

WATERWATCH VICTORIA

QA/QC WEEK 2012

REPORT ON STATE-WIDE RESULTS FOR PHYSICOCHEMICAL PARAMETERS AND MACROINVERTEBRATES



**November
2012**

1.0 Background

Waterwatch Victoria is a state-wide community based water quality monitoring organisation that aims to increase local community understanding and ownership of waterway and catchment issues. Community volunteers and Waterwatch coordinators are involved in the monitoring of waterway health, including water quality and macroinvertebrate indicators.

Waterwatch Victoria's QA/QC Week program is an annual event co-ordinated at a state-wide level. It involves the testing of laboratory prepared standard samples by monitors and coordinators to ensure that their equipment and monitoring techniques are accurate. For more information on Waterwatch Victoria's Data Confidence Framework, guidelines and data confidence plans, visit www.vic.waterwatch.org.au

This report provides a simple summary of the state-wide data provided by both co-ordinators and monitors during QA/QC Week 2012. It follows on from similar programs that have been conducted annually since 1998. Further detail can be found within the regional reports that have been distributed to the Waterwatch coordinators.

2.0 Methods

2.1 Physico-chemical Parameters

Stable 'Mystery' reference water samples were prepared for pH, electrical conductivity (EC), turbidity and orthophosphate by Australian Chemical Reagents (Roach Analysts), QLD. Each parameter was further divided into a low range sample (A) and a high range sample (B) giving a total of 8 unique samples.

Physicochemical 'mystery' solutions were prepared to specifications recommended by the state Waterwatch Victoria office. Values listed in Table 1 are the averaged solution concentrations of the subset measured during QA/QC Week.

Individual parameter solutions were provided to all regions in separate bottles with labelled instructions for sample preservation and use. Acceptable upper and lower quality control limits for each parameter (excluding low range orthophosphate) were set according to the standards outlined in the Waterwatch Victoria Data Confidence Framework.

Feedback from previous QA/QC events highlighted an issue with regard to colour matching between the orthophosphate mystery samples and the colour comparator wheels. As a consequence it was decided to widen the acceptable limits in 2010 and 2011 from $\pm 20\%$, as outlined in the data confidence framework, to $\pm 40\%$.

After trialling a number of additives, a small amount of yellow food die was added to the 2012 mystery samples to improve the colour match. As a result the acceptable limits for the low range PO₄ samples were reduced to - 20% and +33%. The +33% upper limit was chosen as it fits in with the values marked on the popular Macherey Nagel Visocolor comparator (0.05, 0.07, 0.10 and 0.15 mg/L).

In previous years there has also been concern amongst a small number of participants over possible health impacts relating to the use of Formazin based turbidity samples. In light of this issue a new silica based turbidity solution was trialled during QA/QC week 2012.

Table 1. True values and acceptable limits for phys-chem parameters.

Parameter	Sample	Acceptable Range	True Value	Lower Limit	Upper Limit
pH (pH units)	A	± 0.3	6.0	5.7	6.3
	B	± 0.3	8.5	8.2	8.8
EC (µS/cm)	A	± 10%	600	540	660
	B	± 10%	7500	6750	8250
Turbidity Meter (NTU)	A	± 20%	16	13	19
	B	± 20%	60	48	72
Turbidity Tube (NTU)	A	± 25%	16	12	20
	B	± 25%	60	45	75
Orthophosphate mg/L (P)	A	- 20% +33%	0.075	0.06	0.10
	B	± 20%	0.35	0.28	0.42

A total of 1540 phys-chem samples were sent out across the state for QA/QC Week 2012. A total of 354 participants took part in the event including 17 coordinators and 337 monitors. Please note that not every participant attempted all eight samples as regional co-ordinators decided which samples they, and their monitors, would assess prior to QA/QC Week 2012. The minimum number of samples assessed by any one participant was two, with the majority assessing between four and seven. All participants were provided with event codes to allow their results to be included in the state-wide analysis anonymously.

