA negotiations	06/11/02
AWA agreement	20/11/02
AWA article	20/11/02
Request for Symposium Paper	24/12/02
Credit card offer acceptance	04/02/03
PO Box renewal	12/03/03
AHA dedication to corporate members	08/04/03
Member list to AWA	16/05/03
2004 interest group AWA arrangement	02/06/03
Member list to AWA	11/07/03

The Future:
2004 will see the AHA keeping up its representation for Hydrographers and the industry. We look forward to the Hydrographic Workshop in on the Gold Coast. I look forward to additional help from the new chairman and hope we can get more input from the state/territory/provincial/national reps. I want the association to concentrate on the three "Rs" of a good association: Relevant, Representative and Raging.

Sincerely Scott
Walker AHA
Secretary
19/08/03

Accepted by Bill Steen / Seconded by Alex Springall.

PUBLICITY OFFICER REPORT
I have been enjoying the challenge of putting together the newsletters and Journals over the last year, even on my steam driven computer (anyone remember Windows 3.1!)

A move back to the mainland saw sourcing a new printer for the newsletter. While there was nothing wrong with the Tasmanian based printer used over the last few years the move to a local printer improved the logistics of co-ordinating delivery of masters and images, especially for the quarterly Journal. The new printer was also able to supply reasonable colour facilities for the cover at a very reasonable price so the February Journal saw the re-introduction of a colour cover.

Publications over the last year have seen Journals published:
August 2002, 22 pages
November 2002, 24 pages
February 2003, 28 pages
May 2003, 20 pages

Newsletters were prepared for
June/July, 2002
September/October, 2002

December 2002/January 2003
June/July 2003

Postings of newsletters and Journals saw a review of membership and more particularly memberships that had lapsed. Over the last twelve months membership renewal reminders have taken various forms via the newsletters and Journal. August 2002 saw a label inside the front cover indicating date membership was due, reminder on envelope of November 2002 Journal (after which 1996 and 1997 expirees were removed from mailing list), a reminder in the editorial of December/January newsletter (after which 1999 expirees were removed from mailing list), reminder letter to 2001 expirees in May 2003 Journal and recently a separate follow up reminder letter to 2001 expirees.

Besides members receiving Journals a copy of the Journal is also forwarded to the State Library of New South Wales. I did learn that they would only accept journals published in New South Wales for free, but if the Journal was published from interstate they had to purchase it (even if it was submitted to them at no charge! - couldn't quite work that one out!) Courtesy copies were also forwarded to the New Zealand Hydrological Society for their information.

Besides preparing the Journals and newsletters a number of job ads were forwarded to members via email lists. At last count I think that about 15/16 job ads have been forwarded to members over the last twelve months. The jobs were submitted by employers and by net surfing.

As always I am always open to submissions for the newsletter. While the last conference gave me a good supply of articles they are not endless! The next conference will provide the next burst of material but things might get a bit thin prior to that! Photos for the cover are always welcome.

Mic Clayton, Publicity Officer AHA

Accepted by Bill Steen / Seconded by Mick Yemm.

Election of new Chairman:
Graham Armstrong nominated by Scott Walker.
Seconded by Mic Clayton.
Accepted by Graham Armstrong via nomination form.
Elected un-opposed.

General Business:

- **2004 Hydrographic Workshop**

To be held at the ANA Hotel Surfers Paradise, Gold Coast. QLD
July Tuesday 27th to Friday 30th 2004.
1st Announcement, July 2003
2nd Announcement, October 2003 with a call for papers.
3rd Announcement, January 2004 with invitations to the corporate sector. Paper abstracts also required.
Paper submissions before 1st May 2004
Registration 1st June 2004.
Contact Paul Martin or Ray Alford for further details.
07 38925610.

- **AWA agreement to continue.**

- Missed out on **Wollongong Hydrological Symposium** but will look out for further opportunities to promote the industry.

- **OTEN** future under a cloud. We gave unconditional support and await to hear the outcome of its review. In the meantime it business as usual for the 65 students enrolled in the Hydrography course.

- **Membership drive**, Motion to lower membership to $90 for all ($30 for students / retirees) and extend existing members who paid full subscriptions by two months.

Motion by Bill Steen / Seconded by Wayne Soutter.
Accepted

- Discussion about the **Corporate Membership** category and decision made for Committee to review its operation/continuation.

- Michael Whiting raised **standardisation issues re: variables and quality codes.**

This will be discussed on the web site over the ensuing months.

- **Newsletters** will be via PDF from the web unless otherwise notified.

Next **Annual General Meeting** will be held Tuesday 27th of July at the ANA Hotel Surfers Paradise as part of the next AHA Conference.

Motion by Mic Clayton / Seconded by Jason Venables.

Meeting Closed 17:59

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 27h, 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.

Convenors

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

AHA Office Bearers and Contacts

Chairman, Graham Armstrong,

Secretary, Scott Walker
Scott.Walker@sydneywater.com.au

Treasurer, Max Hayes
gipps-hydro@i-o.net.au

Publicity Officer, Mic Clayton
michaelc@tassie.net.au

Public Officer, John Skinner

State Reps:

Queensland: Ray Alford
e-mail ray.alford@dnr.qld.gov.au
Phone: (07) 5530 8693

New South Wales: Faye Edden
e-mail f.edden@greenspan.com.au

South Australia: Mark Harvey
e-mail harvey.mark@saugov.sa.gov.au
Phone: (08) 8226 8075

Western Australia: Michael Whiting
e-mail michael.whiting@watercorporation.com.au
Phone: 0412 184 946

Northern Territory: David Williams
e-mail david.williams@nt.gov.au

Victoria: Max Hayes e-mail gipps-hydro@i-o.net.au Phone: (03) 5174 2964

Tasmania: Stephen Buckland
e-mail stephen.buckland@hydro.com.au
Phone (03) 6230 5283

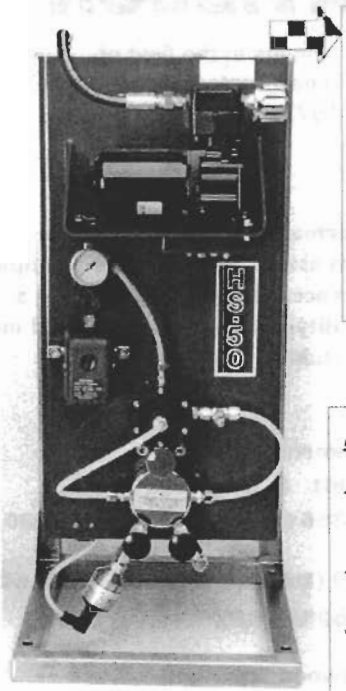
A.C.T.: Bill Steen
e-mail wjs@hydsys.com
Phone: (02) 6292 1926

