[redacted]

From: Michael Turnell [redacted]
Sent: Friday, 15 March 2019 5:59 PM
To: Pigliardo, Tina [redacted] Lovius, Leo [redacted]
Cc: Utter, Megan [redacted] Shirvill, Natasha [redacted]
Wright, Robert [redacted]
Subject: RE: Voluntary Information Request about meter accuracy concerns [DLM=Sensitive:Legal]
Importance: High

Dear Tina and Leo,

I can confirm that I have uploaded our letter and supporting documents to OurShare. I have received confirmation emails from ourshare@accc.ourshare.com.au that the documents have been received with success but please do advise if this has not occurred on your end.

In any event, I attach our letter for your reference.

Kind regards,

From: Pigliardo, Tina [redacted]
Sent: Thursday, 7 February 2019 1:27 PM
To: Michael Turnell [redacted]
Cc: Utter, Megan [redacted] Shirvill, Natasha [redacted]
Subject: RE: Voluntary Information Request about meter accuracy concerns [DLM=Sensitive:Legal]

Dear Michael,

I can confirm that an extension of time till **15 March 2019** has been accepted. We understand that MI will provide a full response to our questions at that time.

We understand that you have documents which you may consider to be sensitive and or confidential. Please note that the ACCC has formally set out how we collect, use and

disclose information in the Australian Competition Consumer/Australian Energy Regulator Information Policy. I have attached a link to the policy which appears on our website https://www.accc.gov.au/publications/accc-aer-information-policy-collection-and-disclosure-of-information

In summary, and consistent with the policy, the ACCC's approach is that information, including confidential information, collected by the ACCC/AER may be viewed by ACCC/AER members, staff and consultants such as legal or economic advisers. The ACCC may then use that information as part of its performance of its duties and functions. The ACCC is committed to treating confidential information responsibly and in accordance with the law. Generally, the ACCC will consult with the person who has provided the confidential information about any disclosure of the information beyond ACCC/AER members, staff and consultants such as legal or economic advisers. This is subject to any prejudice to the ACCC's investigations that might otherwise occur as a consequence of any such consultation.

If you have any queries about the ACCC/AER Information Policy or this matter generally, please contact me in the first instance.

Kind regards

Tina Pigliardo
Assistant Director – Insurance, Water and Wireline Markets| Infrastructure Regulation Division
Australian Competition & Consumer Commission
Level 18 | 2 Lonsdale St (Casselden Place) Melbourne VIC 3000 | http://www.accc.gov.au
T: [redacted]

From: Michael Turnell [redacted]
Sent: Thursday, 7 February 2019 11:39 AM
To: Pigliardo, Tina [redacted]
Cc: Utter, Megan [redacted] Shirvill, Natasha [redacted]
Brett Jones [redacted]
Subject: RE: Voluntary Information Request about meter accuracy concerns
[DLM=Sensitive:Legal]

Dear Tina,

Thank you for your time over the phone earlier this morning.

MI confirms it will provide the information requested to the ACCC on a voluntary basis, but it is unlikely that it can be collated by the requested date of 22 February 2019. This is mainly due to the extensive history of exchange with this particular customer, which includes material collated by staff no longer with MI. In those circumstances, we request an additional 3 weeks to respond, to 15 March 2019.

[redacted]

[redacted]

Kind regards,

Michael Turnell | Legal Advisor | **MI** Murrumbidgee Irrigation
[redacted]
www.mirrigation.com.au
Research Station Road, Hanwood | Locked Bag 6010, Griffith NSW 2680

From: Pigliardo, Tina [redacted]
Sent: Wednesday, 30 January 2019 5:09 PM
To: Michael Turnell [redacted]
Cc: Utter, Megan [redacted]; Shirvill, Natasha [redacted]
Brett Jones [redacted]
Subject: RE: Voluntary Information Request about meter accuracy concerns
[DLM=Sensitive:Legal]

Hi Michael

Thank you we look forward to your assistance with our enquiries.

Kind regards

Tina Pigliardo
Assistant Director – Insurance,Water and Wireline Markets| Infrastructure Regulation Division
Australian Competition & Consumer Commission
Level 18 | 2 Lonsdale St (Casselden Place) Melbourne VIC 3000 | http://www.accc.gov.au
[redacted]

From: Michael Turnell [redacted]
Sent: Wednesday, 30 January 2019 5:05 PM
To: Pigliardo, Tina [redacted]
Cc: Utter, Megan [redacted] Shirvill, Natasha [redacted]
Brett Jones [redacted]
Subject: RE: Voluntary Information Request about meter accuracy concerns
[DLM=Sensitive:Legal]

Dear Tina,

I acknowledge receipt of your letter. I will be in contact should we require additional time to respond.

Kind regards,

Michael Turnell | Legal Advisor | **MI** Murrumbidgee Irrigation
[redacted]
www.mirrigation.com.au
Research Station Road, Hanwood | Locked Bag 6010, Griffith NSW 2680

From: Pigliardo, Tina [redacted]
Sent: Wednesday, 30 January 2019 4:37 PM
To: Michael Turnell [redacted] Brett Jones [redacted]
Cc: Utter, Megan [redacted] Shirvill, Natasha [redacted]
Subject: re: Voluntary Information Request about meter accuracy concerns
[DLM=Sensitive:Legal]

Dear Michael

As discussed today please find attached our voluntary information request. Should you have any queries about this request please do not hesitate to contact me or Natasha Shirvill (who works Monday, Thursday and Fridays) on [redacted]

Kind regards

Tina Pigliardo
Assistant Director – Insurance,Water and Wireline Markets| Infrastructure Regulation Division
Australian Competition & Consumer Commission
Level 18 | 2 Lonsdale St (Casselden Place) Melbourne VIC 3000 | http://www.accc.gov.au
[redacted]

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Murrumbidgee Irrigation

Postal Locked Bag 6010, Griffith NSW 2680
Offices • Research Station Rd, Hanwood NSW 2680 • Dunn Ave, Leeton NSW 2705
Contact T (02) 6962 0200 F (02) 6962 0209 E info@mirrigation.com.au
www.mirrigation.com.au ABN 39 084 943 037

15 March 2019

Robert Wright
General Manager Insurance
Water and Wirelines Markets
Australian Competition and Consumer Commission
Level 17
2 Lonsdale St
Melbourne VIC 3000

Email [redacted]

Dear Mr Wright

RE: REQUEST FOR INFORMATION - METER ACCURACY CONCERNS

I write in response to your letter dated 30 January 2019 in respect of the above and have responded to each of your questions in turn. Additional contextual information and supporting documents are provided where appropriate.

MI meter fleet

1. How many meters does MI own and maintain within the MI network?

3,787.

2. How many of MI's customers have a MAD meter?

MI currently has 1,356 MAD meters in its asset fleet comprising 1,184 Series 2 and 172 Series 3 meters. Note that some customers will have more than one meter on their landholding(s).

3. Please describe the circumstances of the MAD meter roll out.

In the early 1990's - prior to privatisation - MI commenced upgrading its 80-year old meter fleet. This was in the context of the National Water Initiative and the beginning of water reform in Australia. At the time there was a COAG agreement to work towards metering standards. In 2008 Technical standards for metering were issued identifying +/- 5% as the standard for in-field meter accuracy. MI was part of the industry lead group (ANCID) that developed the technical standards. This was followed by the release of NSW Interim Standards in 2009 which identified a transition pathway in the absence of pattern approved meters, and grandfathering arrangements for existing assets. The Australian Standards were published in 2013. Pattern approved meters have only become readily available in the market place over the last few years.

The original selection of meters, prior to the development of the Australian Standard - and well before any pattern approved meters were available - included MACE Agriflow Doppler (**MAD**) and

Electromagnetic meters. These meters were selected by MI to replace its Dethridge meters. In particular, the MAD meters were selected because of their accuracy and reliability. Specifically:

- Operational and engineering performance had been demonstrated in the field to be within +/- 5% and 2.5% in the laboratory.
- Ongoing in-situ testing over a period of years demonstrated the meters to be reliable and accurate.
- Independent tests conducted by Thiess Services Pty Ltd supported their accuracy.

3a. When were the MAD meters installed?

Between 1990 and 2009.

3b. Who installed the meters, and what were the installers' qualifications or certifications at the time of roll out.

MI installed the meters. Our installers were trained by the manufacturers (MACE) and subsequently worked with MACE to develop their installation guidelines.

Metering arrangements with customers, including complaint handling

4. Who is responsible for meter maintenance?

MI is responsible for meter maintenance. Our staff are accredited as validators under the National Framework (the 'Metrological Assurance Framework').

5. Please describe or provide copies of MI's policies and procedures to resolve metering complaints. How long have these policies and procedures been in place?

The methodology described below has been routinely undertaken over at least the last 10 years. In brief, it involves a staged approach that begins with a desk top review of factors including water order history and crop type, proceeds to a meter validation check reviewing configurable settings and escalates to in-field verification if required:

1. Initial review, which may include but is not limited to:
    - A review of water usage against water orders, crop type and rainfall events;
    - A review of water use over previous irrigation seasons; and
    - A physical inspection of the meter.
2. In the event an irregularity is identified in step 1, or the customer requests an investigation, then an investigation commences which may include but is not limited to:
    - Downloading historical data to check for abnormal flow readings; and
    - Calibration check to ensure the correct parameters are in use.

3. If no irregularities are found in steps 1 or 2, MI informs the customer that the meter has been investigated and no irregularities were evident and that the meter is operating as per design.

4. In the event an irregularity is discovered in step 1 and 2, further investigation would include but is not limited to:

   - Replacement of any defective part; and
   - Flow verification is conducted.

At any stage during the investigation if there is evidence that the meter has not been measuring within the required metering accuracy MI will replace or repair the affected meter. If the customer has been disadvantaged by the inaccuracy, MI will reimburse any charges and water above the actual usage.

If no irregularities are found, the customer may request a flow verification test be conducted on the meter. In this case, the customer would be required to pay the cost of the test(s) and be reimbursed by MI should the tests conclude an error in measurement that is detrimental to the customer and greater than the infield meter accuracy of 5% above actual usage.

6. Approximately, how many complaints has MI received about the accuracy of its meters or related concerns (e.g. billing disputes) in the last six years? What steps did MI take to resolve these complaints?

Metering and related enquiries are received by MI via multiple pathways including field operators and customer services, as well as formal written enquires or complaints. Many of these are resolved at the point of enquiry (as per step 1 in point 5 above) and do not proceed to an investigation.

For the period 1 January 2013 to date, we have undertaken 36 investigations related to meters.

7. How many complaints received about MAD meters remain unresolved to date? If unresolved please explain why?

There are currently 3 open meter investigations, 2 relating to MAD meters. All open investigations were received in February 2019, as such, these investigations are not yet finalised.

[redacted]

Alleged MI representations about meter accuracy and testing

8. From January 2013 to current, did MI make any statements in writing to its customers about the accuracy of the MAD meters? If so please provide copies of the documentation (Factsheets, newsletters, presentations or other documents).

We have annexed a folder to this letter titled "Public communications", which includes extracts of MI's Annual Reports and Newsletters from 2013 onwards. The extracts detail each time that MI has made mention of anything to do with its meters. A review of these extracts demonstrates that the focus of the discussion has been on meter replacement and upgrades due to modernisation works

undertaken by MI. There were no statements made regarding the accuracy of MAD meters made in these documents.

9. How often does MI test and/ or maintain its meters? What testing methodology does this involve?

MI audits one third of its meter installations annually. Additionally, all operating meters are read at regular intervals by field staff and the readings are cross referenced against water orders to identify any outliers that indicate discrepancies between orders and actual usage. With respect to MAD meters, the audit process involves a thorough physical inspection of the meter configuration that checks the current state and location of the meter components and associated civil structures against the installation requirements set by the manufacturer. This requires the pumping out of the meters so that the internal pipe can be inspected for probe location, pipe integrity, siltation and/or other debris that may affect the meter accuracy. Additionally, the meter configuration is checked for any sign of tampering that may indicate a change in the metrology of the meter. Any issues at the site are rectified at the time and the outlet is checked again the following year to ensure that the issues have not recurred.

In addition to the audit program specific investigations and/or maintenance occur as required when there is evidence of possible meter creep, or a marked change in usage patterns indicating potential non-compliance or theft. The investigation is to confirm that the meter is installed as per manufacturer's specifications and that the usage history is consistent with the orders placed and water usage for the crop type.

Meter testing (flow verification) occurs when required to resolve an investigation or an escalated complaint. Testing involves confirming that the flow-rate passing through the meter is accurate and requires the use of an infield verification rig to compare flows over different flow rates. The procedure for use of a verification rig is titled "MI Flowmeter Validation and Verification Procedure" and is located in the folder titled "Test results".

