**Report of the Joint Water Testing Trial done to Assess the Value of Streamwatch Water Monitoring Against Hornsby Shire Council Water Quality Monitoring**

**Background**

This trial was discussed at meetings 25.06.2019 and 11.10.2019 involving Hornsby Council (HSC) water quality officers and management and four local community groups: Hornsby Heights Bushcare, Larool Ck Streamwatch, Glenorie Environment and Creative Arts Centre and Still Ck Landcare. Refer to Appendix 1. Aims included: review Streamwatch (Sw) activities and value, use the water data, avoid site duplication and community engagement. The trial commenced in November 2019 for monthly joint sampling at 6 sites for a planned 6 months. This timing was delayed due to the drought, some flooding and the COVID-19 lockdown and completed in September 2020. The sites are composed of 2 Ecohealth, 2 industrial and 2 post-water treatment sites. 2 of these were new to Streamwatch volunteers.

This report is issued as the first step to achieve the following:

* Compare the HSC and Sw results to determine the level of confidence in Sw work
* Identify the value to HSC of the Sw results
* Identify how Sw could be changed to be of more value to HSC
* Identify a potential redesign of Sw to be more use for HSC, other LGAs and NSW agencies

**Context**

The trial was set up with the four volunteer groups operating independently and coordinating with HSC. There was no attempt to tidy up equipment and processes, but just to operate as the groups do now. Most of the volunteers had been doing the work for years. One volunteer dropped out for health reasons and was replaced by another who was trained by a volunteer. Until July 2020 here had been no effective technical support for over 2 years. There has been no adherence to the long-term Streamwatch quality assurance processes for more than three years so no routine equipment calibration and process checking has occurred. Greater Sydney Landcare Network (GSLN) took over as host from Australian Museum in July 2019.

Refer to the Streamwatch Manual for a description of Streamwatch equipment and processes. Refer to Appendix 2 for a description of the hSC equipment, calibration and processes.

Streamwatch is a citizen science activity based around condition monitoring of waterways, the first stage of an environmental maintenance program for water. Hence, there are two elements to be reviewed:

* the citizen part: did the volunteer groups perform according to plan?
* the science part: are the results of use, to whom and to what level?

**Variability**

This originates with different people, sampling locations, sampling processes, testing processes, equipment and materials. In this trial sampling locations and times were the same. The trial was mainly done blind because the majority of the Streamwatch results become apparent later, although there was some awareness on some occasions of the HSC probe results. Variations in sampling processes were observed between volunteers: use of cool bags, EC calibration at home or on site, EC testing at home or on site, container flushing etc.

In this trail, although there is variability in the HSC testing, this is ignored to provide a base for the Streamwatch results because the HSC equipment is calibrated each time both before and after a sampling/testing day so is likely to be more reliable. Samples for some parameters are sent to NATA accredited laboratories,

**The Citizen Performance:** a good result

Arrival to sample at the set time: 48/51 or 94%.

Did the tests and reported the results: 48/48 or 100%, but one group was late with 3 results

Individual parameter results reported: 321/328 or 98% ( eg 2 missed, 2 lack of Petrifilm)

Warning provided for 2 unconfident results by Glenorie: arranged meeting with another group at next testing session to check calorimeter, materials and methods.

One large discrepancy between the EC result on site and at home (different sampler and tester) was not followed up sufficiently by Still Ck group.

The date of an EC calibration solution change was not recorded, despite a significant variation.

**The Science Performance**: a mixed result

This depends on the variable being monitored and of course its intended application. All data originates in the tab provided by HSC, based on HSC data and data from 3 groups (Glenorie Sw data was added later by the author).

The 48 site/time data sets were analysed by 3 methods:
1. Simple statistics: mean, median, range and standard deviation for differences, absolute differences and % difference: this showed some useful results, limited by the 48 points.

2. Using the HSC calibration acceptances: this showed that most Sw data were outside the HSC calibration acceptance range.

3. Time series plots of the results for each site separately: this showed that except for Phosphate, most of the time the trends generally matched.

**Overall Conclusion**: Sw testing is not able to replace HSC testing to the same accuracy, but useful to a lower standard, except for Phosphate.