New Zealand: Martin Doyle
email martn@tdc.govt.nz
Phone 0064 3 544 3414

HYDROLOGICAL SERVICES PTY LTD
SYDNEY, AUSTRALIA

ISO 9001

GAS PURGE COMPRESSORS AND ACCESSOIRES:



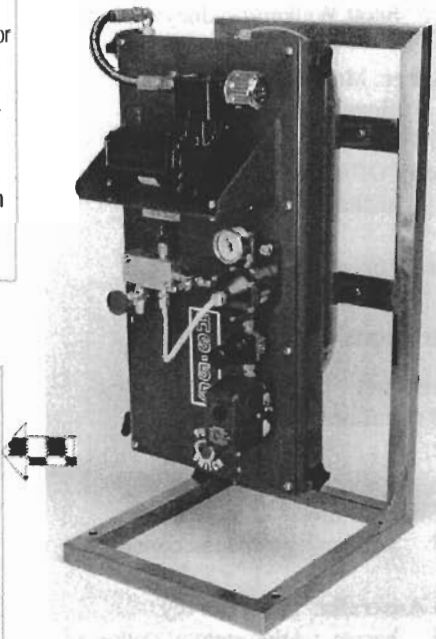
HS-50 Compressor:

- Durable industrial strength compressor for years of continous reliability
- 13.5 Litre/3.5 US Gallon receiver tank for superior purging capability
- Fully integrated 2 stage air drying system with oil/ moisture trap and hydrophobic filter

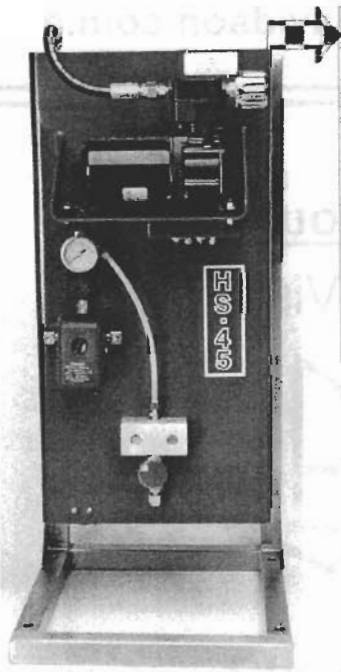
HS-50 COMPRESSOR

HS-55 Compressor:

- Innovative maintenance free gas purge system
- Manual purge
- Suitable for use with most pressure transducers and data loggers
- OH& S Answer to heavy gas bottles



HS-55 COMPRESSOR



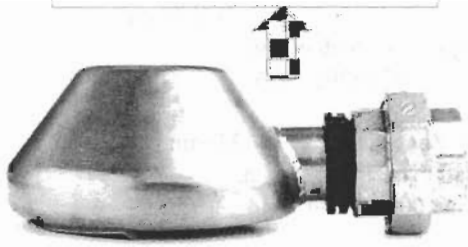
HS-45 Compressor:

- Designed to replace conventional nitrogen gas bottle supply to bubble unit/ gas purge system for water level measurements
- Incorporates a maintenance free air drying system utilising 'Self Purging' Membrane, Filter Dryer and Auto Drain Moisture Traps

HS-45 COMPRESSOR

Gas Chamber Orifice (GCO):

- Designed to replace the standard orifice in a gas purge water level measurement system
- Bubble rates as low as 10 bubbles per minutes can be used
- Designed to be fitted to existing installations.
- Removable copper screen for cleaning



Gas Chamber Orifice

Visit Our Website at WWW.hydrologicalservices.com

Innovative Data Collection – The Next Step

This paper was presented at the 11th Hydrographic Conference, Homebush, 2002.
Manly Hydraulics Laboratory

Introduction

Accurate data collection is very important, but what is the next step once the variable of interest has been measured? Data may be used in a variety of ways, including storing for later use, near real-time download for compliance checking or alert and more recently for presentation and incorporation into decision support systems. Adding value to hydrographic data is an important step in bridging the gap between environmental data collection and the management of environmental systems. Manly Hydraulics Laboratory (MHL) has a vast amount of experience in collecting data and adding value to it in a variety of ways that depend on the needs of the client.

Data collection programs have been established for many years and there are now large existing data sets and real time data available that provide good information for activities such as checking variables against compliance levels. However, in raw form these data sets have limited value to environmental managers. Environmental managers require simpler interpreted information that can be derived by converting data into information through the application of analytical tools. These tools may operate on longer time series or combine data from different sources, such as Bureau of Meteorology rainfall and MHL flow gauging, to derive more relevant parameters for managers.

Recent advances in analytical tools and more affordable monitoring systems provide a range of opportunities for the development of 'smart' tools that can assist managers make timely decisions on a range of issues. These applications include development of sampling triggers, assessment of flushing and water quality, alert systems for flood evacuation, and assessment of the status of intermittently closing coastal lagoons to assist in entrance management procedures.

This paper examines the types of data that are collected by MHL and will provide examples of innovative uses of near real-time data to assist in management applications.

Data Collection

MHL operates a network of automatic environmental data collection stations throughout NSW, which include telemetered recording of rainfall, water level, flows, water quality, ocean water levels (tides) and ocean wave heights. Specific water quality variables measured include chlorophyll-a, pH, dissolved oxygen, turbidity and salinity.

The network of gauges is linked to MHL's computer system where the data is stored. MHL staff or automated systems retrieve the data and present it in an accessible format. This may include a Web interface to the data, which provides the capability for clients and/or the public to examine the data and check the data quality in near real-time. Models exist which are used for predicting future trends or events and enhancements can be readily developed by interfacing with a variety of software packages.

Converting Data to Information—'Value Adding'

The "next step" in the use of collected data is integration into a decision support system to allow overview of the data by environmental managers. The availability and enhancement of the data has a vital role in well-informed management decisions.

This type of 'value adding' to data requires good understanding of system response, which is developed through a model with well established inputs and outputs and a clear understanding of model limitations and possible errors. To get the best possible results for use by environmental managers it is important to have a good knowledge of how to apply the model and relevant presentation of simplified outputs.