10. Has MI had some or all of its MAD meters independently tested? If so, what were the circumstances (including dates) and the results of such testing? Please provide copies of any reports relevant to such testing.

MI has previously had 9 of its MAD meters independently tested between 2002 and 2015. This testing was undertaken by Ventia and Theiss. Prior to the selection of the MAD meters, the meter was vigorously tested in the current configuration at the Manly Hydraulic Laboratory. The results of each of these tests (including dates) have been included in the folder titled "Test results".

This independent testing was part of our metering integrity program. A range of customer meters were selected including some who had indicated concerns with higher than average crop water use.

In 2009, the results of the Theiss tests were in some instances greater than 5%. However, as all of these were bias to the customer, we considered this to be acceptable and in line with our conservative position.

11. What company statements has MI made about the frequency of meter testing?

We have included extracts of MI's Annual Reports and Network Services Plan that refer to our audit and inspection program and highlight that testing is an exception. These are the same documents as referred to in question 8 above.

12. A representative of MI, Matthew Thorpe, is alleged to have stated verbally at the 2015 AGM that the MAD meters met the AS4747 standard. We have also been provided with a screenshot [Attachment A], allegedly of Mr Thorpe's notes for the AGM presentation, that states "tests continue to confirm for us that meters are performing within target ranges consistent with the Australian Standards". Can you please confirm whether Matthew Thorpe made both these statements to customers at the AGM and, if so, provide the information on which MI relied in making these statements. Please provide the full set of notes that Mr Thorpe used for his presentation.

Mr Thorpe, in his role as Executive Manager of Operations, was assigned a 15-minute time slot during the AGM to give a presentation on past happenings in the 2014-2015 water year and to discuss future priorities and forecasts in the 2015-2016. A copy of Mr Thorpe's PowerPoint presentation and speaking notes is located in the folder titled "2015 AGM".

I can confirm that Mr Thorpe did state in his presentation that "tests continue to confirm for us that meters are performing within target ranges consistent with the Australian Standard." I can also confirm that Mr Thorpe *did not* state in his presentation that MI's meters met the AS4747 standard.

Mr Thorpe's statement about MI's meters performing within target ranges consistent with the Australian Standards was based on our history and experience of the MACE meters since original installation. Overall there have been few issues compared to the number of meters and the ongoing processes describe above have all combined to provide confidence in the MI metering fleet.

In addition, independent testing of 3 meters by Ventia in 2015 demonstrated that the meters, where maintained and operated correctly, were within the standards. Test results are annexed to this letter and show that for 2 of the 3 meters tested in-situ, the results were within +/- 5% across the flow rate range under rated operating conditions. This result is consistent with the requirements of section 4.3 of *AS4747.2: Technical requirements for closed conduit meters fully charged*, particularly section 4.3.2.2 which is reproduced below. The meter that did not meet the criteria (+8%) belonged to the Complainant and is discussed in response to your question 15.

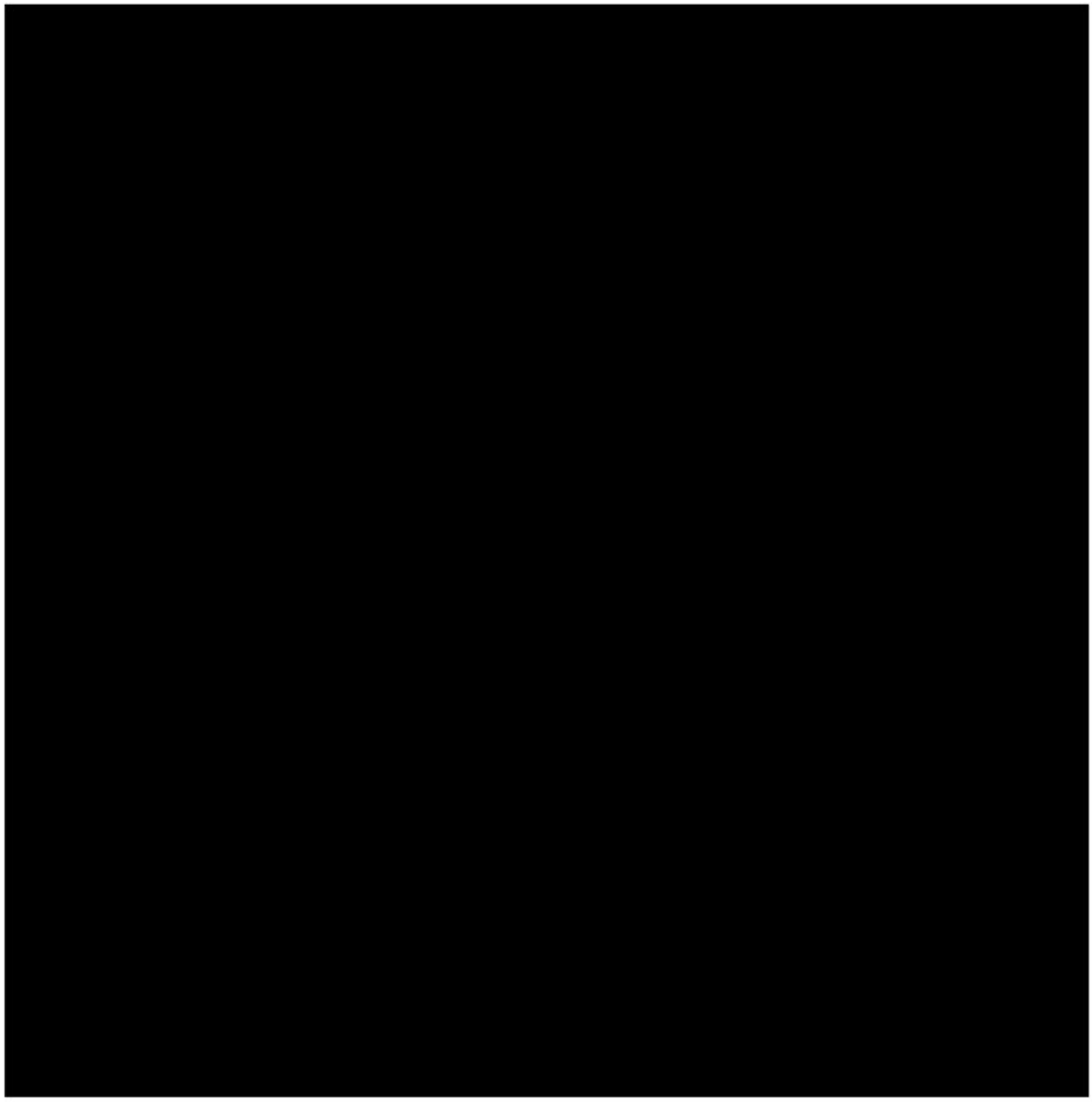
4.3.2.2 ***In situ testing***

Where a meter is tested in situ via direct volumetric comparison in accordance with AS 4747.8, the errors (of indication) shall not exceed ±5.0% across the flow rate range ($Q_1 \leq Q \leq Q_4$) under rated operating conditions.

14. Please provide a list of attendees for the 2015 MI AGM.

A list of the attendees for the 2015 AGM can be found in the "2015 AGM" folder.

[redacted]



Basis for concerns about meter accuracy

16. Is MI aware of or does it hold any concerns regarding the accuracy of the MAD meters? If yes, what is the basis for any such concerns?

Yes. The MACE Doppler meters were appropriate technology for their time - noting that pattern approved meters did not exist. As per our response at 15 above, we have concerns regarding the accuracy of these meters when they have been unused for an extended period, used at low flow, or not maintained. Under these circumstances, the build-up of silt or other debris in the conduit is known to impact the accuracy of any meter reading.

We are continually reviewing and updating our meter fleet and procedures to provide best for business and cost-effective customer solutions. As part of our meter replacement program we are now using pattern approved electromagnetic (MAG) and slip meters.

Next steps

Should you have any queries with the above response, please do not hesitate to contact our Legal Advisor, Michael Turnell on [redacted] or at [redacted]

Yours sincerely

Brett Jones
Chief Executive Officer

CC: Tina Pigliardo
[redacted]

Metering mentions newsletter and NSP since 2013

Metering mentions:

NSP

2 LEVELS OF SERVICE

This section identifies the core levels of service we aim to provide customers during the five-year NSP period.

Our service levels are reviewed periodically to ensure we meet customer expectations for service delivery and achieve the right balance between service levels and costs.

Table 1 provides a summary of our core service levels for the next five years and the targets we aim to achieve. Performance against the prescribed targets will be published in our Annual Report each year from the 2012-13 financial year. Further information on our customer service goals for each service level is provided overleaf. Service level measurement and calculation details can be found in Appendix B.

Table 1: Levels of service for NSP period

Service Standard	Target (2012-2017)
Water Delivery	
Irrigation season length	300 days
Water order delivery timeframe	100% compliant orders within 48 hours
Meter reading frequency	100% active meters read monthly
Flow rate share (when enacted)	100% water delivered in line with DE

water order.

2.1.3. Meter reading

Our customer service goal is to undertake monthly meter readings of all active meters during the irrigation season. Customers can monitor their own water usage by generating a Water Statement report through EasyWater. Unmetered supply usage is predetermined based on available announced allocation or the outcomes of usage assessments. In the event of a faulty meter, usage assessments will be conducted that take into account history of use, climatic conditions, land use, breakdown period and water orders lodged.

We have adopted an annuity period of 100 years that is based on the estimated useful life of infrastructure assets that typically range from 15-100 years. It incorporates major periodic maintenance intervals for categories of infrastructure assets including:

- regulating structures;
- access bridges and culverts;
- road bridges and culverts;
- supply channels;
- drainage channels;
- metered outlets;
- minor structures; and
- major projects.

Energy charges		A charge to recover electricity costs of certain IHS pressurised supply systems. Energy charges are based on passing on energy costs incurred to customers connected to a high pressure IHS system on a proportional basis. The nature and structure of charges are as per the applicable Origin Energy tariffs that apply to NSW business customers. Energy charges for individual IHS supply systems are levied on the proportion of customer metered water usage and time of use during peak, shoulder and off-peak periods. Time of use for customers without a metered supply is deemed to be at peak periods. Origin Energy usage periods and tariffs for 2011-12 are included in Appendix E to give IHS customers an indication of the current tariff structure. Energy price assumptions for the NSP period are included in Section 6.1.
Usage	Bulk water usage charges	A water usage charge levied by State Water passed on to customers. This charge is determined by actual physical usage of water, metered or deemed to have been used, multiplied by IPART confirmed rates (where available).

Table 16: Level of service measurement and calculation details

Service standard	Measurement details	Calculation details
Water Delivery		
Irrigation season length	Newspaper advertisement dates	Season closure date – season commencement date
Water order delivery timeframe	EasyWater report	(Compliant orders delivered / total compliant orders received) x 100
Meter reading frequency	EasyWater report	(Number of meter readings taken / total number of active meters) x 100

Newsletters

May-June 2013

Winter Maintenance Program

Maintenance work is scheduled during winter close of supply to avoid impacting customer service. Works will include:

- Regulators: The replacement of a major regulator at Lockhart Road and 18 minor regulators are to be replaced or upgraded throughout the system. Scour protection works at the Bundigerry Regulator are due to commence mid June.
- Channels: Two kilometres of the concrete lined Warburn supply channel will be relined. Earth channel reconstruction and desilting will also be undertaken.
- Bridges, culverts and minor structures: Fifteen minor structures are scheduled to be replaced. Maintenance will include metered outlets works and repairing doors.

Sept 2013

Works Update

Asset Refurbishment Program

Extensive maintenance work was carried out across our channel system over the supply works closure period. With water delivery services having now recommenced, our works team has returned to normal operations.

We are continuing our bridges and culverts replacement program, which is focusing on the drainage system. We have also been working through an influx of maintenance requests for minor metering and channel issues as we refilled the system.

October 2013

Works Update

Asset Refurbishment Program

The Old Wilbriggee Road culvert was recently completed. A large road culvert near the Fivebough Road/McCracken's Road intersection in Leeton has also been replaced. Both projects required road closures and we'd like to thank local residents and businesses for their cooperation and patience during this period.

We've also completed the installation of the time of use meters for the IHS pump stations on Laterals 13 and 16 in Hanwood and Lateral 54 in Leeton. These will enable us to monitor individual energy usage and assist in the efficient operation of the IHS systems.

December 2013

Works update

Asset Refurbishment Program: Our meter replacement program is continuing with 10 new meters installed over the past month.

Sept 2014

Asset Refurbishment Program

Our 2014/15 capital works program continues and includes the replacement of meters, bridges and culverts. We are also continuing to manage the general requirements associated with refilling and operating the system. Drainage channels are currently being treated with Glyphosate herbicide to

Oct 2014

Works Update

We are continuing our 2014/15 capital works program which includes the replacement of meters, bridges and culverts.