The Victorian Waterwatch Data Confidence Framework sets out minimum requirements for equipment to be used by monitors and co-ordinators to conduct water quality analysis. A summary of the requirements for monitoring Standards 3 and 4 is provided in Table 2 below.

Table 2. Minimum requirements outlined in the Data Confidence Framework.

Parameter	Standard 3	Standard 4
EC	Low range = minimum resolution of 0.10 mS/cm	Low range = min resolution of 0.10 mS/cm
	High Range = minimum resolution of 10 mS/cm	High Range = minimum resolution of 10 mS/cm
pH	pH meters (not strips)	pH meters (not strips)
Turbidity	Turbidity tubes	Turbidity meter
P04	Comparator	Colorimeter

2.2 Macroinvertebrates

A total of 75 'Mystery' macroinvertebrate samples of known taxonomic composition were prepared by Instream Solutions. These samples were provided to test the co-ordinators and monitors identification skills at variable taxonomic resolutions. The 'mystery' samples consisted of six macroinvertebrates that are naturally found in the majority of Victorian bioregions so not to disadvantage participants (Table 3). Coordinators and monitors were asked to identify the macroinvertebrates at the Order, Family and common name level.

Table 3. Macroinvertebrate "Mystery Sample" taxa list.

Family	Common Name	Found in Victorian Bioregions
Corixidae	Water Boatmen	Highlands, Forest A, Forest B, Cleared Hills and Coastal plains
Amphipod (Order)	Scud, Sideswimmer	Highlands, Forest A, Forest B, Cleared Hills and Coastal plains
Chironomidae	Non Biting Midge, Bloodworms	Highlands, Forest A, Forest B, Cleared Hills and Coastal plains
Corbiculidae	Little basket Shell	Highlands, Forest A, Forest B, Cleared Hills and Coastal plains
Baetidae	Mayfly	Highlands, Forest A, Forest B, Cleared Hills and Coastal plains
Hydrobiidae	Water Snail, Introduced Snail	Highlands, Forest A, Forest B, Cleared Hills and Coastal plains

3.0 Results

3.1 Physicochemical

The following table summarises the coordinators results across all of the eight regions. A 100 percent pass rate was achieved for four of the eight parameters.

Table 4. Coordinator pass rates for the physicochemical parameters.

Parameter	Sample	Number of results (n)	2012 Pass Rate %	2011 Pass Rate %
pH (pH units)	A	14	71	88
	B	9	100	93
EC ($\mu\text{S}/\text{cm}$)	A	16	100	94
	B	9	100	100
Turbidity (NTU)	A	16	50	100
	B	9	67	100
Orthophosphate mg/L	A	11	73	66
	B	5	100	70

As can be seen in Figure 1 the coordinator results for the pH and EC parameters were quite similar to those recorded in 2011. However, a significant drop in the pass rate was recorded for both the low range and high range turbidity samples. After discussions with a number of coordinators it is apparent that this drop is related to the switch from Formazin to silica based turbidity solutions and does not represent a slip in capabilities. Although the silica based solutions could be measured accurately with turbidity meters, they were much harder to measure with the Turbidity Tubes. Taking readings in high light levels or slightly shaking the tubes appears to change the reflective properties of the silica solutions and this in turn caused a larger proportion of participants to overestimate the turbidity levels.

