

TRIED AND TRUE - COMMUNITY WATER QUALITY MONITORING BRINGING ABOUT CHANGE

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Introduction

Waterwatch is a national water quality monitoring and catchment education program involving schools, community groups and landholders. It was established by the Australian Government during 1993 and in 2007 reported over 3000 Waterwatch groups monitoring water quality at over 7000 sites throughout 200 catchments (Waterwatch website, 2007) .

Waterwatch volunteers conduct biological and habitat assessments plus physical and chemical water tests. Although there is some reluctance in the scientific community to accept community data as valid, the Waterwatch program has established elements of a successful citizen science program including scientific protocols, standardised methods and equipment, training and support for volunteers, data verification and a procedure for quality assurance.

The success of this long term citizen science program is also demonstrated by real world examples where volunteers and community data contribute to the identification of water quality problems and the implementation of actions to address them.

The Waterwatch program has been operating on the Central Coast of New South Wales since 1997. In this paper, we provide case studies of where community water quality data and community volunteers have identified problems within local catchments and undertaken actions to address those problems. We highlight the case study of the Long Jetty Waterwatch group that has been monitoring over thirty stormwater drains entering Tuggerah Lake over the past five years. Deteriorating water quality entering the lakes and reoccurring high phosphate levels in one particular drain prompted the group to take action to rectify this problem. As a result they have been working with Wyong Shire Council to find a solution. After further investigation the Waterwatch group found the drain with the reoccurring high phosphate could be attributed to runoff from a local golf course. Action has since been taken by the council and golf course to rectify this problem and the group continues to monitor. The council will also be implementing a stormwater quality improvement program along the lake foreshore beginning with four drains identified as high priority from Waterwatch data.

Location

The Central Coast of New South Wales is generally thought to encompass Gosford and Wyong local government areas (although at times has been defined to also include Lake Macquarie local government area).

Gosford and Wyong local government areas have a total area of 1,854 square kilometres with a population of 322,650 in 2011. The population is concentrated along the coast and

Brisbane Water and Tuggerah Lakes. The Central Coast is the ninth largest urban area in Australia (RGIP Discussion Paper 2014).

The Central Coast Regional Strategy (2005) describes the region as "rich in natural resources and diverse ecosystems with more than half the region comprising natural parks, forests, conservation areas, drinking water catchments and waterways".

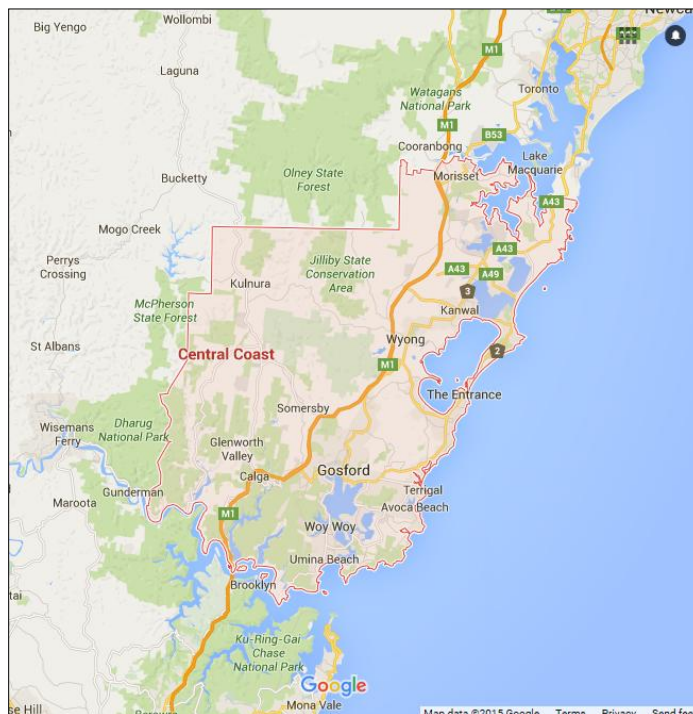


Figure 1: Map showing the Central Coast of NSW (Google Maps, 2015)

Community Environment Network

The Community Environment Network (CEN) Incorporated is a network of community and environment groups from Gosford, Wyong and Lake Macquarie local government areas. It is a not-for-profit, community based organisation formed in 1997 with a membership comprising both individuals and groups. The vision of CEN is to work for ecologically sustainable development and against threats to it.