Oct 2015

Meter covers damaged

Customers are asked to take care when handling the black covers on our Siemens MAG8000 flow meters, as the lids can be easily broken off, resulting in the meter's display being directly exposed to UV rays. This is likely to damage the display on the meter. These meters are used across the IHS systems, as well as the new pipelines in Lake Wyangan. If your meter cover is missing or damaged, please advise us as soon as possible to avoid further costly damage to the meter.

Dec 2015

Technology making us more efficient and improving safety

Tablet PC's have been issued to all of our division operators and field staff to improve the responsiveness and efficiency of our operations.

The new Tablet PC's allow us to be more responsive with staff able to make adjustments remotely, enter data on site, review worksheets, and enter meter readings and maintenance data. This improves efficiency with reduces travel required and no double entry of information.

JANUARY 2018 Newsletter

December supply challenges

Water released from our dams (Blowering and Burrinjuck) takes up to seven days to reach our supply network via the Murrumbidgee River. Our customers are only required to order water 48 hours in advance. This means that there is always the potential for a mismatch between supply from the River and our local customer demand. In the lead up to Christmas, and despite our best forecasting efforts, such a mismatch occurred and we were faced with a potential 4-5 days of significant water supply restrictions.

Photo: A temporary pump at East Mirrool Regulator was used in December 2017

By using our new automated structures differently and working with key Council stakeholders to manage non-essential usage, we reduced the extent and severity of the supply impact on customers to one day of restriction each on the Sturt and Main Canal supply systems.

Our new metering technology was put to good use during this period, helping us identify customers who were taking water without an order or above their ordered flow rate. Our customer service and delivery teams were then able to contact these customers, and ensure their supply was adjusted so as not to impact other customers.

May 2018

New outlets improve on-farm efficiency

As part of our modernisation program we are installing new, and upgrading, metered farm outlets so they are automation ready. This will allow remote operation and monitoring of outlets, which will in turn benefit customers through:

- Greater flexibility in water delivery
- Lower fixed charges
- Consistent flow rates
- Workplace health & safety advantages due to reduced manual labour, and
- Lower maintenance and operational costs resulting in cost savings that MI can pass on to customers.

Goolgowi customers, Murray Robertson and his son Harry, have replaced three of their 15ML outlets with one 60ML. (Pictured right)

Murray said like all farmers they are looking to get the most out of the water available and "chase the return per megalitre."

"The new larger outlet is great and has exceeded my expectations," he said.

"This program has given us the opportunity to reconfigure outlets to get the flow rate most suited to our farming needs."

For more information about our Outlet Automation Program contact us on (02) 6962 0200.

June 2018

Outlets: As part of our modernisation program we are installing new, and upgrading, metered farm outlets so they are automation ready. For more information about our Outlet Automation Program contact us on 6962 0200.

July 2018

Farm outlets: As part of our modernisation program we are installing new, and upgrading, metered farm outlets so they are automation ready. For more information about our Outlet Automation Program contact us on 6962 0200.

August 2018

Farm outlets: As part of our modernisation program we are installing new, and upgrading, metered farm outlets so they are automation ready. For more information about our Outlet Automation Program contact us on 6962 0200.

December 2018

Our new metering technology was also put to good use during this period, helping us identify customers who were taking water without an order or above their ordered flow rate. Our customer service and delivery teams contacted customers, and their supply was suspended or adjusted so as not to impact others.

Annual Report 2018, Page 6

December supply challenges

In the lead up to Christmas 2017, and despite our best forecasting efforts, there was a mismatch between supply from the Murrumbidgee River and our local customer demand, and we were faced with a potential 4-5 days of significant water supply restrictions. By using our new automated structures differently and working with key Council stakeholders to manage non-essential usage, we reduced the extent and severity of the supply impact on customers to one day of restriction each on the Sturt and Main Canal supply systems. Our new metering technology was put to good use during this period, helping us identify customers who were taking water without an order, or above their ordered flow rate. Our Customer Service and Delivery teams were then able to contact these customers and ensure their supply was adjusted, so as not to impact other customers.

March 2018

NSW Water Reform Action Plan launched

The NSW Government launched its Water Reform Action Plan and commenced consultation on water take measurement and metering, transparency of water entitlement and allocation ownership, and better management of environmental water.

Annual Report 2018, Page 14

Water reform

The NSW Water Reform Action Plan was released this year in response to a series of public investigations and inquiries into the NSW government Water Department. Concerns around water sharing plan governance, metering adequacy and water take compliance have resulted in an urgent reform agenda, the loss of senior bureaucrats and the establishment of a new regulator the Natural Resources Access Regulator.

The loss of confidence in NSW water governance also manifested itself in a threat to the Sustainable Diversion Limit Adjustment Mechanism – part of the Murray-Darling Basin Plan.

The adjustment mechanism reduces the water recovery target by 650GL and was the subject of a Disallowance motion in the Australian Parliament. We increased our lobbying efforts including directly through key opposition members and the Ministerial Council to ensure that the Disallowance motion did not succeed.

Annual Report 2016, Page 24

Annual Report 2016, Page 25

Our asset refurbishment works commissioned in 2015/16 included:

- The upgrading of three pump stations
- The replacement of 73 meters
- Three road bridge replacements
- Culvert replacements
- Regulator upgrades, and
- The refurbishment of around six kilometres of earthen supply channels.

Annual Report 2016, Page 26

Metering

Our metering audit program continued in 2015/16 to ensure the ongoing integrity of metering installations. During the year, 1,120 doppler meter installations were validated. A third of all installations are audited each year, resulting in each meter being inspected every three years. Out of service meters are given maintenance priority.

Annual Report 2016, Page 26

Hanwood Modernisation Project

The $40.2 million Hanwood Modernisation Project was completed in October 2015, providing a modern and efficient water delivery system to around 210 landholdings in the Hanwood area.

This project was funded through a $149.6 million Australian Government grant to MI through the Sustainable Rural Water Use and Infrastructure Program under Round Two of the Private Irrigation Infrastructure Operator's Program in NSW (PIIOP2).

The project, delivered by the Murrumbidgee Irrigation Area Renewal Alliance (MIARA), involved replacing 12.4 km of ageing concrete-lined supply system channels with gravity flow pipelines, the installation of electronic flow meters with remote monitoring on 67 outlets and the replacement or upgrading of 87 regulating structures within the Hanwood project area. Gravity pipelines were chosen based on key design parameters including service life, durability and lower operational costs for customers.

All of the channels in Hanwood have now been switched into automatic control.

This project has enabled us to better control pools between regulators, reduce water losses through escapes and improve service reliability for our customers.

Annual Report 2016, Page 27

MIA Modernisation Project

The MIA Modernisation Works includes the Yenda, Bilbul and Leeton areas, with the project set to benefit farmers and the broader community. Works were approved in September 2015 with construction commencing in March 2016.

This project forms part of the $149.6 million in funding we received under Round Two of the Private Irrigation Infrastructure Operator's Program in NSW (PIIOP2).

The MIA Modernisation Works will replace ageing infrastructure at significant risk of failure or at the end of its service life in the project areas. It will also involve replacing concrete lined channels and the installation of automation on our supply canal regulators. Over 150 Dethridge wheels will be replaced by electronic flow meters with remote monitoring capabilities and around 1,500 existing meters will have remote monitoring capabilities installed as part of the Integrated Remote Meter Monitoring System (IRRMS).

The Murrumbidgee Irrigation Area Renewal Alliance (MIARA) is responsible for the construction of the MIA Modernisation Works. All MIARA staff were relocated to a site compound at Wade Park in Yenda in January 2016, with their office strategically located close to where the majority of construction activities will take place for the next two years. The close proximity of the site compound to the main construction areas enables MIARA supervisors and engineers to more effectively manage the safety and quality of construction activities, as well as material deliveries.

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Asset refurbishment program

Since 1998, our asset refurbishment program has been primarily funded by the NSW Government under both the Asset Refurbishment Funding Deed (ARFD) and the Road Bridges and Culverts Funding Deed. These deeds are contractual agreements between us and the NSW Government for the provision of funds, paid in annual instalments, to improve the condition of our infrastructure assets.

Each year an annual works program is approved by the NSW Government and funded in that financial year. The ARFD funding arrangement commenced in 1998 and expired in June 2015. From July 2015 we will be required to self-fund all asset refurbishment programs. The Road Bridges and Culverts Funding Deed is still ongoing.

Our program to upgrade non-compliant meters and asset refurbishment works commissioned in 2014/15 included:

- Replacement of 45 Dethridge outlets in Hanwood
- Replacement of 38 metered outlets
- Replacement of 35 walkways
- Replacement of 16 road bridges and culverts
- Two regulator replacements, including six door upgrades
- Replacement of one subway

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Metering

Our metering audit program continued in 2014/15 to ensure the ongoing integrity of metering installations. During the year, 910 doppler meter installations were audited as per the company's target rate to audit a third of all installations each year resulting in each meter being inspected every three years.

In addition, all active meters are regularly visually inspected by Division Operators. Meter usage data is compared to customer order data, to further monitor meter performance.

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Hanwood Modernisation Project

Construction works for the $30.4 million Hanwood Modernisation Project continued over the past year, with the project set for completion by September 2015.

The project involves replacing 12.4 km of ageing concrete-lined supply system channels with gravity flow pipelines, the installation of electronic flow meters with remote monitoring on 67 outlets and the replacement or upgrading of 87 regulating structures within the Hanwood project area.

Gravity pipelines were chosen based on key design parameters including service life, durability and lower operational costs for customers.

Pipeline installation was completed during the 2014/15 irrigation season and managed through system shutdowns to reduce the time and cost pressures associated with construction during the winter maintenance

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- Time-of-use meters for the integrated horticultural supply pump stations on Laterals 13A and 16 in Hanwood and Lateral 54 in Leeton were installed. This enabled reporting on operational efficiency and the more accurate apportionment of energy charges.

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Lake Wyangan Modernisation Project

Significant progress has been made on the $54 million Lake Wyangan Modernisation Project being delivered by the Murrumbidgee Irrigation Area Renewal Alliance (MIARA). This project aims to improve the capacity, efficiency and reliability of the irrigation network through the replacement of open channels with gravity pipelines, the expansion and relining of the Lake View Branch Canal using an innovative shotcrete application, and the upgrade of flow control structures with automation. In order to minimise supply disruptions to customers, the majority of the works were scheduled for completion during the supply works closure period.

By the end of November, almost all of the planned 13.8 kilometres of gravity pipelines replaced the ageing open channel system around Lake Wyangan. By installing pipelines alongside the existing channels, water supply to customers was able to be maintained throughout construction. The existing open channels are being decommissioned, removed and back filled to restore the ground profile.

A total of 9.8 kilometres of concrete channel on the Lake View Branch Canal was relined in 2013 - over one kilometre more than was scheduled for the break between seasons. Local supplier, Area Pre-Mix, has played a vital role in determining the optimal shotcrete mix parameters. The canal has been widened to increase supply capacity to customers and is designed for an 80 year working life.

Construction works recommenced at Lake Wyangan in May 2014 to complete the remaining 5.8 kilometres of channel relining and associated works. The replacement of regulator, offtake and escape structures have continued to progress well and are on track to be completed on schedule. By isolating the most downstream sections of the canal, regulator replacement works were able to continue throughout the irrigation season, reducing pressures on the tight construction timeframe.

Automation capabilities have been progressively installed on metered outlets and regulating structures throughout 2014 in the Lake Wyangan area. By enabling increased reaction times compared with manual operation, automation will improve the reliability and efficiency of the system, particularly during potential times of restriction. It is expected that the automation system will be fully operational in 2014/15.

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Leeton Off-Farm Modernisation Project

In March, MI's Board of Directors approved the business case for the $17.8 million Leeton Modernisation Project. This project involves upgrades to existing infrastructure to reduce water losses and replace ageing infrastructure at the end of its service life. This project will see upgrades in the Wamoon, Yanco, Cudgel and Lateral 165 areas. The works will involve converting channels to pipelines, channel automation and meter replacements. The project is currently in the design phase, with completion expected by the end of 2016.

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NSP SERVICE LEVEL TARGETS

SERVICE STANDARD	TARGET (2012-2017)
WATER DELIVERY	
Irrigation season length	300 days
Water order delivery timeframe	100% compliant orders within 48 hours
Meter reading frequency	100% active meters read monthly
Flow rate share (when enacted)	100% water delivered in line with DE

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Table 6: Service Level Targets and Performance

SERVICE STANDARD	TARGET (2012-2017)	PERFORMANCE	COMMENTS
WATER DELIVERY			
Irrigation season length	300 days	Achieved	
Water order delivery timeframe	100% compliant orders within 48 hours	Achieved	
Meter reading frequency	100% active meters read monthly	Not achieved	Target not was achieved due to rain events and electronic meter issues.
Flow rate share (when enacted)	100% water delivered in line with DE	Not achieved	EADYWATER system is not yet configured to report on this target.