The following section outlines a few examples of MHL projects that have involved value adding to hydrographic data to assist clients with management decisions.

Case Studies

Camden Haven Floodwatch System

The Camden Haven Floodwatch System is comprised of a suite of computer programs and field instrumentation linked together to monitor and predict water levels for the more effective management of potential flooding in the lower reaches of the Camden Haven River.

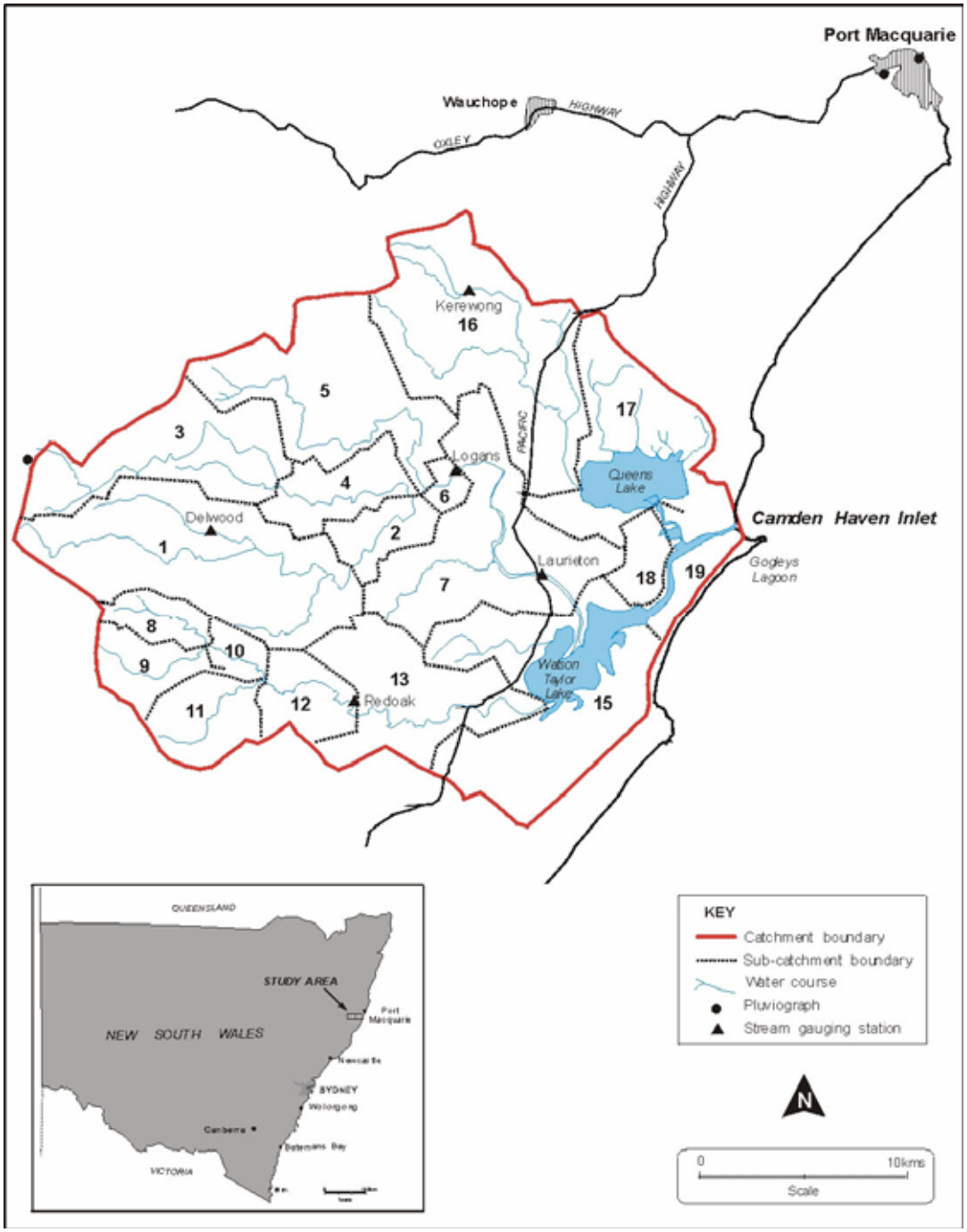


Figure 1. Camden Haven catchment map

The system involves extracting real-time water level, rainfall, flow, ocean tide and wave height data and running a numerical model to develop future predictions through a web browser interface. Based on these future predictions the system sends alarms to various people using SMS, Web pages, e-mails and faxes. A remote user can access the MHL computer to examine the collected data and model predictions as well as control recovery of the data and distribution of the results by facsimile.

The Camden Haven River enters the ocean near North Haven on the NSW north coast approximately 285 km north of Sydney and 25 km south of Port Macquarie. The river has a catchment area of 720 km^2, which extends 32 km to the west and 25 km north to south. The estuary consists of two lakes, Watson Taylors Lake to the south and Queens Lake to the north (Figure 1).

The lower reaches of the Camden Haven River run between Watson Taylors Lake and the ocean with a connection to Queens Lake via Stingray Creek approximately mid-way. In order to model the behaviour of the Camden Haven River at Laurieton it was necessary to model water levels in Watson Taylors Lake, Queens Lake and the ocean. This was done via a hydrology model producing flow into the lakes and a box model producing flow between the lakes and the ocean. The ocean is modelled using predicted tides and tidal anomalies. Laurieton water levels were then determined by estimating the hydraulic gradient along the river.

The computer model is used to predict water levels for
12 hours in advance for two different scenarios of combined environmental conditions (rainfall and ocean water levels). The two scenarios are:

1. Abating Conditions – assumes no more rainfall. The tailwater level is the predicted tide plus a tidal anomaly over the next 12 hours.
2. Persisting Conditions – assumes average rainfalls for the previous six hours will continue for the next six hours and tailwater conditions determined from the predicted tide plus a tidal anomaly for the next 12 hours.

Lake Conjola Decision Support System

The Lake Conjola decision support system was developed following an Entrance Management Study, which found that closure of the lake entrance to the ocean occurs periodically and causes deterioration of water quality and increases flood risk to local low-lying areas. The decision support system monitors the tides in the lake and alerts Council when the entrance channel has shoaled to a point that dredging is required to prevent closure.