CEN has a number of functions including:

- supporting the activities of members, both individuals and groups, in their activities that lead to improved environmental outcomes
- responding to environmental, planning and natural resource management issues as they arise
- participating in strategic processes
- seeking funding and delivering projects that lead to positive environmental outcomes.

In addition to activities on the Central Coast, CEN is also the state coordinator for the Land For Wildlife program and delivers this program through partnerships with regional providers including Councils, agencies and non-government organisations. CEN is

developing a similar model of a state wide network to strengthen the Waterwatch program across the state.

About the Waterwatch program

Waterwatch is a national water quality monitoring and catchment education program involving schools, community groups and landholders. It was established in Australia by the Federal Government during 1993. In 2007, it was reported that there were over 3000 Waterwatch groups monitoring water quality at over 7000 sites throughout 200 catchments. (*Waterwatch Website 2007*). The Waterwatch program recruits, trains and support volunteers to conduct biological and habitat assessments plus physical and chemical water tests.

The program has two levels of water quality monitoring - one for primary school students (Primary kit) and the other for high school students and community volunteers (Senior kit). The Primary testing kit includes temperature, turbidity, pH and electrical conductivity (salinity). The Senior kit includes all those tests from the Primary kit with the addition of Available Phosphate, Dissolved Oxygen and *E. coli* added.

Volunteers are trained by a Waterwatch coordinator in monitoring methods and use of equipment. Training manuals are available to support volunteers, teachers and schools.

On-going support is provided by the Waterwatch coordinator including support visits, maintenance of kits, equipment and chemical stocks, data verification, Quality Assurance Trials (QA) further training as required and special events as outlined below.

Data is uploaded to a NSW-wide database on the Atlas of Living Australia. The procedure involves verification of data by the Waterwatch coordinator before being accepted on the database.

The Waterwatch program has developed a model that includes a number of annual events in order to maintain the level of engagement of volunteers and provide "snapshots" of ecosystem condition. These include:

- Water Bug Surveys (Spring and Autumn)
- Phosphorus Awareness Week (P-Week)
- Catchment Crawls – catchment 'snap-shot'
- Events – eg. World Wetlands Day
- Promotion – displays, talks, field days, workshops
- Catchment specific projects

Citizen Science - Old But New

There are many attempts to provide a definition of the term citizen science. Trumbull et al (2000) define it as *“research and monitoring that relies on volunteers to collect data without direct supervision”*.

In 2014, the term "citizen science" was added to the Oxford English Dictionary as follows:

citizen science n. scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions.

The number of citizen science programs and prominence of citizen science has increased significantly in recent years. However, citizen science is not new. The Audubon Society's Christmas bird count in the United States is one of the world's longest running citizen science projects whereby volunteers have been collecting data on birds on a specific day since 1900 (Donnelly et al, 2014).

The education value of citizen science programs is generally accepted however the validity and reliability of citizen science data is often questioned. Thornton and Leahy (2012) cite a number of papers that validate that citizen science programs can generate acceptable data and compare data generated by citizen science programs with results obtained by professionals.

Thornton and Leahy (2012) also investigated the level of trust in citizen science data for a water evaluation and testing program. Some of the elements discussed in this paper that increased trust included:

- interpersonal trust in students, teachers and other community member volunteers
- familiarity with testing kits and protocols
- familiarity with water quality data
- quality assurance / quality control measures

A study by Belt and Krausman (2012) that evaluated population estimates of mountain goats based on citizen science found that more frequent site visits balanced out lower detection probability by volunteers and resulted in abundance estimates that were less variable than those of biologists. Belt and Krausman (2012) also cited a number of studies that suggested that careful training and sampling design may allow citizen science programs to achieve results that are as reliable as those from professional monitoring programs. The paper also noted that citizen science data are often collected on spatial scales and conducted over a longer term than most agency budgets would allow (Belt and Krausman, 2012).