APPENDIX 3: MANLY HYDRAULICS TEST RESULTS

DPWS
NSW DEPARTMENT
OF PUBLIC WORKS
AND SERVICES

Manly Hydraulics Laboratory Irrigation Testing Facility

An irrigation testing facility has been constructed at MHL to test irrigation flowmeters in flow conditions as near as possible to those in the field. The rig, developed as part of the Know the Flow project, allows testing of complete flow measurement installations over a range of conditions. These include the common irrigation arrangement where the flowmeter is installed in a pipe draining from an open supply channel. This is in contrast to the usual method of testing flowmeters in a pipe rig where these field approach conditions cannot be simulated. Typical testing can include evaluation of the accuracy of installations and their sensitivity to the various adverse flow conditions that occur in the field and headloss measurements over a range of flows.

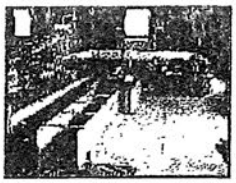
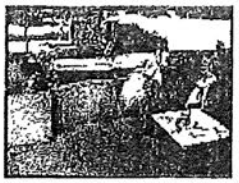
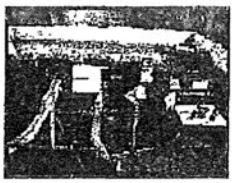
The facility comprises a regulated water supply, two electromagnetic flowmeters, an upstream head box, a test area and drainage system. The layout of the rig is shown in the images below. One side of the head box is constructed from marine plywood to allow either open channel or piped flow measurement systems to be easily installed for testing. The general specifications of the rig are:--

Water Supply	Gravity pipelines from Manly Dam. 10m head. Total available flowrate more than 25ML/day.
Flow Measurement	Two electromagnetic flowmeters, flowrate and totaliser display, NATA calibrated. Measurement of uncertainty 0.25% of measured quantity or 60L. In-situ calibration verification system fitted.
Head Box	Above ground, 7.2m x 6.0m x 1.2m. Mechanical water level follower reading to 0.1mm.
Test Area	8.0m x 6.0m. Longer installations can also be accommodated.
Drainage	Below ground channel to waste or to 2 x 0.8ML volumetric tanks

A range of approach conditions, such as flow across an intake or eddy shedding from abrupt changes in geometry, can be simulated by arranging baffles in the head box. Piped flow systems requiring more than 1.2m of head can be tested using other facilities at the Laboratory.

Currently a Dethridge emplacement is installed in the test area to enable testing of devices inserted either in the emplacement or immediately upstream or downstream, however the test area is sufficiently wide to enable other devices to be installed in parallel.

Some Views of the Test Rig

			
A schematic view of the flow test rig.	A general view of the flow test rig.	A close-up view of the test section.	A close-up view of the head box and test section.

For inquires about this facility contact:--
Manly Hydraulics Laboratory
110b King Street
MANLY VALE 2093
SYDNEY
AUSTRALIA

Telephone Number : + 61 2 99490200
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MANLY HYDRAULICS LABORATORY

110B King Street
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NSW DEPARTMENT
OF PUBLIC WORKS
AND SERVICES

Telephone 02 9949 0200
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8 January 2002

EDP8-00495

MACE
1/2A Pioneer Avenue
Thornleigh NSW 2120

Attention: Mr Brian Sayah

Laboratory Verification of Accuracy of MACE AgriFlo Series II Ultrasonic Flowmeter

Enclosed is the letter report on the Laboratory Verification of Accuracy of MACE AgriFlo Series II Ultrasonic Flowmeter undertaken by NSW DPWS - Manly Hydraulics Laboratory for Measuring and Control Equipment Company Pty Ltd on 12 December 2001.

Yours sincerely,

Peter Davidson
Manly Hydraulics Laboratory

Laboratory Verification of Accuracy of MACE 'AgriFlo' Series II Ultrasonic Flowmeter

Undertaken By NSW Public Works Department – Manly Hydraulics Laboratory

For

Measuring and Control Equipment Co. Pty Ltd

12 December 2001

Section 1 Equipment

Equipment to be Tested:

MACE AgriFlo, Ultrasonic Flowmeter, Series II

Transducer used: 2 inch 'BSP', Insert Type velocity sensor.

Equipment Brochure and Specification can be viewed in Attachment No. 1

Test Equipment:

ABB 250mm full bore Electromagnetic Flowmeter, MagMaster

Sensor Serial No. V/31122/35/1

Transmitter Serial No. VKEo61602

Meter Size: 250mm

Date Last Calibration: 20 August 2001

Accuracy verified to 1% of Original Certificate

Flowmeter Calibration and Flowmeter Calibration Verification Certificate can be viewed in Attachment No. 2

Pipe Type at MACE Installation:

Vinidex 300mm UPVC H.D. Stormwater pipe

Outside Diameter (OD): 315.5mm

Inside Diameter (ID): 304.1mm

Stilling Pool between MagMaster and AgriFlo:

Approximate dimensions: 7.2m * 7.2m * 1.2m deep.

Section 2 Methodology

Introduction

The purpose of the test was to verify the performance and accuracy of the MACE AgriFlo, Ultrasonic Flowmeter, Series II.

The testing took place on Wednesday 12 December 2001 at Manly Hydraulics Laboratory, King Street, Manly Vale, NSW, Australia.

The testing was limited to the 2 inch BSP insert type velocity transducer. The test was carried out for flow rates from 150 litres per second down to 30 litres per second. The AgriFlo meter was stable at a flowrate of zero.

Methodology

Water from Manly Dam travels through a 250mm closed UPVC conduit, via gravity means, into the stilling pool. The Electromagnetic flowmeter installed approximately 3m before the conduit feeds into the stilling pool.

A hand operated valve is used to release the flow into the pool.

The water settles as it flows into the stilling pool and into the pipe where the MACE AgriFlo is installed. At the end of the Vinidex pipe is a timber headwall designed to ensure the pipe can be kept full throughout the test.

The MACE AgriFlo was configured for the installation. The integration time was set to 15 seconds. The data was logged at 30 second intervals.

Seven tests, each around 10 minutes in duration, were carried out overall. Due to the stilling structure between the Electromagnetic Flowmeter and the MACE AgriFlo a reasonably long period of time lapsed between each test. The lag time was to allow for the flow to settle prior to commencement of each test.

The flowrate was taken to around 150l/s and then stepped down by increments of around 20l/s until a flow of 30l/s.

The Electromagnetic Flowmeter was set to display total flow and flowrate. The total flow readings were recorded at the start and finish of each test. The average flowrate over the 10 minute period was then derived.

The comparison of data was then carried out and is shown in the results section of this report. The raw data captured from the MACE AgriFlo are shown in Appendix A. Graphical results of the data are shown in Appendix B.

Section 3 Results

Results

Table 3.1 Electromagnetic Flowmeter Results and Calculated Average Flowrates

Test No.	Date	Start Time	Duration Seconds	Total Volume Litres	Average Flow Litres/Second
1	12/12/2001	11:16:00	611.73	92077	150.519
2	12/12/2001	11:45:30	611.48	80203	131.162
3	12/12/2001	12:08:00	610.52	67657	110.819
4	12/12/2001	12:29:00	613.83	54747	89.189
5	12/12/2001	12:58:00	630.67	44369	70.352
6	12/12/2001	13:17:00	608.96	30826	50.620
7	12/12/2001	13:48:00	608.84	18515	30.450

Table 3.2 Comparison of AgriFlo Measured Flow versus MagMaster Average Flow and Percentage Difference

Date	Time	AgriFlo Flowrate Litres/Sec	MagMaster Average Flowrate Litres/Sec	Percentage Difference
Test No.1				
12/12/2001	11:16:00	150.0	150.519	-0.345%
12/12/2001	11:16:30	149.0	150.519	-1.009%
12/12/2001	11:17:00	147.0	150.519	-2.338%
12/12/2001	11:17:30	150.0	150.519	-0.345%
12/12/2001	11:18:00	150.0	150.519	-0.345%
12/12/2001	11:18:30	151.0	150.519	0.320%
12/12/2001	11:19:00	151.0	150.519	0.320%
12/12/2001	11:19:30	151.0	150.519	0.320%
12/12/2001	11:20:00	151.0	150.519	0.320%
12/12/2001	11:20:30	150.0	150.519	-0.345%
12/12/2001	11:21:00	153.0	150.519	1.648%
12/12/2001	11:21:30	151.0	150.519	0.320%
12/12/2001	11:22:00	150.0	150.519	-0.345%
12/12/2001	11:22:30	148.0	150.519	-1.674%
12/12/2001	11:23:00	150.0	150.519	-0.345%
12/12/2001	11:23:30	153.0	150.519	1.648%
12/12/2001	11:24:00	151.0	150.519	0.320%
12/12/2001	11:24:30	151.0	150.519	0.320%
12/12/2001	11:25:00	150.0	150.519	-0.345%
12/12/2001	11:25:30	151.0	150.519	0.320%
12/12/2001	11:26:00	150.0	150.519	-0.345%
Test No.2				
12/12/2001	11:45:30	129.0	131.162	-1.648%
12/12/2001	11:46:00	127.0	131.162	-3.173%
12/12/2001	11:46:30	125.0	131.162	-4.698%
12/12/2001	11:47:00	128.0	131.162	-2.411%
12/12/2001	11:47:30	128.0	131.162	-2.411%
12/12/2001	11:48:00	127.0	131.162	-3.173%
12/12/2001	11:48:30	125.0	131.162	-4.698%
12/12/2001	11:49:00	128.0	131.162	-2.411%
12/12/2001	11:49:30	128.0	131.162	-2.411%
12/12/2001	11:50:00	126.0	131.162	-3.936%
12/12/2001	11:50:30	126.0	131.162	-3.936%
12/12/2001	11:51:00	129.0	131.162	-1.648%
12/12/2001	11:51:30	127.0	131.162	-3.173%
12/12/2001	11:52:00	127.0	131.162	-3.173%
12/12/2001	11:52:30	126.0	131.162	-3.936%
12/12/2001	11:53:00	125.0	131.162	-4.698%
12/12/2001	11:53:30	127.0	131.162	-3.173%
12/12/2001	11:54:00	127.0	131.162	-3.173%

12/12/2001	11:54:30	129.0	131.162	-1.648%
12/12/2001	11:55:00	128.0	131.162	-2.411%
12/12/2001	11:55:30	127.0	131.162	-3.173%
12/12/2001	11:56:00	128.0	131.162	-2.411%
Test No 3				
12/12/2001	12:08:00	111.0	110.819	0.163%
12/12/2001	12:08:30	112.0	110.819	1.066%
12/12/2001	12:09:00	111.0	110.819	0.163%
12/12/2001	12:09:30	111.0	110.819	0.163%
12/12/2001	12:10:00	111.0	110.819	0.163%
12/12/2001	12:10:30	110.0	110.819	-0.739%
12/12/2001	12:11:00	111.0	110.819	0.163%
12/12/2001	12:11:30	111.0	110.819	0.163%
12/12/2001	12:12:00	110.0	110.819	-0.739%
12/12/2001	12:12:30	109.0	110.819	-1.641%
12/12/2001	12:13:00	110.0	110.819	-0.739%
12/12/2001	12:13:30	109.0	110.819	-1.641%
12/12/2001	12:14:00	109.0	110.819	-1.641%
12/12/2001	12:14:30	109.0	110.819	-1.641%
12/12/2001	12:15:00	110.0	110.819	-0.739%
12/12/2001	12:15:30	111.0	110.819	0.163%
12/12/2001	12:16:00	111.0	110.819	0.163%
12/12/2001	12:16:30	110.0	110.819	-0.739%
12/12/2001	12:17:00	111.0	110.819	0.163%
12/12/2001	12:17:30	110.0	110.819	-0.739%
12/12/2001	12:18:00	110.0	110.819	-0.739%
Test No 4				
12/12/2001	12:29:00	90.0	89.189	0.909%
12/12/2001	12:29:30	90.0	89.189	0.909%
12/12/2001	12:30:00	90.0	89.189	0.909%
12/12/2001	12:30:30	90.0	89.189	0.909%
12/12/2001	12:31:00	88.0	89.189	-1.333%
12/12/2001	12:31:30	90.0	89.189	0.909%
12/12/2001	12:32:00	90.0	89.189	0.909%
12/12/2001	12:32:30	90.0	89.189	0.909%
12/12/2001	12:33:00	90.0	89.189	0.909%
12/12/2001	12:33:30	89.0	89.189	-0.212%
12/12/2001	12:34:00	91.0	89.189	2.031%
12/12/2001	12:34:30	90.0	89.189	0.909%
12/12/2001	12:35:00	90.0	89.189	0.909%
12/12/2001	12:35:30	90.0	89.189	0.909%
12/12/2001	12:36:00	90.0	89.189	0.909%
12/12/2001	12:36:30	89.0	89.189	-0.212%
12/12/2001	12:37:00	90.0	89.189	0.909%
12/12/2001	12:37:30	90.0	89.189	0.909%
12/12/2001	12:38:00	89.0	89.189	-0.212%
12/12/2001	12:38:30	90.0	89.189	0.909%
12/12/2001	12:39:00	90.0	89.189	0.909%