**Temperature**: OK: Sw mostly consistent within the 0.5 C equipment constraint tracked similarly to HSC and within 1 C but skewed -0.5 C

**Available Phosphate**: POOR: Sw results are unreliable and show large unexplained variations, 21% showed unacceptable variation, with most of these from 2 groups that were unexplained despite comparative colorimeter and materials investigation across 3 groups. Note that Sw results below 0.07 are unreliable due to equipment constraints. Phosphate measurement needs further investigation.

**Dissolved Oxygen**: OK: Sw tended to follow the HSC trends but showed high variability with up to 4mg/L for 2 groups, but means and medians were close.

**pH**: OK: Sw results were not accurate but often close and 79% within 0.5 pH unit. The Sw equipment measurement constraints was 0.5 units. Mean & median variance was 0.6 with 92% of Sw readings lower.

**Electrical Conductivity**: GOOD: Sw showed good comparative results, but the calibration solution is critical. Up to 150 variance occurred. The early tests for all 3 Still sites showed large variations. This was traced to a faulty calibration solution subsequently replaced. Still Ck group has routinely used 2 probes for some time and the probes have shown very similar results.

**Turbidity NTU**: OK: Sw results followed the HSC trends but were limited by the equipment constraints to the tube 10, 15 etc whereas HSC used the more accurate probe. Where there was a large variance, it was at high readings and both results were high. Sw groups also used the colorimeter FTU readings but no comparison could be made using this.

**E. coli**: GOOD: Sw results are a useful guide to conditions. Results were lower than HSC (which uses a NATA laboratory to assess). 84% of results matched if the following 3 bands are used: 0/200; 201/1000; >1000. There are high absolute variances but not in relative terms.

**Waterbugs**: on 1.11.2019 a single joint sampling (HSC uses University of New England) was carried out at STIL1 Crosslands. The autumn sampling was cancelled due to COVID-19. Refer to Appendix 3 for the results of this single comparison. This demonstrates that reasonable Order level accuracy was achieved in this case but not to family level, as had previously had been done due to to the difficulty of maintaining skills when doing the task only 6 monthly.

**Conclusions**:

The joint HSC/Sw report is still to be written. However, HSC considered the following benefits resulting from Sw volunteers carrying out water monitoring:

New partnerships

Ground truthing

Compliance and incidence reporting

Advocacy and stewardship

Catchment knowledge

Eyes and ears on the ground

These results showed that Sw testing is not able to replace HSC testing to the same accuracy, but useful to a lower standard, except for Phosphate, which needs investigation for the high number of outliers.

Sw results are suitable for pollution incidence reporting and for longer term monitoring of the waterways, but processes need to be reviewed and annual quality assurance resumed.

C J Noon 10.12.2020

**Appendix 1 a: Extracted Notes from Initial Meeting with Hornsby Shire Council and Four Local Streamwatch Groups 25 June 2019**

(Slightly modified for explanatory purposes for this and the following report)

**Streamwatch groups** at meeting: Larool Ck Streamwatch, Hornsby Heights Bushcare, Glenorie Environment and Arts Centre, Still Ck Landcare

**Objectives:**

A review of Streamwatch and council test equipment and techniques.

A way to ensure data is relevant, not duplicated and contributes to Hornsby water knowledge.

How Sw can assist water quality officers and contribute to educating and engaging the wider community.

Discuss AUSMAP options.

**Value of volunteers to Council:**

Eyes and ears on the ground

Assist with education and community engagement

Assist with innovation eg flow

**Water testing, what happens now:**

In general, the physical/chemical tests by Streamwatch are a large subset of Council tests, but not flow, enterococci, nitrogen.

Streamwatch sites tested were selected based on creeks local to volunteers. HSC sites were reviewed in 2017 and split into Ecohealth and other sites, with Streamwatch sites in both categories.

Sw tests monthly, Council mainly quarterly, with some variations (including continuous monitoring)

Biological testing, macroinvertebrates, is done by SW at 3 sites in spring and autumn with unstructured notes for riparian observation. Council uses UNE at some sites for macroinvertebrates, who additionally provide a much more rigorous riparian assessment.

Microplastics not done by HSC or Sw

**Opportunities that exist:**

Sharing of resources

Data management

Quality assurance

**Needs by Streamwatch** if Landcare funding fails:

Test materials, approx $1800 pa for 8 sites

QA to ensure reliable data

**Potential changes:**

Delete some Streamwatch sites, change frequency.

Streamwatch tests some Council or new sites.

Streamwatch use some Council equipment and use contracted laboratories instead.