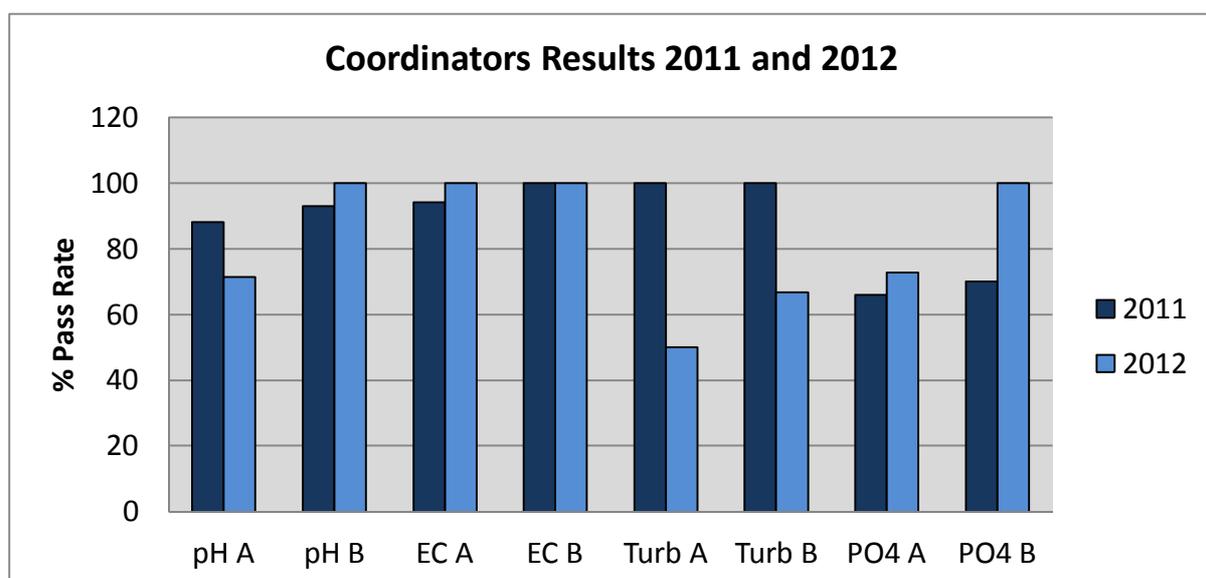


Figure 1. Comparison of Coordinator pass rates between 2011 and 2012.

Coordinators orthophosphate results have shown an improvement in 2012 even though the acceptable limits were narrowed from those used in 2011. It seems likely that the addition of the yellow food die is making it easier for participants to measure PO₄ concentrations when using the colour comparators.

The state-wide results for the monitors are summarised in Table 5 below.

Table 5. Monitor pass rates for physicochemical parameters.

Parameter	Sample	Number of results (n)	2012 Pass Rate %	2011 Pass Rate %
pH (pH units)	A	174	84	92
	B	121	89	87
EC (µS/cm)	A	201	93	86
	B	101	90	85
Turbidity (NTU)	A	207	54	86
	B	111	54	88
Orthophosphate mg/L	A	176	70	71
	B	53	45	62

As was the case with the coordinators, the monitors pass rates for the pH and EC parameters remained relatively stable between 2011 and 2012 while the Turbidity parameters showed a significant decrease. The low range orthophosphate pass rates remained similar despite the reduction in acceptable limits while the high range scores were significantly lower in 2012.