Test No:5				
12/12/2001	12:58:00	69.0	70.352	-1.922%
12/12/2001	12:58:30	69.0	70.352	-1.922%
12/12/2001	12:59:00	69.0	70.352	-1.922%
12/12/2001	12:59:30	70.0	70.352	-0.500%
12/12/2001	13:00:00	68.0	70.352	-3.343%
12/12/2001	13:00:30	69.0	70.352	-1.922%
12/12/2001	13:01:00	70.0	70.352	-0.500%
12/12/2001	13:01:30	69.0	70.352	-1.922%
12/12/2001	13:02:00	68.0	70.352	-3.343%
12/12/2001	13:02:30	68.0	70.352	-3.343%
12/12/2001	13:03:00	68.0	70.352	-3.343%
12/12/2001	13:03:30	69.0	70.352	-1.922%
12/12/2001	13:04:00	69.0	70.352	-1.922%
12/12/2001	13:04:30	69.0	70.352	-1.922%
12/12/2001	13:05:00	69.0	70.352	-1.922%
12/12/2001	13:05:30	70.0	70.352	-0.500%
12/12/2001	13:06:00	69.0	70.352	-1.922%
12/12/2001	13:06:30	69.0	70.352	-1.922%
12/12/2001	13:07:00	69.0	70.352	-1.922%
12/12/2001	13:07:30	69.0	70.352	-1.922%
12/12/2001	13:08:00	69.0	70.352	-1.922%
Test No:6				
12/12/2001	13:17:00	49.0	50.62	-3.200%
12/12/2001	13:17:30	50.0	50.62	-1.225%
12/12/2001	13:18:00	49.0	50.62	-3.200%
12/12/2001	13:18:30	50.0	50.62	-1.225%
12/12/2001	13:19:00	49.0	50.62	-3.200%
12/12/2001	13:19:30	46.0	50.62	-9.127%
12/12/2001	13:20:00	50.0	50.62	-1.225%
12/12/2001	13:20:30	48.0	50.62	-5.176%
12/12/2001	13:21:00	53.0	50.62	4.702%
12/12/2001	13:21:30	55.0	50.62	8.653%
12/12/2001	13:22:00	50.0	50.62	-1.225%
12/12/2001	13:22:30	51.0	50.62	0.751%
12/12/2001	13:23:00	52.0	50.62	2.726%
12/12/2001	13:23:30	50.0	50.62	-1.225%
12/12/2001	13:24:00	46.0	50.62	-9.127%
12/12/2001	13:24:30	50.0	50.62	-1.225%
12/12/2001	13:25:00	50.0	50.62	-1.225%
12/12/2001	13:25:30	47.0	50.62	-7.151%
12/12/2001	13:26:00	52.0	50.62	2.726%
12/12/2001	13:26:30	49.0	50.62	-3.200%
12/12/2001	13:27:00	50.0	50.62	-1.225%
Test No:7				
12/12/2001	13:48:00	29.0	30.45	-4.762%
12/12/2001	13:48:30	29.0	30.45	-4.762%
12/12/2001	13:49:00	29.0	30.45	-4.762%

12/12/2001	13:49:30	29.0	30.45	-4.762%
12/12/2001	13:50:00	29.0	30.45	-4.762%
12/12/2001	13:50:30	30.0	30.45	-1.478%
12/12/2001	13:51:00	30.0	30.45	-1.478%
12/12/2001	13:51:30	30.0	30.45	-1.478%
12/12/2001	13:52:00	29.0	30.45	-4.762%
12/12/2001	13:52:30	30.0	30.45	-1.478%
12/12/2001	13:53:00	29.0	30.45	-4.762%
12/12/2001	13:53:30	30.0	30.45	-1.478%
12/12/2001	13:54:00	30.0	30.45	-1.478%
12/12/2001	13:54:30	30.0	30.45	-1.478%
12/12/2001	13:55:00	30.0	30.45	-1.478%
12/12/2001	13:55:30	30.0	30.45	-1.478%
12/12/2001	13:56:00	29.0	30.45	-4.762%
12/12/2001	13:56:30	29.0	30.45	-4.762%
12/12/2001	13:57:00	30.0	30.45	-1.478%
12/12/2001	13:57:30	30.0	30.45	-1.478%
12/12/2001	13:58:00	30.0	30.45	-1.478%

Discussion of Results

Generally the results indicate that the MACE AgriFlo Ultrasonic Flowmeter, Series II tended to understate flowrate slightly over the seven tests carried out.

The percentage difference as an average was highest during Test No.2. The average error for Test No.2 was -3.069%. The negative sign means the AgriFlo was understating.

The smallest error was recorded during Test No. 1. The average error for Test No.1 was +0.092%.

The results can be summarised by perusing the table below:

Table 3.3 Comparison of AgriFlo Average Flow versus MagMaster Average Flow and Percentage Difference

Test No.	AgriFlo Average Flowrate (l/s)	MagMaster Average Flowrate (l/s)	Percentage Difference
1	150.381	150.519	-0.092
2	127.136	131.162	-3.069
3	110.333	110.819	-0.438
4	89.809	89.189	0.696
5	68.950	70.352	-1.993
6	49.810	50.620	-1.601
7	29.571	30.450	-2.885

Section 4 Conclusion

From the tests carried out on 12 December 2001 and the results presented in this report we can conclude that the overall average accuracy, for the test undertaken, of the MACE AgriFlo Ultrasonic Flowmeter, Series II is +/- 1.34%.

Appendix A – AgriFlo Downloaded Data

!Program	FloCom	2.0.0.3			
!Download	Start	12/12/2001	14:58:24		
!Ident					
!SerialNo	10709				
!Version	300	142			
!Logger	Time	12/12/2001	13:58:22		
!Logger	temperature	29.8			
!					
!Channels	3				
!Names		Velocity	Primary depth	Flow rate	
!Units		m/s	m	l/s	
!					
!Total		flow	units	l	
!					
!Battery	OK	6.31V			
!Points	183				
!					
!Interval	30				
12/12/2001	11:16.00	*Note	Host comms. end	Unit restarted	
12/12/2001	11:16:00	2.118	1.8	150.000	
12/12/2001	11:16:30	2.104	1.8	149.000	
12/12/2001	11:17:00	2.079	1.8	147.000	
12/12/2001	11:17:30	2.122	1.8	150.000	
12/12/2001	11:18:00	2.129	1.8	150.000	
12/12/2001	11:18:30	2.14	1.8	151.000	
12/12/2001	11:19:00	2.14	1.8	151.000	
12/12/2001	11:19:30	2.14	1.8	151.000	
12/12/2001	11:20:00	2.136	1.8	151.000	
12/12/2001	11:20:30	2.125	1.8	150.000	
12/12/2001	11:21:00	2.161	1.8	153.000	
12/12/2001	11:21:30	2.14	1.8	151.000	
12/12/2001	11:22:00	2.118	1.8	150.000	
12/12/2001	11:22:30	2.097	1.8	148.000	
12/12/2001	11:23:00	2.125	1.8	150.000	
12/12/2001	11:23:30	2.158	1.8	153.000	
12/12/2001	11:24:00	2.143	1.8	151.000	
12/12/2001	11:24:30	2.14	1.8	151.000	
12/12/2001	11:25:00	2.122	1.8	150.000	
12/12/2001	11:25:30	2.14	1.8	151.000	
12/12/2001	11:26:00	2.129	1.8	150.000	
12/12/2001	11:26:45	*Note	Host comms. start		
12/12/2001	11:34:15	*Note	Host comms. end		
12/12/2001	11:34:30	1.961	1.8	139.000	
12/12/2001	11:35:00	2.004	1.8	142.000	
12/12/2001	11:35:30	1.986	1.8	140.000	
12/12/2001	11:36:00	1.961	1.8	139.000	
12/12/2001	11:36:30	1.964	1.801	139.000	
12/12/2001	11:37:00	*Note	Host comms. start		

12/12/2001	11:45:15	*Note		Host comms. end	Unit restarted
12/12/2001	11:45:30		1.829	1.801	129.000
12/12/2001	11:46:00		1.797	1.8	127.000
12/12/2001	11:46:30		1.772	1.801	125.000
12/12/2001	11:47:00		1.804	1.8	128.000
12/12/2001	11:47:30		1.808	1.801	128.000
12/12/2001	11:48:00		1.794	1.8	127.000
12/12/2001	11:48:30		1.765	1.801	125.000
12/12/2001	11:49:00		1.815	1.8	128.000
12/12/2001	11:49:30		1.808	1.8	128.000
12/12/2001	11:50:00		1.776	1.801	126.000
12/12/2001	11:50:30		1.783	1.8	126.000
12/12/2001	11:51:00		1.822	1.801	129.000
12/12/2001	11:51:30		1.79	1.8	127.000
12/12/2001	11:52:00		1.79	1.8	127.000
12/12/2001	11:52:30		1.783	1.801	126.000
12/12/2001	11:53:00		1.762	1.8	125.000
12/12/2001	11:53:30		1.797	1.8	127.000
12/12/2001	11:54:00		1.797	1.8	127.000
12/12/2001	11:54:30		1.826	1.801	129.000
12/12/2001	11:55:00		1.811	1.801	128.000
12/12/2001	11:55:30		1.801	1.801	127.000
12/12/2001	11:56:00		1.815	1.8	128.000
12/12/2001	11:56:30		1.797	1.801	127.000
12/12/2001	11:57:00		1.797	1.801	127.000
12/12/2001	11:57:30		1.794	1 801	127.000
12/12/2001	11:57:45	*Note		Host comms. start	
12/12/2001	12:07:30	*Note		Host comms. end	Unit restarted
12/12/2001	12:08:00		1.574	1.801	111.000
12/12/2001	12:08:30		1.578	1.801	112.000
12/12/2001	12:09:00		1.564	1.801	111.000
12/12/2001	12:09:30		1.567	1.801	111.000
12/12/2001	12:10:00		1.567	1.801	111.000
12/12/2001	12:10:30		1.56	1.801	110.000
12/12/2001	12:11:00		1.567	1.801	111.000
12/12/2001	12:11:30		1.571	1.8	111.000
12/12/2001	12:12:00		1.556	1.801	110.000
12/12/2001	12:12:30		1.546	1.801	109.000
12/12/2001	12:13:00		1.553	1.801	110.000
12/12/2001	12:13:30		1.546	1.801	109.000
12/12/2001	12:14:00		1.546	1.801	109.000
12/12/2001	12:14:30		1.542	1.8	109.000
12/12/2001	12:15:00		1.549	1.8	110.000
12/12/2001	12:15:30		1.571	1.801	111.000
12/12/2001	12:16:00		1.574	1.801	111.000
12/12/2001	12:16:30		1.56	1.801	110.000
12/12/2001	12:17:00		1.567	1.801	111.000
12/12/2001	12:17:30		1.549	1.8	110.000
12/12/2001	12:18:00		1.549	1.8	110.000
12/12/2001	12:18:30		1.567	1.801	111.000