**Appendix 1b: Extracted Notes from Second Meeting with Hornsby Shire Council and Four Local Streamwatch Groups 11 October 2019**

**Decision on selected joint site/time sites:**

Industrial site monitoring:

Larool Ck: monthly both SW and HSC sites

Sams Ck: monthly HSC site

Post Waste Water Treatment Plant site monitoring:

Glenorie: Glenorie Ck Tekapo site: monthly both SW and HSC sites

Galston: Cobar Ck Wylds Rd site: monthly HSC site

Ecohealth Catchment health site monitoring:

Still Ck Mansfield Rd: monthly both SW and HSC sites

Still Ck Crosslands: monthly both SW and HSC sites, plus 6 monthly macroinvertebrat

**Appendix 2: Hornsby Shire Council Water Testing Calibration**

Refer to the Photo of the calibration report

**Equipment**: probe Yoekal model 615: for pH, EC, DO Turbidity, Salinity, Temp, GPS

Main service: quarterly at supplier

Operator service: top up electrolytes, change membrane

Temperature is important: calibration is via thermometer to eg 10.6 ie 0.1

Calibration at start of day and checked again at end of day: discard day’s data if out of tolerance

Time taken to calibrate: started at 7.30 finished at 8.30, includes some explanation delays: say 50 minutes

If multiple people are using the probe, one person must have responsibility for calibration. Fo volunteers, this would include the same person checking at the end of the testing day.

**Tolerances**: checked at end of day

Temp: +/-0,2

DO @ 0%: 0.5% DO @ 100%: +/-5%

EC air and water @ 0 uS/cm: 2uS/cm EC air and water @ 1413 uS/cm: 15uS/cm

EC tap water @ approx 200 uS/cm: 15.0 uS/cm

Turbidity NTU @ 0: 0.5 NTU Turbidity NTU @ 200: 10.0 NTU

Salinity @ 0 ppt: 0.01 ppt Salinity @ 35 ppt: 0.5 ppt

pH @ temps 10, 7 & 4: 0.1 pH @ temps 7dil x10: >0.05

**Conclusions**: Problems for volunteers with:

time spent on double calibration unless testing many sites: logistics constraints

storage of calibration solutions eg turbidity is toxic and must be locked etc

cost approx $8k

**Samples sent to NATA registered laboratory**:

Phos

Faecal colliforms, enterococci, E coli

Total Nitrogen, oxidised N NOx NH3

Total suspended solids

CBOD5: carbon based oxygen demand (5 day trial) eg for sewage

K, F

Christopher Noon 24.08.2020 with Kristy Guise and Jessica Lumbroso

**Appendix 3: Macroinvertebrates Joint Testing Comparison**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Order | Family | signal | EPT | Taxa | **STIL1 UNE Crosslands** | **STIL1 CJN Note: Order ID only** | **STIL1 CJN Comments** |
| Acarina | Oxidae | 6 | N | Flabellifrontipoda | 16 | Many |  |
| Ephemeroptera | Baetidae | 5 | Y | Bungona | 1 | 1 | Family found previously |
| Ephemeroptera | Leptophlebiidae | 8 | Y | Atalophlebia | 12 | 6 | Family found previously |
| Epiproctophora | Corduliidae | 5 | N | Procordulia | 1 | 1 | Dragonflies |
| Epiproctophora | Gomphidae | 5 | N | Austrogomphus | 3 | 3 |  |
| Gastropoda | Hydrobiidae | 4 | N | Potamopyrgus | 14 | Many |  |
| Plecoptera | Gripopterygidae | 8 | Y | Eunotoperla |  | 1 | Family found previously |
| Trichoptera | Calamoceratidae | 7 | Y | Anisocentropus | 15 | 5 | Family found previously |
| Trichoptera | Hydroptilidae | 4 | Y | Hellyethira |  |  |  |
| Trichoptera | Leptoceridae | 6 | Y | Oecetis | 1 | 1 |  |
| Trichoptera | Leptoceridae | 6 | Y | Triplectides | 2 | 2 |  |
| Trichoptera | Philopotamidae | 8 | Y | Hydrobiosella |  |  |  |
|  |  |  |  |  |  |  |  |
| Note that CJN results are not necessarily identified as the correct Family, but are placed separately to note that different Families were noted in the given numbers. |
| The results for STIL1 were taken at the same time on the same day in the same location by UNE and CJN. |