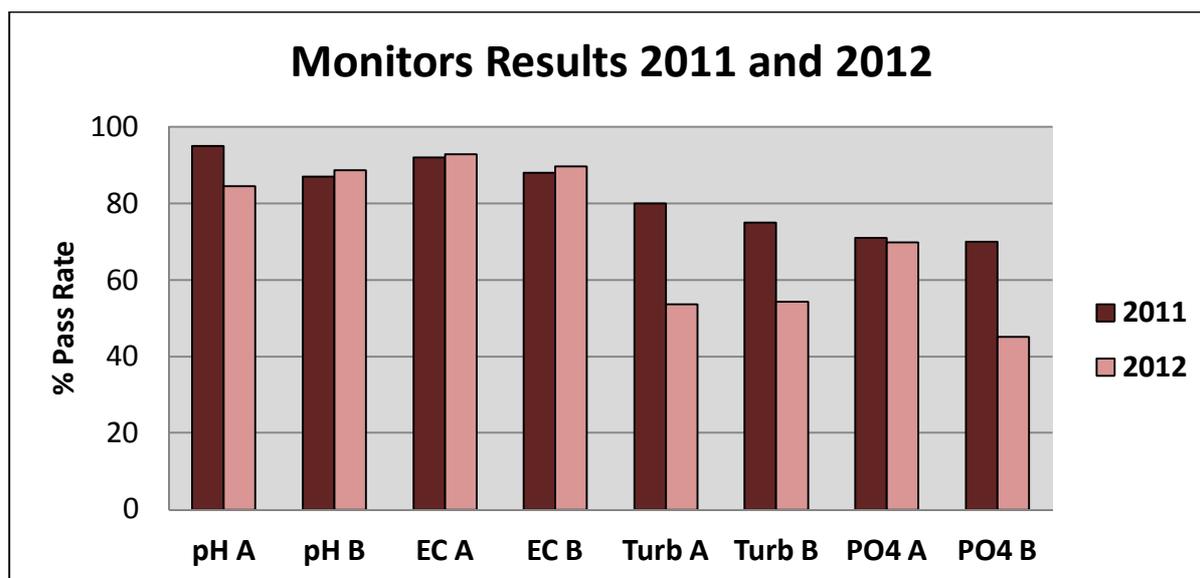


Figure 2. Comparison of monitor pass rates between 2011 and 2012.

A comparison between the performance of the co-ordinators and that of the monitors, in 2012, is provided in figures 3 and 4 below. For the low range samples the monitors had surprisingly higher pass rates for both the pH and Turbidity samples.

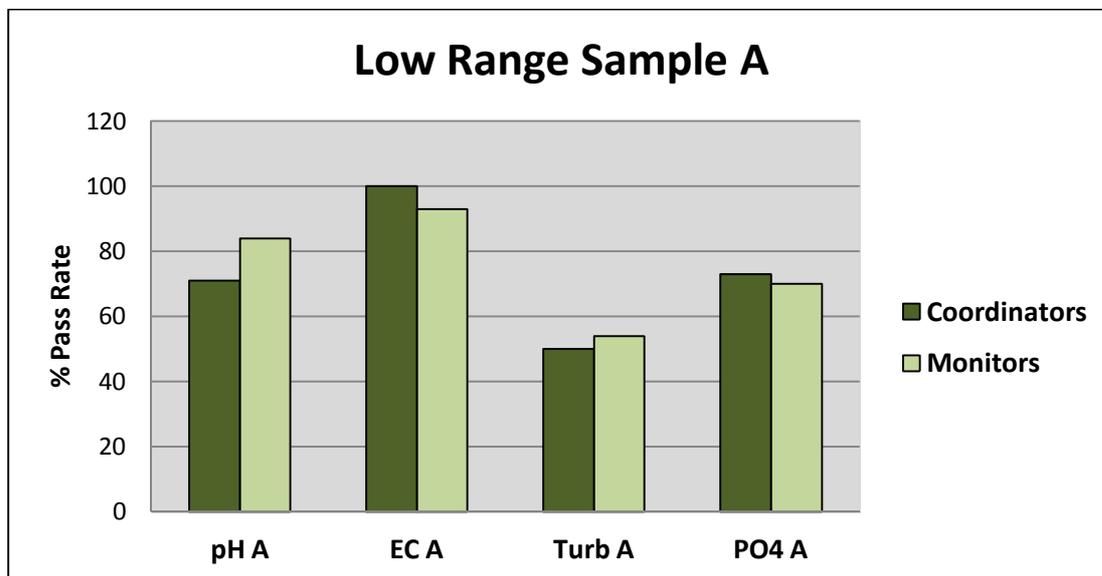


Figure 3. 2012 Pass rates for coordinators and monitors – Low Range

Results for the high range parameters were more in line with expectations and coordinators pass rates were consistently higher when compared with the monitors' results.