12/12/2001	12:19:15	*Note		Host comms. start	
12/12/2001	12:28:30	*Note		Host comms. end	Unit restarted
12/12/2001	12.29:00		1 267	1.801	90.000
12/12/2001	12:29:30		1.267	1.802	90.000
12/12/2001	12:30:00		1.274	1.801	90.000
12/12/2001	12:30:30		1.27	1.802	90.000
12/12/2001	12:31:00		1.249	1.801	88.000
12/12/2001	12:31:30		1.274	1.801	90.000
12/12/2001	12:32:00		1.27	1.802	90.000
12/12/2001	12:32:30		1.274	1.802	90.000
12/12/2001	12:33:00		1.27	1.802	90.000
12/12/2001	12:33:30		1.252	1.801	89.000
12/12/2001	12:34:00		1.288	1.801	91.000
12/12/2001	12:34:30		1.267	1.802	90.000
12/12/2001	12:35:00		1.274	1.801	90.000
12/12/2001	12:35:30		1.267	1.801	90.000
12/12/2001	12:36:00		1.274	1.802	90.000
12/12/2001	12:36.30		1.259	1.801	89.000
12/12/2001	12:37:00		1.274	1.802	90.000
12/12/2001	12:37:30		1.277	1 802	90.000
12/12/2001	12:38:00		1.259	1.801	89.000
12/12/2001	12.38:30		1.267	1.802	90 000
12/12/2001	12:39:00		1.274	1.801	90.000
12/12/2001	12:39:30		1.263	1.801	89.000
12/12/2001	12:40:00		1.263	1.801	89.000
12/12/2001	12:40:30		1.259	1.802	89.000
12/12/2001	12:41:00		1.277	1.801	90.000
12/12/2001	12:41:30		1.27	1.802	90.000
12/12/2001	12:42:00		1.274	1.802	90.000
12/12/2001	12:42:30		1.217	1.801	86.000
12/12/2001	12:43:00		1.027	1.801	73.000
12/12/2001	12:43:30	*Note		Host comms. start	
12/12/2001	12:55:30	*Note		Host comms. end	Unit restarted
12/12/2001	12.56:00		0.998	1.802	71.000
12/12/2001	12:56:30		0.984	1.801	70.000
12/12/2001	12:57:00		0.973	1.802	69.000
12/12/2001	12:57:30		0.98	1.802	69.000
12/12/2001	12:58:00		0.97	1.802	69.000
12/12/2001	12:58:30		0.973	1.801	69.000
12/12/2001	12:59:00		0.973	1.802	69.000
12/12/2001	12:59:30		0.988	1.802	70.000
12/12/2001	13:00:00		0.966	1.802	68.000
12/12/2001	13:00:30		0.98	1.802	69.000
12/12/2001	13:01:00		0.991	1.802	70.000
12/12/2001	13:01:30		0.973	1.802	69.000
12/12/2001	13:02:00		0.963	1.802	68.000
12/12/2001	13.02:30		0.966	1.802	68.000
12/12/2001	13:03:00		0.963	1.802	68.000
12/12/2001	13:03.30		0.973	1.802	69.000
12/12/2001	13:04:00		0.98	1.802	69.000

12/12/2001	13:04:30		0.973	1.802	69.000
12/12/2001	13:05:00		0.977	1.802	69.000
12/12/2001	13:05:30		0.984	1.802	70.000
12/12/2001	13:06:00		0.97	1.802	69.000
12/12/2001	13:06:30		0.973	1.802	69.000
12/12/2001	13:07:00		0.977	1.802	69.000
12/12/2001	13:07:30		0.97	1.802	69.000
12/12/2001	13:08:00		0.977	1.802	69.000
12/12/2001	13:08:30		0.97	1.802	69.000
12/12/2001	13:09:00		0.991	1.802	70.000
12/12/2001	13:09:30		0.98	1.801	69 000
12/12/2001	13:10:00		0.977	1.802	69.000
12/12/2001	13:10:15	*Note		Host comms. start	
12/12/2001	13:15:45	*Note		Host comms. end	Unit restarted
12/12/2001	13:16:00		0.719	1.801	51.000
12/12/2001	13:16:30		0.712	1.801	50.000
12/12/2001	13:17:00		0.691	1.802	49.000
12/12/2001	13:17:30		0.708	1.802	50.000
12/12/2001	13:18:00		0.698	1.801	49.000
12/12/2001	13:18:30		0.708	1.802	50.000
12/12/2001	13:19:00		0.698	1.801	49.000
12/12/2001	13:19:30		0.655	1.801	46.000
12/12/2001	13:20:00		0.708	1.802	50.000
12/12/2001	13:20:30		0.683	1.802	48.000
12/12/2001	13:21:00		0.748	1.801	53.000
12/12/2001	13:21:30		0.784	1.801	55.000
12/12/2001	13:22:00		0.701	1.801	50.000
12/12/2001	13:22:30		0.719	1.802	51.000
12/12/2001	13:23:00		0.734	1.802	52.000
12/12/2001	13:23:30		0.701	1.801	50.000
12/12/2001	13:24:00		0.655	1.802	46.000
12/12/2001	13:24:30		0.701	1.802	50.000
12/12/2001	13:25:00		0.708	1.802	50.000
12/12/2001	13:25.30		0.666	1.802	47.000
12/12/2001	13:26:00		0.741	1.801	52.000
12/12/2001	13:26:30		0.687	1.802	49.000
12/12/2001	13.27:00		0.705	1.802	50.000
12/12/2001	13:27:30		0.215	1.801	48.000
12/12/2001	13:28:00		0.705	1.801	50.000
12/12/2001	13:28:30		0.666	1.801	47.000
12/12/2001	13.29:00		0.712	1.801	50.000
12/12/2001	13:29:30		0.687	1.802	49.000
12/12/2001	13:30:00		0.687	1.801	49.000
12/12/2001	13:30:30	*Note		Host comms. start	
12/12/2001	13:47:00	*Note		Host comms. end	Unit restarted
12/12/2001	13:47:00		0.414	1.801	29.000
12/12/2001	13:47:30		0.415	1.801	29.000
12/12/2001	13:48:00		0.406	1.802	29.000
12/12/2001	13:48:30		0.409	1.802	29.000
12/12/2001	13:49:00		0.414	1.801	29.000

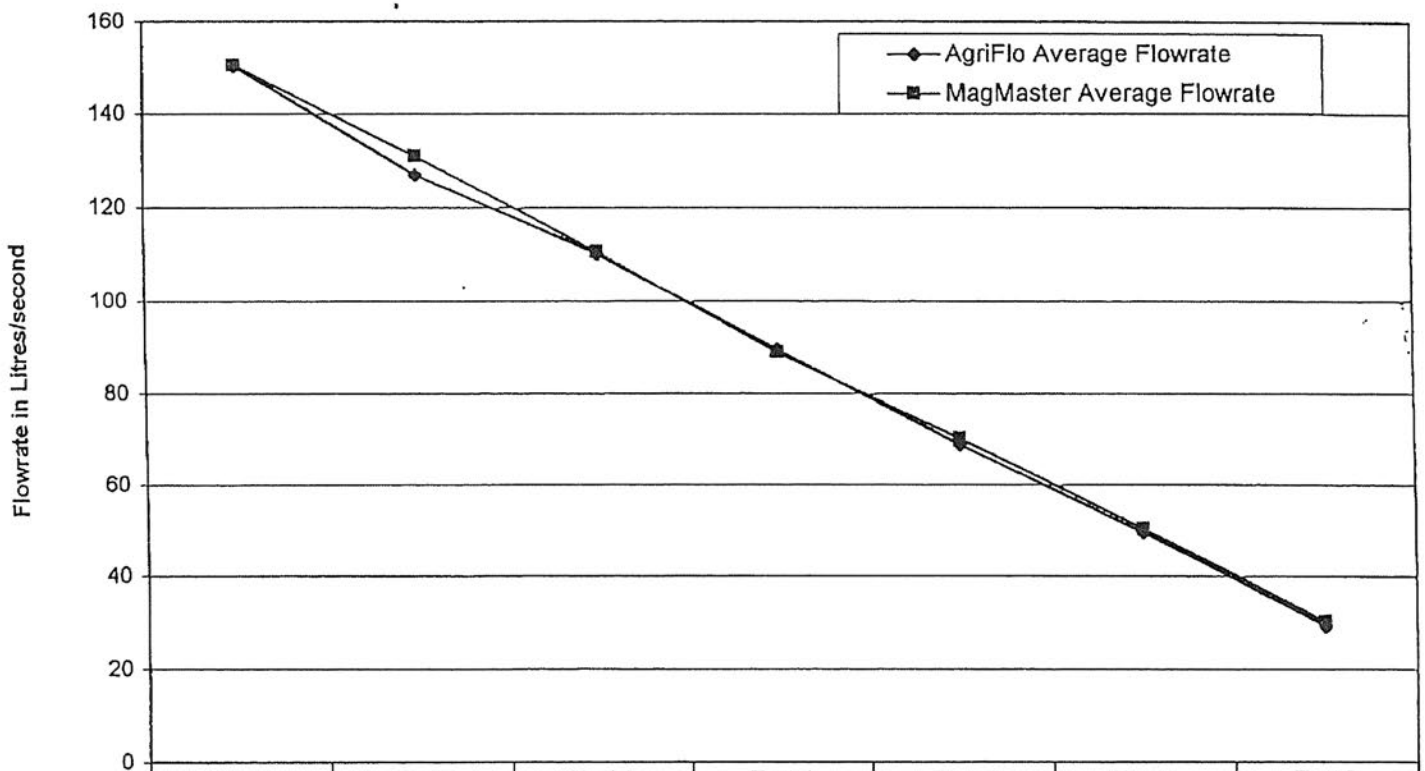
12/12/2001	13:49:30		0.416	1.802	29.000
12/12/2001	13:50:00		0.415	1.802	29.000
12/12/2001	13:50:30		0.419	1.801	30.000
12/12/2001	13:51:00		0.417	1.802	30.000
12/12/2001	13:51:30		0.419	1.802	30.000
12/12/2001	13:52:00		0.415	1.802	29.000
12/12/2001	13:52:30		0.421	1.802	30.000
12/12/2001	13:53:00		0.414	1.801	29.000
12/12/2001	13:53:30		0.424	1.802	30.000
12/12/2001	13:54:00		0.426	1.801	30.000
12/12/2001	13:54:30		0.423	1.801	30.000
12/12/2001	13:55:00		0.422	1.802	30.000
12/12/2001	13:55:30		0.426	1.802	30.000
12/12/2001	13:56:00		0.406	1.802	29.000
12/12/2001	13:56:30		0.407	1.802	29.000
12/12/2001	13:57:00		0.422	1.801	30.000
12/12/2001	13:57:30		0.424	1.801	30.000
12/12/2001	13:58:00		0.42	1.802	30.000
12/12/2001	13:58:15	*Note		Host comms. start	

!

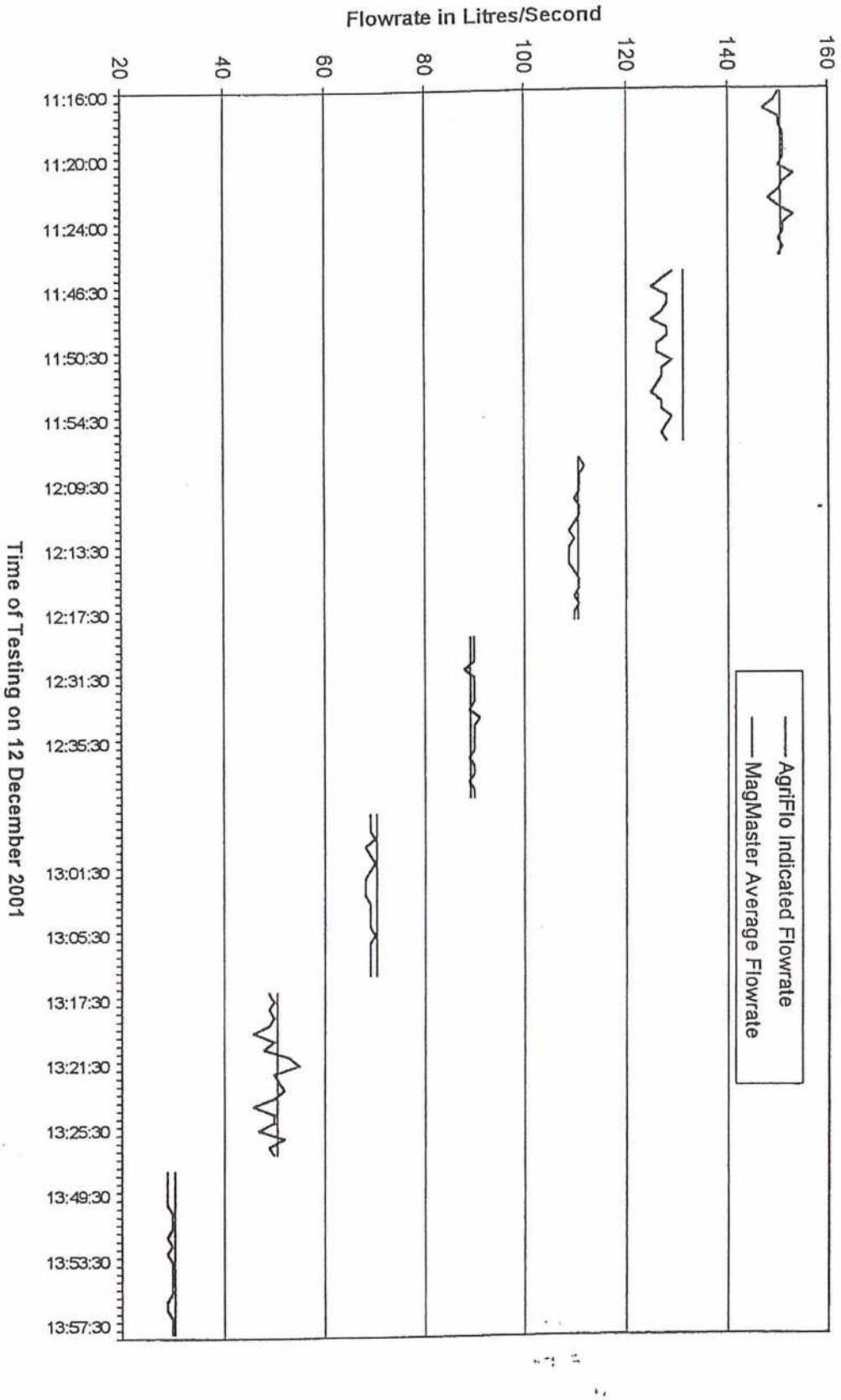
!Download End 12/12/2001 14:58:26

Appendix B – Graphical Results

MACE AgriFlo Test - Average Flow Comparison

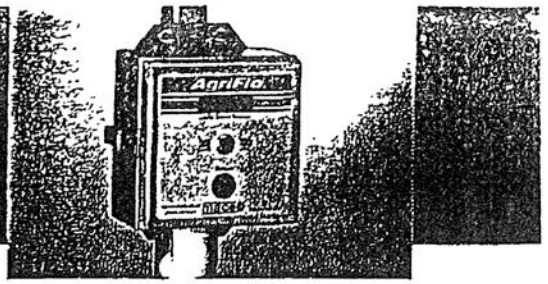


	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7
AgriFlo Average Flowrate	150.381	127.136	110.333	89.809	68.950	49.810	29.571
MagMaster Average Flowrate	150.519	131.162	110.819	89.189	70.352	50.620	30.450