The system makes use of a relationship that was discovered between the tidal constituent M2 and the constriction of the entrance based on observations and records of rainfall and storm events. As the entrance begins to be constricted by sand deposition the M2 constituent in the lake is reduced. Long-term monitoring of the tidal range recorded by a water level recorder in the entrance channel therefore provides an easy means of detecting shoaling of the entrance.

Within the decision support system various trigger levels have been set which indicate the state of the system and required actions to prevent closure. The system provides advance warning of entrance closure so that the essential activities that must be carried out prior to dredging can be set in train to enable dredging to commence before closure is imminent. It is important to initiate the entrance works at the appropriate time; that is in time to finish the works before closure but not prematurely because a flood may scour the channel naturally.

The system is hosted on the Internet and displays a rolling assessment of M2 tidal constituent against time (Figure 2); offshore wave height, period and direction; and rainfall. Selected Council officers are notified via email, fax or SMS when M2 reaches key trigger levels so that appropriate action can be taken.

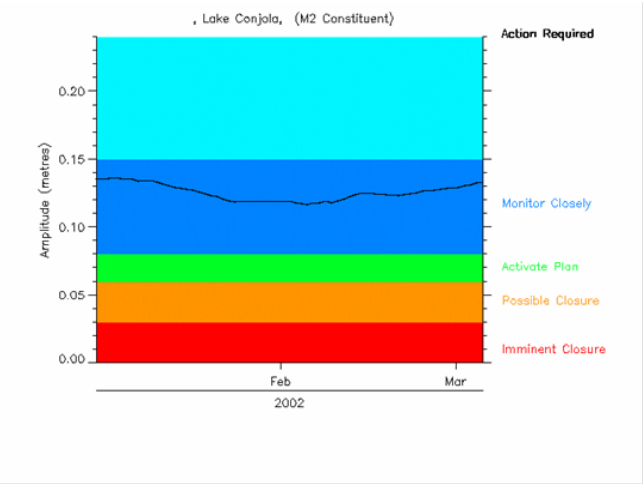


Figure 2. Lake Conjola decision support tool - Web display for entrance management

Manly Lagoonwatch

LagoonWatch is a real time rainfall and water level monitoring system for coastal lagoons that provides early flood warning and predictions as well as a cost efficient means of flood mitigation and potentially water quality management.

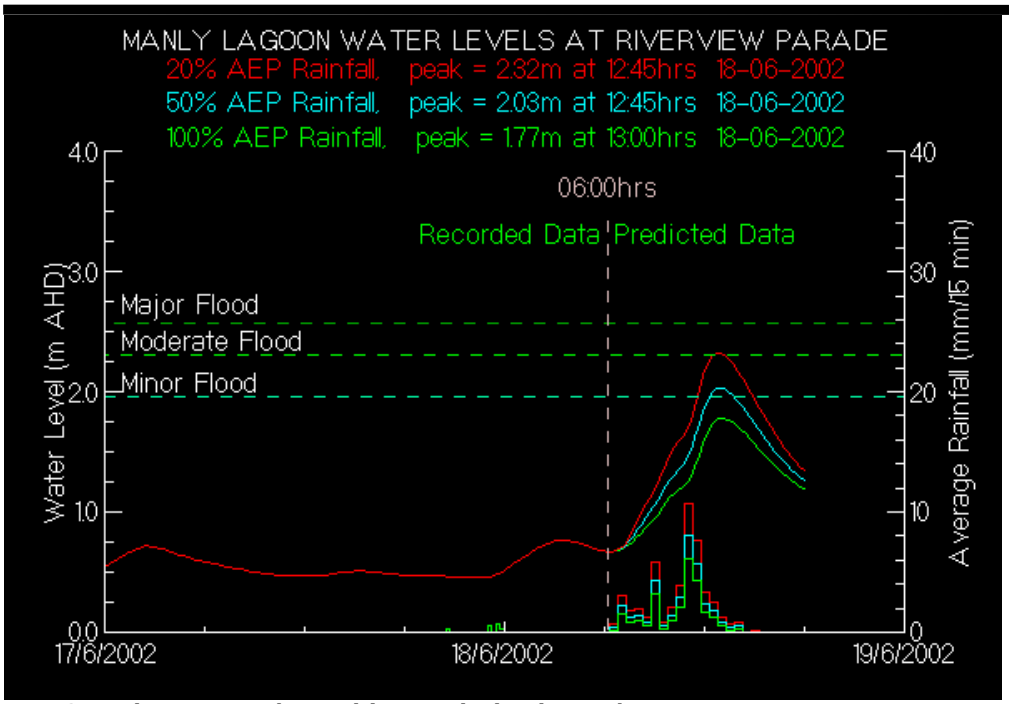


Figure 3. Manly Lagoonwatch – model output displayed on Web page

Manly Lagoon responds to tides, ocean surges, wave setup and rainfall. Real time data from instruments which monitor these processes is combined in a numerical model which then predicts the water level for twelve hours in the future for three potential weather options. The model predicts water levels for the following three future environmental scenarios:-

1. 100% Annual Exceedance Probability (AEP) - A typical rainfall event with a duration of nine hours and an intensity exceeded approximately once every year. This is approximately equal to a 1 year annual recurrence interval rainfall event.
2. 50% Annual Exceedance Probability (AEP) - A typical rainfall event with duration of nine hours and an intensity exceeded approximately once every two years.
3. 20% Annual Exceedance Probability (AEP) – A typical rainfall event with a duration of nine hours and an intensity exceeded approximately once every five years.

Two different rainfall scenarios are also considered:-

1. Abating Conditions – assumes no more rainfall. The tailwater level is the predicted tide plus a tidal anomaly over the next 12 hours.
2. Persisting Conditions – assumes average rainfalls for the previous six hours will continue for the next six hours and tailwater conditions determined from the predicted tide plus a tidal anomaly for the next 12 hours.

A publicly accessible Web page displays actual water levels for the previous day and model predictions for the upcoming twelve hours (Figure 3). Summaries of rainfall, water level and ocean wave height data are also available on the Web page.

Access to real-time data, further model scenarios and model results are available on another Web page with access restricted to designated Council and MHL personnel. This also provides inundation scenarios for various flood levels and warning of possible entrance breakout events.

Conclusion

Data collection is just the first step in the process of hydrographic data application. Consideration of the next step, that is the further use of the data, can be important in deciding how, what and where data should be measured. The data may be used in a variety

of ways, including storing for later use, near real-time download and presentation, and incorporation into decision support systems.