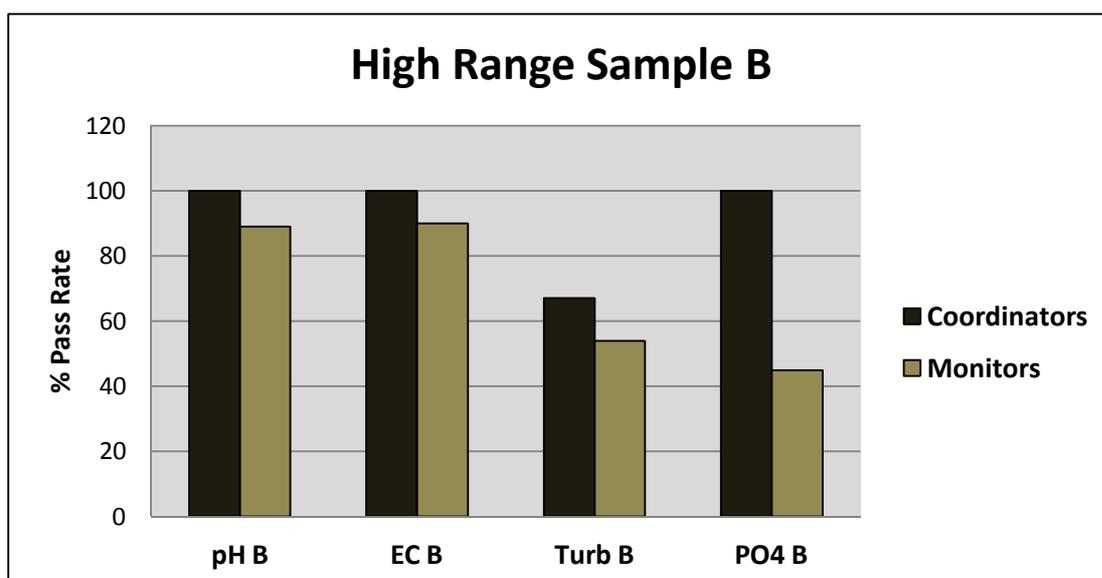


Figure 4. 2012 Pass rates for coordinators and monitors – High Range

3.2 Macroinvertebrates

Eleven coordinators and twenty five monitors attempted to identify the macroinvertebrate 'Mystery samples'. Bugs were identified by eye, hand lens or microscope, using a variety of macroinvertebrate keys and picture books. The majority of co-ordinators and approximately half of the monitors attempted to identify the bugs at family level. Pass rates were generally quite good, with the co-ordinators having a slightly higher overall pass rate than the monitors.

As with last year there were several macroinvertebrates included in the vials that can be difficult to identify. A list of common misidentifications made by participants in QA/QC week 2012 is outlined in the table below.

Table 7. Common misidentifications at family level

Macroinvertebrate	Common Mistakes
Corixidae	Notonectidae
Amphipod (Order)	
Chironomidae	
Corbiculidae	Sphaeridae
Baetidae	Leptophlebiidae, Caenidae, Oniscigastridae
Hydrobiidae	Lymnaidae

Identification of macroinvertebrates at family level can be difficult. There are a number of ways individual regions can improve their identification accuracy if they wish to, including; purchasing stereo microscopes, obtaining appropriate family level keys and participating in macroinvertebrate training seminars.

4.0 Discussion

4.1 pH

The 2012 pH results were generally very good however a couple of issues were identified among those participants outside the acceptable range. Firstly there are still several level 3 monitors using pH strips instead of meters and this year, in particular, it appeared to place participants at a distinct disadvantage. Secondly a number of participants outside of the acceptable range calibrated their meters using expired solutions causing their equipment to provide incorrect readings. To ensure data is of the highest standard it is recommended that

monitors maintain a calibration logbook where the expiration dates, after opening, for each calibration solution are recorded.