Attachment No. 1 – AgriFlo Specification

AgriFlo Specifications



GENERAL

Size:	200 mm (W) x 200 mm (H) x 125 mm (D)
Weight:	6 Kg
Enclosure Rating:	IP - 66
Enclosure Material:	316 Stainless Steel
Operating temperature:	-5 to +50 degrees Celsius
Flow Display:	Internal 6 digit 12 mm liquid crystal display of total flow & flow rate (switchable).
Program Memory:	Battery backed NVRAM
Power:	Internal 6 Volt 12Ah Battery with external solar panel or 240V charger
Units of Measure:	User definable (in metric units)
Application Software:	FloCom® PC software for system configuration, data downloading & velocity profile testing.
Flow logging Capacity:	Configuration dependent (to a maximum of approximately 28,000 records).
Flashing Flow Indicator:	High-Intensity LED light flashes proportional to flow rate (user configurable)
Factory Backup	AgriFlo is backed by a 12 months parts and labour guarantee

STRAP MOUNT TRANSDUCER (VELOCITY ONLY)

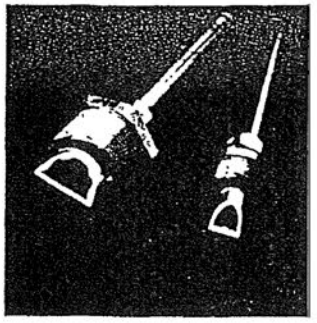
Dimensions:	125 mm length x 50 mm wide x 16 mm high
Pipe intrusion area:	8 cm^2
Method:	Submerged Ultrasonic Doppler
	± 0.025 m/sec to ± 4.0 m/sec (± 8 0 m/sec Optional)
Resolution:	1 mm at 1 0 m/sec
Accuracy:	± 1% at 1.0 m/sec
Sensor cable:	PVC 9 mm diameter up to 50 meters long

COMMUNICATIONS

PC Interface:	On site direct PC via RS232 serial port
Optional:	Radio, Telemetry or GSM. 4-20mA Output

INSERT TRANSDUCER (VELOCITY ONLY)

Shaft dimensions:	400 mm long x 20 mm diameter
Head dimensions:	45mm diam. x 25mm high (2" BSP thread) OR 20mm diam x 20mm high (1" BSP thread)
Pipe intrusion area:	11.25cm^2 (2" BSP) & 4cm^2 (1" BSP)
Method:	Submerged Ultrasonic Doppler
Range:	± 0.025 m/sec to ± 4.0 m/sec (± 8.0 m/sec Optional)
Resolution:	1 mm at 1.0 m/sec
Accuracy:	± 1% at 1.0 m/sec
Sensor cable:	PVC 9 mm diameter up to 50 meters long



Measuring & Control Equipment Co. Pty. Ltd.
ACN 004 740 863
1/2A Pioneer Avenue, Thornleigh NSW 2120
(P.O. Box 911, Pennant Hills NSW 1715)
Tel: (02) 9980-2692 Fax: (02) 9980-2651
www.macequip.com.au

Flowmeter Calibration Verification Certificate

Customer	NSW DEPT OF PUBLIC WORKS - MANLY
Date Performed	Monday 20 August 2001 12:26
Date Certificate Printed	Tuesday 21 August 2001 08:55

Site Details

Location	NSW
Tag	**********
Operator	S Chesworth

Results :

Transmitter Zero	Pass
Transmitter Span	Pass
Transmitter Pulse Output	Pass
Transmitter Analogue Output	Pass
Sensor Electrode Integrity	Pass
Sensor Energising Coil Integrity	Pass

Declared "Don't Know" pipe status appears to be FULL.

Accuracy :

The above tests and results verify that the flowmeter is functioning within normal working limits, and is within ±1% of original calibration certificate.

Transmitter Settings

Sensor Calibration Factor	1.2710/0/5/1.000
Flow Range	200.0 l/s
Response Time Constant	3 seconds
Probe Factors	ins 1.00000, prof 1.00000
Analogue Output	4-20 Forward
Second Analogue Range	100.0% (200.0 l/s)
Pulse Output	1.00000 pulses/l
Totaliser Units	l

Calmaster Details

Instrument, Serial No.	CM0001, x/10092/01/01
Last Calibrated	Fri 20 Oct 2000
Next Calibration Date	Sat 20 Oct 2001
Firmware Version	CalMaster v1.0 36/96
PC Software Version	v2.10 18/01/2000 (F-ena)
DVM Serial No.	
Resistor Serial No.	(Not Used)

Flowmeter Details

Type	MagMaster, Electromagnetic
Sensor S/No.	V/31122/35/1
Transmitter S/No.	VKE061602
Tag No.	**********
Meter Size	250 mm

CalMaster is fully traceable to National and International Standards.
For details please refer to CalMaster Traceability Documentation.

ABB Instrumentation World Flow Technology Centres

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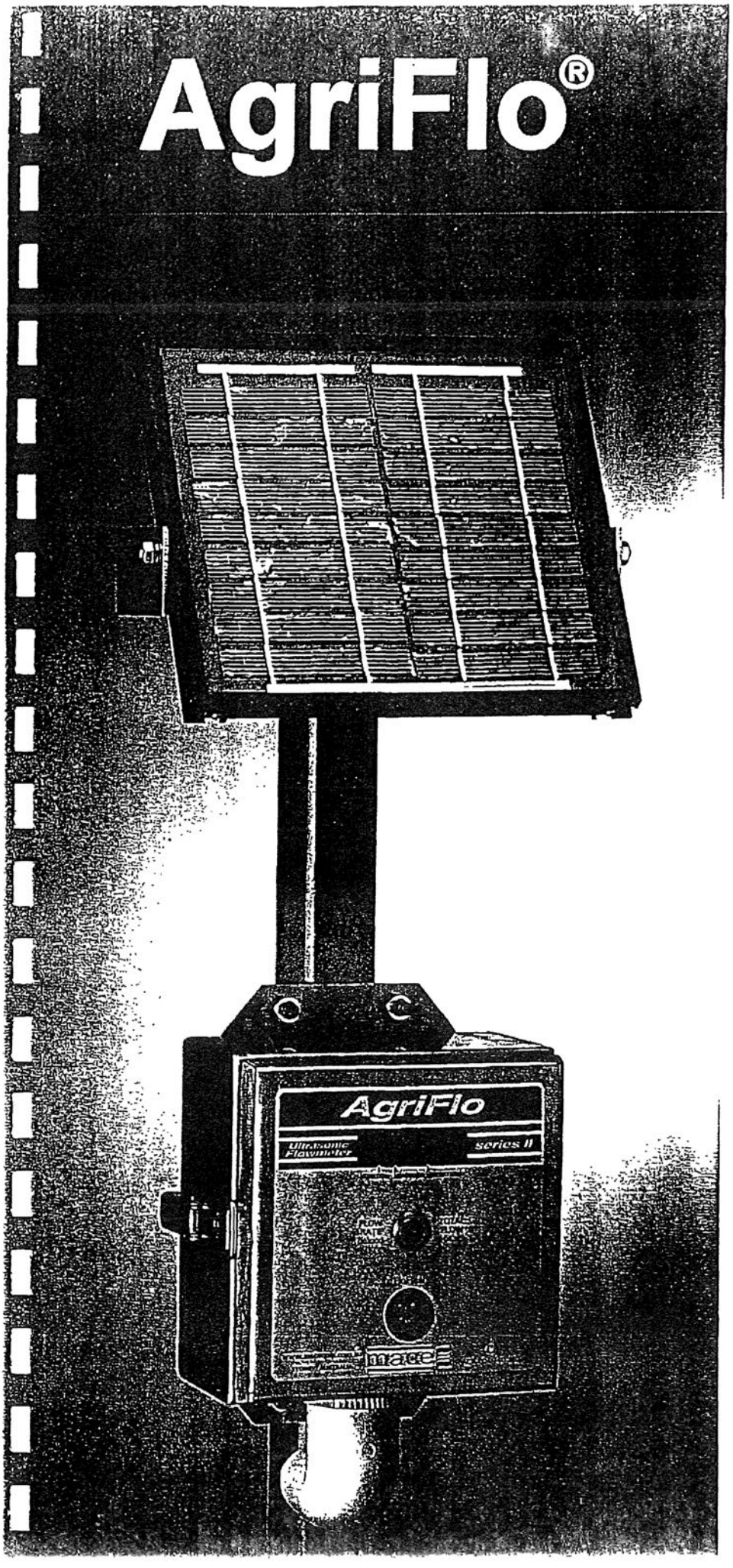
Attachment No. 2 – MagMaster Calibration Certificate



Irrigation Flow Meter

Recognizing the ever-increasing need fc better flow metering in the irrigatio industry, MACE designed and tailor-mad a meter purely for agricultural use.Th MACE AgriFlo is the only flow meter of it kind on the market anywhere in the worlc The instrument is easy to install, easy t use and virtually maintenance free.

Unlike conventional flow meters, AgriFl has **no moving parts and provide minimal obstruction to the flow.** Thi means that the meter stays in servic longer without time-consuming repairs.

The all-new AgriFlo has been designec for functional field use by both irrigator and irrigation supply companies A dua password system allows irrigator acces to flow data, without compromising the integrity of the meter. The AgriFlo case can be padlocked for added security.

Unlike conventional flow meters, AgriFlc gives better than 2% accuracy, even a stream velocities of up to 8 metres pe second!! Imagine a propeller meter lasting more than a few minutes at that speed!!

- Weatherproof, stainless steel case
- Display of total flow and flow rate
- High-intensity flashing flow rate indicator
- Push button for real - time flow rate display
- Vandal resistant design
- Standard flow data logger
- No measurable head loss
- Modular construction for easy servicing & installation

mace

The force in flow.

Attachment No. 2 – MagMaster Calibration Certificate

Flowmeter Calibration Certificate

ABB Instrumentation Pty Limited
ACN 004 224 953

Head Office
70-78 Box Road Caringbah NSW Australia
PO Box 2083 Taren Point NSW 2229 Australia
Telephone (02) 9540 0000
Fax (02) 9540 0001

This laboratory is registered by the National Association of Testing Authorities, Australia. The tests reported herein have been performed in accordance with its terms of registration.

Customer:	NSW Department Of Public Works, Manly					**Our Ref:**	O115414
Order No:	159627			**Item No:**	1	**Job No:**	J47938
Report No:	2677/99	**Test Date:**	15/02/99	**Level:**	0	**Issue No:**	1	**Issue Date:**	17/02/99

FLOWMETER PRIMARY DATA:

Make: ABB **Type:** Electromagnetic **Size:** 250mm
Code/Model No: Water & Waste MagMaster **Serial No:** V/31122/35/1
Specified Flow Range: 200 L/s **Process Connections:** Flanges
Other Details: F1: 1.271 F2: 0 F3: 5 F4: 1.0000

FLOWMETER SECONDARY DATA:

Make: ABB **Type:** Transmitter **Output:** Pulses
Code/Model No: Water & Waste MagMaster **Serial No:** V/31122/35/1

CALIBRATION DATA:

Range of Calibration: 20...200 L/s **Test Rig No:** 2 **Calibration Procedure:** EDM095
Method: Comparison & Volumetric **Water Temp:** 27 Deg C **Density:** 996.5 kg/m³
Other Details: Tests 1 to 5: using comparison method. Test 6: using volumetric method.