The value of data can be greatly increased by integrating with software and incorporating into decision support systems for assisting with management practices. Presenting the data in more readily available forms helps increase the potential uses and the people who can access the data, thus increasing the need for the data to be collected in the first place.

Hydrographic data is used by people in a wide range of disciplines, often in unexpected places. For example, an entomologist may need to look at tidal data to determine the likelihood of mosquito outbreaks in wetlands in relation to medical management decisions. It is therefore important that data is collected and presented in such a way as to make it available and accessible for multifunctional use.

A Comparison of Turbidity Sensors for Continuous Field Deployment

First 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.

1. INTRODUCTION

The Department of Primary Industries Water and Environment operates a number of stream monitoring sites around Tasmania measuring stream levels (flows) as well as a variety of water quality parameters.

Turbidity in water is caused by suspended material such as clay, silt, finely divided organic and inorganic matter, soluble coloured compounds and plankton and microscopic organisms. Turbidity is a measurement of the optical properties of the water body that cause light to be scattered and absorbed rather than transmitted in a straight line through the water. Standard units for turbidity are 'nephelometric units' (NTUs) standardised against Formazin solution. (Bobbi, 1999)

Continuous time series turbidity is measured at a number of sites as part of the water quality monitoring network along with temperature and conductivity parameters.

Data collected at these sites are important components of State (State of Rivers) and Federal (State of the Environment) reporting on water quality in Tasmania.

In State of Rivers (SOR) reporting in recent years reasonable correlations were found between turbidity data and sediment and nutrient loads after analysis of water samples from automated samplers installed at monitoring sites at key monitoring sites (generally stream gauging stations with water quality equipment). This data in turn enabled, via data synthesis and modelling, sediment and nutrient export loads to be estimated for study catchments.

In the SORs for the Brid and Pipers River catchments in the north east of Tasmania it was estimated that, in 1998:

- 925 tonnes of sediment, 2.2 tonnes of phosphorous and 38 tonnes of nitrogen were exported from the Brid catchment (area 145 km^2) (Bobbi, 1999)
- 4,142 tonnes of sediments, 6.5 tonnes of phosphorous and 91.8 tonnes of nitrogen were exported from the Pipers River Catchment (area 380 km^2) (Bobbi, 1999)

Turbidity data from in situ sensors correlated against turbidity values derived from automated water samples in these cases was an important tool for the preparation of these reports.

Turbidity sensors are deployed with the intention of long term installation with minimal servicing regime. Due to the nature of measuring turbidity (measurement of light scatter from particles suspended in the solution) these sensors can tend to suffer from less than satisfactory results when deployed in the field situation if not appropriately deployed and then maintained.

Apart from failure of the sensor (electronic failure or flood damage to sensors) causing loss of data, the quality of data from sensors tends to degrade if regular maintenance routines are not employed or some sort of self cleaning mechanism is a part of the sensor design to assist in keeping the send and receive lenses of the unit relatively clean between maintenance visits.

This study compares the performance and characteristics of three turbidity sensors currently utilised by DPIWE:

- BTG Polymetron TX Pro
- Greenspan TS 100
- Mindata 2600

The backbone of the logger and telemetry system employed by DPIWE is Unidata Starloggers and water quality sensors used are

required to interface with this system. Sensors can be deployed on a permanent in situ basis or form part of temporary installation for specific short term studies

1.1 History of Turbidity Sensor Deployment in DPIWE

Since the mid 1990's the turbidity sensors deployed by DPIWE have been a mix of two makes, BTG/Polymetron and Greenspan. Both units were deployed at stream monitoring sites with minimal servicing in mind as an operational criteria. More recently Mindata turbidity sensors have also been deployed.

Early in the program sensors were initially specified or ranged as 0 - 500 NTU units. Actual stream turbidities actually experienced (from sampling programs) in the rivers monitored have not approached anywhere near the top end value of 500 NTU. In recent years turbidity sensors have been deployed with 0 – 250 NTU ranges to improve accuracy through the range and sensitivity, particularly in the lower turbidity ranges experienced a majority of the time in the streams monitored. Spikes or data above 250 NTU in Tasmanian streams can generally be attributed to other factors including:

- temporary obstruction of lens by weed or debris at time of sensor operation
- algal build up on optical faces
- localised turbidity at the sensor caused by stream bank disturbances through stock access to stream for watering, while turbidity in the bulk of the stream section remains unaffected.

A general review of data collected by sensors deployed in the DPIWE hydrometric network showed that the problems or issues encountered with the sensors deployments, apart from system power failures or outright sensor failure (electronic failure) included:

- failure of lens cleaning mechanisms - in field situations this generally allows algal build up on optical surfaces causing a gradual rise in turbidity values produced by the sensors.

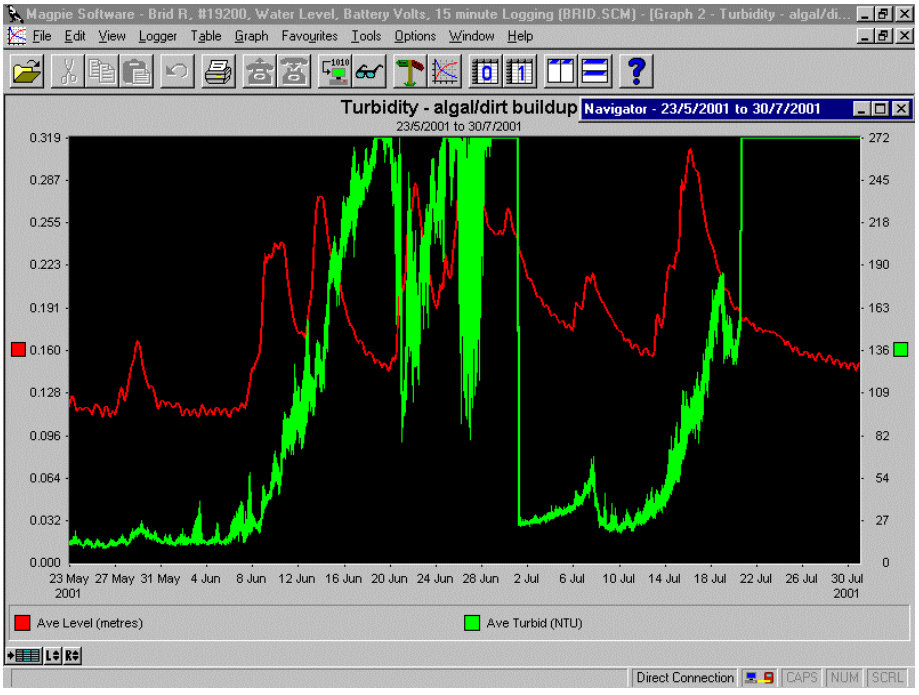


Figure 1: Example of effects of failed turbidity sensor cleansing mechanism on turbidity data