4.2 EC

The EC results for both the coordinators and monitors were again very good. Two issues were identified during QA/QC week 2012. Several of the monitors recorded their results in millisiemens instead of microsiemens, which if not picked up by coordinators, will lead to incorrect values been entered into the Waterwatch database. Secondly a number of participants outside of the acceptable range were carrying out calibration checks using high EC calibration solutions (12,880 $\mu\text{s}/\text{cm}$). For measuring EC in streams that typically have low to moderate conductivity levels it is strongly advised that a mid range EC calibration be used (e.g. 1430 $\mu\text{s}/\text{cm}$).

4.3 Turbidity

The 2012 results clearly indicate that the use of a silica based solution is not suitable for the turbidity tubes which the majority of participants use. It is recommended that for future QA/QC events Waterwatch Victoria should revert to a Formazin based solution. There are a number of options open to those participants who do not wish to handle Formazin, including the use of stream samples collected on the day or the addition of milk to distilled water. Whichever alternative method is used, strict quality assurance measures will need to be put in place to ensure that the data can be used for reporting purposes.

4.4 Orthophosphate

Although the orthophosphate results have improved when compared to those from 2011 there still appears to be several issues impacting participant's ability to achieve results within the acceptable limits. Figure 5 below outlines pass rates for 243 participants split into their equipment category.

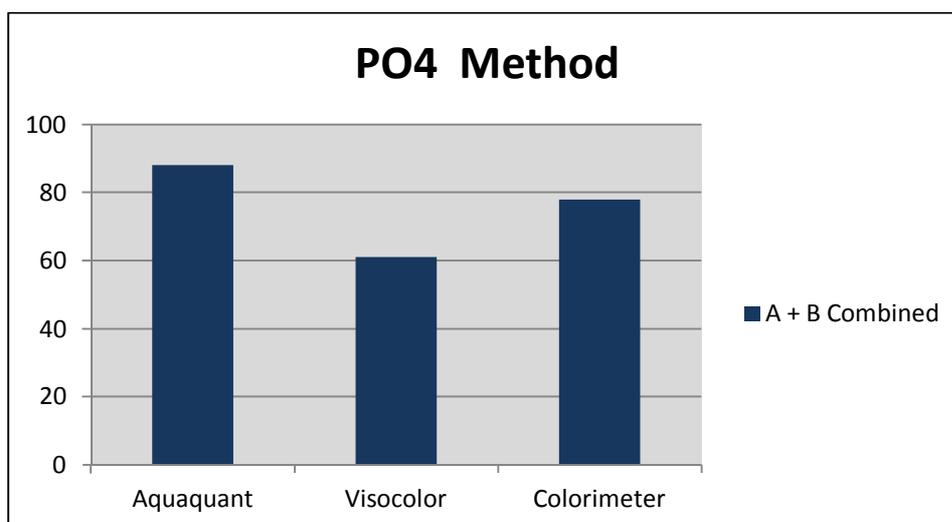


Figure 5. Pass rates for participants by equipment type. It includes both monitors and coordinators across both sample ranges.

Surprisingly participants using the Merck Aquaquant® comparators obtained the highest pass rate at 88%. These comparators appear to have the best color match with the mystery samples, however, they are only used by a couple of regions and are also very expensive. Participants using the The Machery- Nagel Visocolor comparators obtained the lowest pass rate at 61%. It appears that while the color intensity of the Visocolor wheel and sample matches quite well there is still a perceptible difference in the color hue.

It is recommended that further trials with food dyes be carried out prior to QA/QC week 2013 to try and improve color matching with the Visocolor comparator. Care must be taken so that any changes made do not negatively impact the accuracy of the colorimeters or the Merck brand comparators.

The monitors' high range pass rates were very low in 2012 with many participants using the low range comparator kits and recording their answer as 0.25mg/L. The high range samples need to be tested with a high range kit or else the sample needs to be diluted prior to testing.

Appendix 1: Data

Raw data from QA/QC Week 2011 can be accessed in excel spreadsheet format upon request from Waterwatch Victoria.