CALIBRATION RESULTS:

Test No	Nominal % of Maximum Flowrate	Measured Quantity Litres	Indicated Quantity Litres	Error %
1	100	60438	60424	- 0.02
2	80	32472	32481	+ 0.03
3	60	32696	32668	- 0.09
4	50	30948	30901	- 0.15
5	25	21317	21292	- 0.12
6	10	15043	15011	- 0.22

Measurement Uncertainty: ±0.25% of measured quantity or ±60L, whichever is greater.

Calibrated by: G Ashcroft **Certified by:** P J Parsons
Position: Calibrator **Position:** Supervisor

Signature: ..... **Signature:** .....

J47938.doc

MACE AgriFlo® Flowmeter Specifications, and Guidelines for Installation & Maintenance

Measuring & Control Equipment (MACE)
Unit 1/2A Pioneer Avenue
THORNLEIGH NSW 2120
PH (02) 9980 2692
Fax (02) 9980 2651

PREAMBLE

MACE is a wholly Australian owned company, established in 1968, serving the environmental monitoring market. As a major hydrographic instrument supplier to water authorities in Australia, MACE is proud of its history and service and is committed to the provision of high technology equipment for the water and sewer monitoring market. This is achieved through excellence of design, engineering and service.

In 1973 MACE introduced its first ultra-low powered electronic instrument and since that time has been committed to Research & Development of the most advanced range of data loggers and hydrological measurement systems in the world.

Locally manufactured, MACE produces equipment, which withstands the test of time for performance, reliability and durability, even in the harshest environmental conditions. MACE has been quality certified by NATA to ISO9002 for the manufacture and supply of environmental measuring and control equipment since 1991.

MACE released its first Doppler ultrasonic flow monitoring family in 1987. Since that time, well over 1500 units have been sold in the Australian water and wastewater industries. Typical monitoring applications for MACE flow equipment are: sewer flow; sewer treatment plant stations; stormwater flow, irrigation flow and industrial "point of discharge". These applications have meant that MACE has had to design equipment capable of not only recording accurate and repeatable data but also surviving, under the harshest conditions.

The MACE AgriFlo is an ultrasonic flowmeter that utilises the Doppler Effect to measure the average velocity of stream flows in pipes and open channels.

Unlike mechanical flowmeters, the MACE AgriFlo has no moving parts. This means a considerably safer workplace in some irrigation systems. Furthermore, because the AgriFlo provides minimal obstruction to the flow, irrigation water is delivered through outlets with minimal losses and degradation to channels and other supply structures. A single ultrasonic velocity sensor is capable of being used in pipes ranging from 0.15 m diameter through to 2 m diameter with better than 2 % accuracy at stream velocities up to 4 m/s (optional 8 m/s).

The MACE AgriFlo gives a real-time display of cumulative total and instantaneous flow rate as well as recording historical flow data with enough memory (battery backed) for several irrigation seasons.

This paper outlines the specifications of the MACE AgriFlo as well as providing guidelines for its installation and maintenance.

METER SPECIFICATION:

The AgriFlo® Flowmeter electronics are housed in an enclosure made of 316 Stainless Steel with an IP66 weatherproof rating. The flowmeter has a six digit local Liquid Crystal Display (LCD) with readouts of both Total Flow (in SI units) and Instantaneous Flow in user configurable units (e.g. ML / day). The AgriFlo has an inbuilt, high-intensity light which, when enabled, flashes proportional to volume of flow. The instrument also has an inbuilt flow recorder with enough memory for several seasons' worth of data. The AgriFlo® Flowmeter has the ability to be configured for external communication to a telemetry system for remote data access.

The AgriFlo® Flowmeter has been specifically designed for use in irrigation applications. As such, the meter has been tamper-proofed using both mechanical and electronic features. The meter electronics can be padlocked and the sensor sealed at the time of installation using a MACE SensorLok Seal. Electronically, the meter monitors the status of its power supply and velocity sensor and can be interrogated if it is suspected that the solar panel or sensor has been tampered with. Furthermore, it can only be interrogated if the user has access to the password. A duel password system means that the irrigator can access data without accessing important instrument information.

The AgriFlo® Flowmeter has an internal lead-acid gel cell rechargeable battery (6 Volt 10Ah), which is recharged using either a 5 Watt 6Volt solar panel or 240 Volt trickle charger. Typical battery life without charging is dependent on measuring frequency and is between 1 and 12 weeks.

As stated above MACE have been designing and manufacturing flowmeters for use in some of the harshest known environments. The insert velocity sensor used by the AgriFlo® is constructed of corrosion resistant Nickel-plated brass and epoxy. The sensor provides only 11.25 cm^2 obstruction to the flow in the pipe and has a debris shedding design to overcome high trash contents in the stream flow. Pumped flows with high loads of sand/silt can lead to erosion of some sensors, particularly plastic types. Since AgriFlo® is able to measure reverse flows, overcoming the problem is simply a matter of turning the sensor around so that the erosion resistant metal is facing the flow. A single velocity sensor can be used in pipes of diameters ranging from 150 mm to 2 metres. For pipes where the body of the pipe is not accessible, MACE manufacture a second "mouse" type velocity sensor fabricated from PVC. For pipes that run only partially full, MACE has developed a transducer which houses both a velocity sensor and a large surface area depth sensor

The MACE AgriFlo® Flowmeter is capable of measuring flows with velocities of ±0.025 m/s up to ±4 m/s. Accuracies of ±2% (full pipe) and ±5% (partially full pipe) are achievable under most site conditions. However, due to the enormous variations that are possible in flow conditions at different sites, these accuracies cannot be guaranteed for all sites. Under difficult site conditions, typical accuracies are in the vicinity of ±4 to ±10%.

METER INSTALLATION

Electronics

The meter electronics that are housed in a 316 SS enclosure are typically either mounted on a pole or on a wall within a pump shed. The enclosure is fixed using either the supplied pole or wall mount fitting using suitable sized bolts (M10 or M12). The front of the enclosure is positioned so that the flashing light (if enabled) is focussed at the correct location.

Solar Panel

The 5 Watt 6 volt solar panel is mounted to the same pole as the meter electronics using the supplied pole mounting kit at a position facing North.

Velocity Sensor

The velocity sensor used by the MACE AgriFlo is installed in a position where a length of 8 straight diameters of pipe exists. For example, if mounting the sensor in a pipe of 300 mm diameter a total of 2.4 m of straight pipe is necessary for optimal performance. The sensor is mounted so that 6 straight diameters are facing the front of the sensor and at least 2 straight diameters at the back of the sensor. Because the AgriFlo can measure forward or reverse flows, it does not matter which way the sensor is faced (i.e. either up or down stream).

Two different sensor types are available for different installations. Where the body of the pipe is exposed (or easily exposable) an insert sensor may be used. This type of sensor is typically used in the majority of sites. MACE also manufacture a sensor which is attached to the *inside* of the pipe (plate mount sensor). This sensor is typically used in those pipes where it is not feasible to expose the pipe. For example in diversions where the pipe is several metres underground or where a road traverses across the pipe. Access to the toe of the pipe is required for mounting a plate mount sensor.

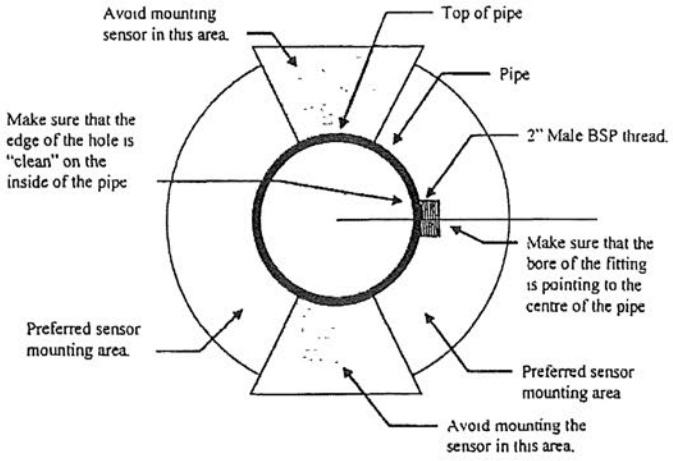


Figure 1. Where to mount an AgriFlo velocity sensor

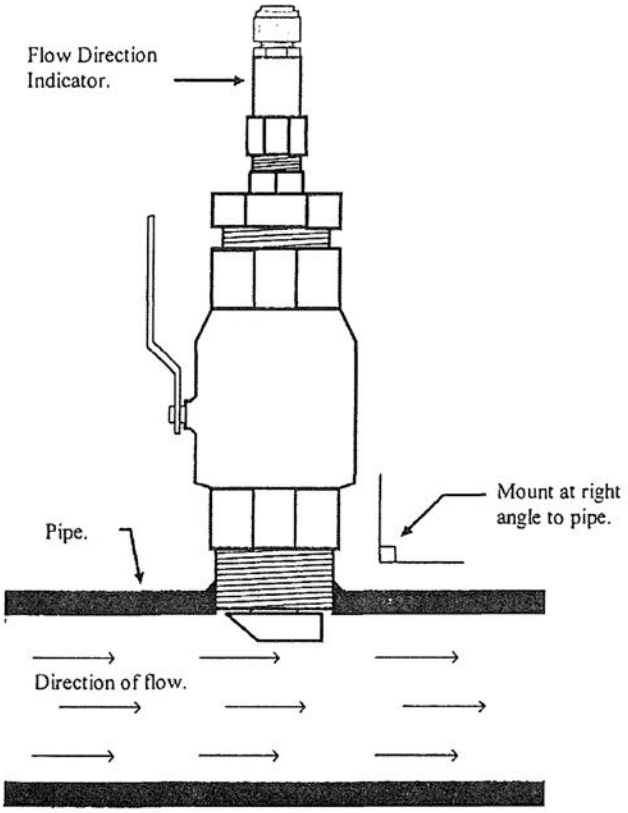


Figure 2. Example of insertion sensor correctly mounted in pipe

Cabling

MACE recommends that the velocity cable be routed through conduit (50 mm). The conduit is attached to the mounting pole and thence to the conduit fitting at the bottom of the SS electronics enclosure. The solar panel cable may be routed through the mounting pole.

METER MAINTENANCE

The AgriFlo flowmeter requires little maintenance once installed. The lead-acid gel cell battery inside the electronics enclosure will not need replacing for several years (5-10 years depending on the frequency of complete discharge). Since the AgriFlo monitors its power supply, an early warning indicator of low battery power is provided on the LCD readout. When the low battery indicator becomes visible, this acts as a reminder to check for damage to the solar panel and/or its cable, or merely that the panel requires cleaning.

The velocity sensor may require cleaning occasionally. The frequency of cleaning is dependent on the trash load within the stream flow. In the majority of sites, the sensor will not require cleaning for several seasons.

COSTS FOR SUPPLY, INSTALLATION & COMMISSIONING

Installation & Commissioning

Installation and commissioning of a MACE AgriFlo typically takes 1.5 to 2 hours depending on the site and given that the correct tools are available for use. For correct commissioning of the instrument, a stream flow is required for approximately 15 minutes to ensure the system configuration settings are correct.

Materials required for installation:

1. Mounting pole (usually 2" galvanised water pipe)
2. Concrete for pole fixing
3. 50 mm conduit (length dependent on site)
4. 50 mm conduit fittings (assorted elbows, T-pieces etc.)
5. 2" BSP nipple, 2" BSP ball valve (optional), thread sealant etc.
6. Assorted fixings, pipe saddles, cable ties etc.

Supply of Flowmeters

MACE AgriFlo FLOWMETER

Type:	Doppler Ultrasonic
Model:	MACE AgriFlo
Housing:	316 Stainless Steel
Velocity Range:	± 4 metres/second, ± 8 metres/second, dependant on sensor chosen.
Software:	MACE FloCom for instrument configuration and data downloading
Display:	Internal 12 mm LCD display.
Power:	Internal 6 Volt battery with external 6 Volt/5 Watt Solar Panel or 240 volt trickle charger
Transducer:	2" BSP Insertion type sensor with 10 metres of cable for 0.15 to 2m full pipes.
or	
	Strap Mount sensor with 10 metres of cable and Polypropylene mounting strap for full pipe culverts.

UNIT LIST PRICE: **$3,225 - 00 each** *(valid as of 17/01/02)* **(ex GST)**

Quantity Discount Structure: *Offered on a per order basis*

1-25 units	0 % off list
26-50 units	5 % off list
51-100 units	10 % off list
>100 units	15 % off list