- Silt build up inside sensor protection shields (more relevant to BTG deployments) - Silt builds up inside the sensor shield and begins covering the optics of the sensor, causing a ramping of sensors readings. This problem is not universal in the network and tends to be site specific and a function of the observed properties of the suspended solids in the stream. The following data plot shows this effect at the North Esk at Ballroom monitoring site where two flood events were recorded well but the subsequent recession period showed a ramping effect due to silt build up inside the shield.

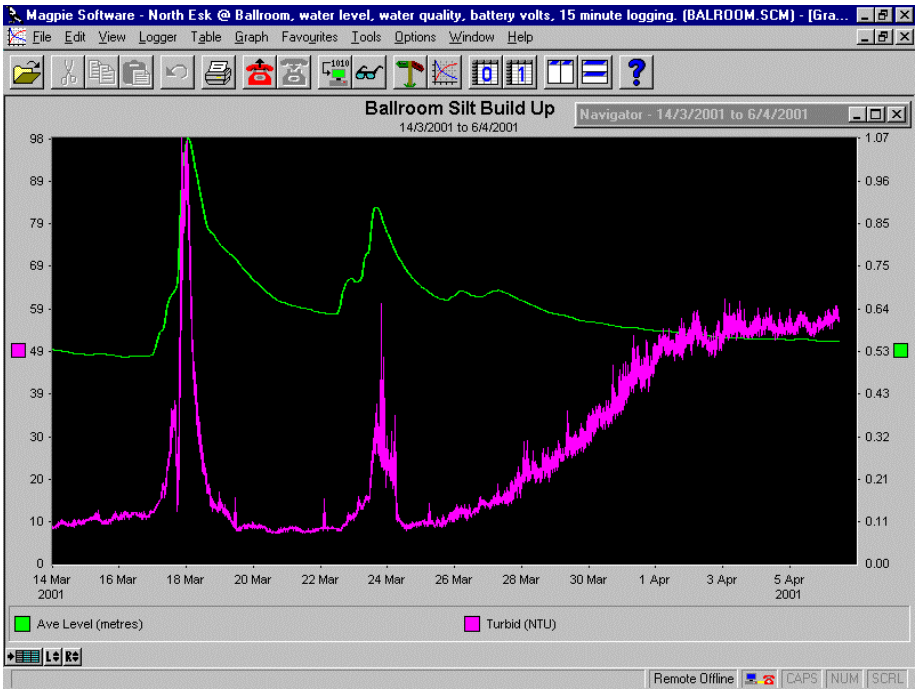


Figure 2: Example of the effects of silt build up inside a turbidity sensor shield on turbidity data.

- Glazed' or 'striated' optical surfaces - This has become a noted problem in the last year or so on with older sensors but effects have differed between sensor makes.

  Original BTG sensors (1995/96) have developed a glazing or striation of the optical surface depending on the properties of the suspended solids present in the stream. Glazing tends to reduce sensitivity of the sensors resulting in under recording of turbidity while striations, resulting from silt being trapped on the wiper and continually grinding lines into the optical surface, result in over recording of values.

  Greenspan sensors glazed or fogged as a result of the deterioration of the anti fouling coating with subsequent gradually increasing over recording of turbidities.

- Interference from weed or aquatic organisms. Weed can be an obvious interference for sensors as it is visible immediately to the hydrometrician. Interference by aquatic organisms may not be as evident. At one monitoring site the larvae of organisms had made their home on and around the lens face and while the sensor cleaning mechanism had kept the optical surface clean these larvae tended to hang off the wiper arm (BTG installation) and fall into the peripheral edges of the beam of the sensors causing higher readings.

While all units currently used by DPIWE measure turbidity based on light scatter, the units differed greatly in a number of features that each is designed with.

1.2 Turbidity Sensor Features

BTG Polymetron.

General:
These units are primarily designed for use in process monitoring situations. Their design is based on a self cleaning sensor connected to a separate transmitter intended for panel mounting in control rooms and the like. The units employ right angle scatter techniques for the measurement of turbidity.

Units are powered by 24 V DC (DPIWE units) with the availability of a 4-20 mA output.

The construction of these units incorporates a sensor head that contains an external wiper that cleans the sensor 'eyes' (send and receive lenses) at predetermined intervals.

The transmitter unit enables a number of user selectable options to be designated, via a basic key pad, to tailor the unit's operation to the process requirements. Some of these features include user selectable range adjustments, availability of output alarms and triggers, self calibration and manual calibration features. The availability of calibration features enables the life of sensor heads to be extended by allowing compensation for deterioration over time of the sensor optics and wear and tear on the external optical surface.

Sensors are interchangeable between transmitters but re-calibration is required if this occurs to match sensor characteristics to the transmitter. The models used by DPIWE at present are no longer manufactured and the newer model components are not interchangeable with the models DPIWE currently uses.

Deployment by DPIWE:

24 v powered units are currently deployed by DPIWE. When initially installed, a basic 12 V to 24 V DC converter unit was designed and built to supply power to the units, as the logging systems and other water quality equipment operate on 12 V DC. The 4-20 mA output from the transmitter was utilised for logging.

In 2000 it was found, following technical advice from the Australian suppliers that the units DPIWE owns could actually run on 12 V DC. This enabled removal of the 12 to 24 V converter from the logging system which had been suspected on a number of occasions of creating electromagnetic interference with other sensors and interfaces deployed at monitoring sites.

Sensors are deployed in the field situation contained within a protective stainless steel shield (painted black inside) to protect the sensor wiper from debris carried by the rivers and to reduce the possibility of interference from external light sources. Holes in the shield permit the passage of water past the sensor. A problem with these shields is that, in some cases, they permit a build up of silt inside the shield by virtue of the fact that water entering the shield slows in velocity thus allowing deposition of silt inside the shield. This slowing down and subsequent build up of silt and debris has, on occasions, created interference with accurate reading of turbidities by the sensor.

Given that the units now used by DPIWE are now longer available or have components interchangeable with newer models, Sensor Technologies in Sydney have worked on refurbishing sensor heads where possible to extend the life of the BTG systems in the DPIWE monitoring network.

Greenspan:

General:
These units use back scatter techniques to measure turbidity. The operational voltage range is 9-27 V DC and outputs available from these units are mA, mV or SDI-12. Ranges are factory set and chosen at time of order. In older units it is possible to re-range or recalibrate the units if required but newer units are now potted in a resin to improve water proofness and it is understood that this option of end user recalibration is now not possible, though recalibration of sensors with SDI-12 outputs can be undertaken using Greenspan SDI-12 software.

The lenses are coated with an anti fouling coating which is claimed to reduce the servicing required to maintain good optical characteristics. The units do not incorporate an integral cleansing mechanism apart from this anti fouling coating.

An optional addition available to assist in maintaining good optical properties of the sensor between maintenance visits is a timer/logger controlled pump which blasts a jet of water onto the lens face at preset intervals.

Deployment by DPIWE:

The first Greenspan units were deployed in 1995. Unfortunately a lack of resources or planning to undertake a regular maintenance regime of these sensors did not auger well for good data collection from these sensors.

Installations at the time did not appear to give much consideration as to the performance characteristics of the sensors and a number of installations gave poor results as a result of poor placement and installation. Some sites had sensors facing weir walls and at low turbidities this was causing high readings as the wall was reflecting light back at the sensor!

A prototype lens cleaning pump from Greenspan was installed early in this period at one site and data from this site was markedly better than data from sites which did not have a cleaning mechanism. Unfortunately the deployment of cleaning systems on the rest of the deployed sensors did not occur until after 1997/1998 after which there was a noticeable improvement in the data collected by these sensors.

All initial units were ranged 0-500 NTU. Recent units have been specified as 0-250 NTU.

Mindata 2600:

These units have been recently been redesigned and incorporate a solenoid activated flapper mechanism or lens protection device (LPD) that covers the sensor when readings are not required, protecting the sensor from organism build up and growths. The sensor is only exposed for the short period required for taking a reading and the opening and closing action of the LPD is claimed to assist with dislodging any algal or silt build up from around the sensor face. Outputs available are mA or mV.

The range of the units are fixed at the time of ordering and are not user changeable.

Deployment by DPIWE

Units used by DPIWE are 4-20 mA outputs for a range of 0 - 250 NTU. Units are deployed via methods similar to that recommended by Mindata in the 2600 user manual, being contained within sturdy PVC pipes with the sensor face positioned flush or just protruding from the end of the PVC pipe.

The LPD is powered from the recorder shelter and no problems have been experienced with power losses over longer cable distances to date. (The longest run in the DPIWE network is 60 metres).

2. COMPARISON TEST PROCEDURE

The three sensors were connected to a Unidata 6004C data logger via a Unidata 6103D interface board fitted with resistors to provide appropriate conditioning of the 4-20 mA signals for the Unidata logger. The data logger operation and sensor control was undertaken via Magpie software. Sensor operation was activated by the data logger through MEA2107 control units. Half hourly logging was undertaken for the duration of the test. The system was powered by a solar charged battery system.

A nearby rain gauge was used to determine whether rain fall was cause of any variations in the turbidity of the dam during the test period. Wind observations were also undertaken to determine if any short term fluctuations in turbidity readings might occur through possible disturbance of the water column due to the action of wind.

Operational current draws, sensor interferences (forward and side) and other general information were recorded prior to deployment and details recorded in Table 1.

Prior to deployment each sensor was two point check calibrated - a straight line relationship being assumed for the units being compared. Turbidity values for calibration checking were a clean water sample of 2 NTU and a turbid water sample from the dam of 226 NTU. Refer Table 2.

Reference turbidity values from the dam and calibration samples for the comparison period were tested using the same Hach 2100P turbidity unit, which had been checked against two sets of secondary standards (Hach gel kits) for accuracy. Spot turbidity readings were taken at varying intervals through the test period and results tabulated in Table 3.

Sensors were deployed on a floating buoy anchored in a farm dam of high turbidity at time of deployment. Deployment of sensors was from July 2001 to December 2001 during which time no cleaning or maintenance of the sensors was undertaken.

3. RESULTS

3.1 GENERAL FEATURES TESTED

Feature Tested	Operational Voltage	Current Draw *	Warm Up time	Forward Interference**	Side Interference	Light Source and detection (From sensor manuals)	Output in Air
BTG 0-500 NTU***	12 - 24 V DC	660mA 810 mA Peak	45 secs	50 mm	negligible	No Details for light source 90^{o} scatter.	1.5 NTU
Greenspan 0-250 NTU S No. 08042	9-27 V DC	70-80 mA	2 secs	300 mm	negligible	Infra-red 860 nm 30^{o} backscatter	14.0 NTU
Mindata 2600 0-250NTU S No. 262002	10-15 V DC	500 - 520 mA 1970 mA peak	1 secs	250 mm	negligible	Infra-red 880 nm 180^{o} backscatter	0.2 NTU

Table 1. General Features Tested.

*Peak current draws for the BTG and Mindata units are listed due to the power requirements of the self cleaning/LPD mechanisms used by these sensors. In the instance of the BTG this peak current is maintained for the period of wiper operation (approximately 20 seconds), while the Mindata unit is less than 1/2 a second as the solenoid is activated. A Greenspan lens cleaning pump system was not available at the time of this study but current field units draw up to 5 amps from a 12 volt supply for 15 seconds every hour (current DPIWE cleaning protocol).

** Forward interference was determined by slowly lowering the sensor through a water column of 2 NTU held in a 150 mm PVC tube with PVC base and observing the sensor output for an increase. The distance from the base was measured once an increase was observed.

*** This unit was a transmitter using a refurbished sensor head.

3.2 SENSOR CALIBRATION

Sample Value	BTG*	Greenspan**	Mindata
2 NTU	2.0	3.0/3.5	3.1
226 NTU	237	200/226	221

Table 2. Two Point Calibration Test Prior to deployment

*The BTG unit was originally scaled as 0-250 NTU. Given that the turbidity of the farm dam was close to this maximum range, at the commencement of the comparison, the unit was re-scaled as a 0-500 NTU unit to assess sensor performance if turbidity exceeded the ranges of the other two sensors.

**At the time of preparing the sensor for deployment in the test the Greenspan Sensor was found to be out of specification. At 226 NTU the unit out-putted 16.4 mA not the expected theoretical 18.46 mA. A straight line relationship was assumed and the Magpie software used to adjust the slope based on a maximum output of 250 NTU @ 17.8 mA to compensate for this error. (Subsequent calibration tests in varying test solutions produced a reasonably straight line fit so this approach was considered acceptable for the purpose of this comparison) Refer to Discussion section.

3.3 SPOT HACH READINGS

Date	Dam Turbidity
27/7/2001 @ 1230	226
4/8/2001 @ 1630	273
22/8/2001 @ 1715	54.2
30/8/2001 @ 2015	98.2
19/9/2001 @ 1000	190
20/9/2001 @ 1000	210
2/10/2001 @ 0630	320
6/10/2001 @ 0845	310
8/10/2001 @ 1615	310
12/10/2001 @ 1700	112
14/10/2001 @ 1600	117

Table 3: HACH 2100P Turbidity spot readings recorded during study.

3.4 DATA TRACES

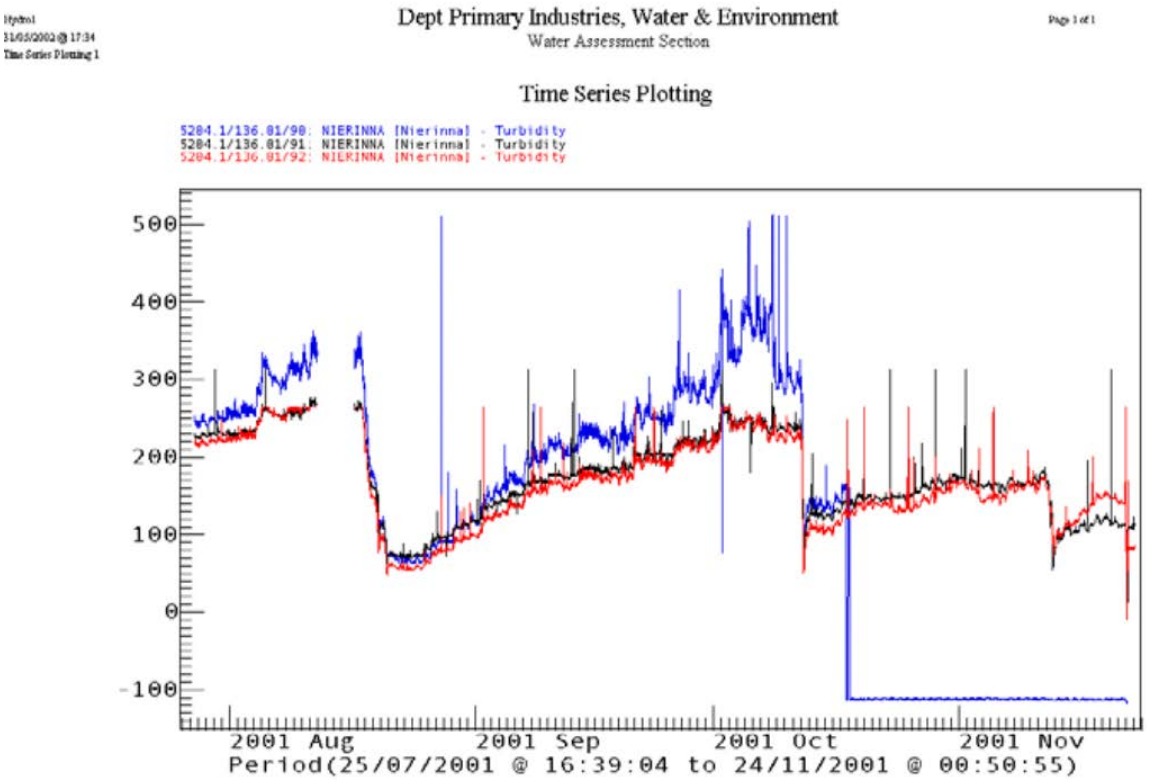


Figure 3: Plot of turbidity sensor results for period of study.

The above data trace shows the bulk of the data collected from the sensors during the study period. Lost data (due to power failures) has been edited from the trace. The drop in the BTG trace (blue trace) is attributable to the failure of the BTG 4-20 mA output circuitry. The red trace is Greenspan data and the black trace is Mindata data.

The second instalment of this paper, containing discussion of the test results and other issues, will appear in the next Journal.

3573 Hydrography Certificate IV Course-- A successful start

To date 53 enrolments, plus 11 doing the bucket course 8046 Hydrology and Environmental Management Statement of Attainment. There has been a late surge, as Thiess Services have just required all their assistant hydrographers to enrol and complete at least 2 modules this year. We said 20 this year would be a good start. The stats by state are 12 NSW, 11 Qld, 1 SA, 2 Tas, 22 Vic, 5 W A. I don't have complete information, but the employers (highest to lowest number of students) include Thiess, Qld DPI-NR, Sydney Water, Water Corporation of WA, NSW DIPNR, Bureau of Meteorology, Tasmanian Hydro, Snowy Mountains Authority, Water Data Services, Ecowise. Next stop Northern Territory and New Zealand!

We are well underway with our development plans.

Distance learning resources for modules 8004R Atmospheric Physics and Hydrology A; and 8004X Hydrography A have been written and both are with the reviewers. The next two modules will be 8004S Atmospheric Physics and Hydrology Band 8004Y Hydrography B, with writers to start on these next week. Enrolments have just closed for 2003, but reopen from early November for immediate start, and we are recording names of intending students to be posted an enrolment pack.

Neil Harper
Teacher of Environmental Science
OTEN
51 Wentworth Rd
Strathfield 2135

ph 1300 360 087
direct 02 9715 8485
email neil.harper@tafensw.edu.au
web: http://www.oten.edu.au

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 Council 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 your 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 its 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.

Contributions to the Journal and Newsletter and Web Site

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.

WATER

We also have a half page presence in Water magazine through our affiliation with the Australian Water Association.

Members are welcome to contribute to this by forwarding the article to the AHA Committee for proofing and then this is forwarded to the AWA for their own editorial proofing before publication

Visit Your Web Site www.aha.net.au