The Waterwatch program is consistent with the conclusions of this research in that it involves:

- training of volunteers in use of equipment
- standardised methods and protocols
- training of volunteers in order to understand water quality parameters
- volunteers encouraged to regularly monitor
- annual quality assurance system in place
- data validation by a Waterwatch coordinator

The value of citizen science is also demonstrated through the ability to lead to better natural resource management. Danielsen et al (2010) examined 104 published environmental monitoring schemes to assess whether participation in data collection and analysis influences the speed and scale of decision-making and action. They found that scientist-executed monitoring informs decisions within regions, nations and international conventions however decisions typically take 3-9 years to be implemented. In contrast, monitoring schemes that involve local stakeholders are much more effective at influencing decisions; these decisions typically taking 0-1 year to be implemented (Danielsen et al, 2010).

Waterwatch on the Central Coast

The Waterwatch program on the Central Coast was initiated in 1997 by a community group, the Clean and Safe Team. After observing poor water quality in a nearby waterway, a group of five community members began investigating how the general community could be more engaged in caring for their catchments and waterways. The group liaised with the Brisbane Water and Gosford Lagoons Catchment Management Committee and, with their assistance, submitted a funding application through the Natural Heritage Trust to develop a community water quality monitoring program.

Initially the program relied largely on community volunteer effort to recruit, train, support and maintain the program with some assistance provided by local Councils and agency staff where possible.

In 2000, the first dedicated Central Coast Waterwatch Coordinator was employed by the Community Environment Network. Since that time, funding has varied from year to year with the need to repeatedly apply for grants through various funding programs and funding bodies in order to sustain the program.

At the height of the Central Coast program during that period, the Coordinator position was 1.2 EFT with the current funding (2015 / 2016) only allowing 0.4 EFT. Throughout that time, the interest and enthusiasm of participants has not waned, merely the capacity to recruit, train and support them. Table 1 suggests that the impact of reduced Waterwatch Coordinator hours is a reduction in the frequency of testing being undertaken by groups.

Year	Central Coast Waterwatch staff (EFT)	No. groups	No. sites	No. data sets	Estimated volunteer in-kind (\$)*
2005 / 2006	0.9	28	58	150	23,730
2006 / 2007	1.2	28	58	197	77,375
2007 / 2008	1.2	32	82	411	190,330
2008 / 2009	1.0	32	62	332	142,435
2009 / 2010	0.8	33	75	376	184,848
2010 / 2011	0.5	34	77	366	142,376
2011 / 2012	0.5	24	67	263	68,610
2012 / 2013	0.6	22	77	145	62,243
2013 / 2014	0.3	21	72	178	73,895
2014 / 2015	0.8	33	88	145	82,358

Table 1: Waterwatch activity for period July, 2005 - June, 2015

* in-kind estimate includes community participation in monitoring, events, field days, training, workshops, promotion activities.

The Waterwatch program has often been described as providing the “eyes of the catchment”. The interest, willingness and availability of trained volunteers has been recognized as providing a resource that it is unlikely a Council or agency would fund to the

same level. In fact, the Waterwatch program provides a very cost effective way of implementing a water quality monitoring program for a relatively small investment of resources.

Case studies of Waterwatch Success

Similar to many citizen science programs, Waterwatch has received some criticism as not providing scientifically rigorous data and "only having value as an education program". The education value of the program cannot be underestimated in its own right however, the water quality data also contributes an important data resource for natural resource management.

At the very least, the regularity of testing and consistency of volunteers carrying out tests is able to describe long term trends and unusual spikes in the water quality results at a particular site.

In addition, many volunteers come to the program with skill sets that often support a high degree of rigour in undertaking the testing methodologies. This has been reflected in the Annual Quality Assurance (QA) program implemented by the Central Coast Waterwatch. The QA program requires groups to test an unknown sample for key parameters. These standards are also tested by NATA registered laboratories and the results compared. Where discrepancies occur, further testing and training is undertaken with groups to identify and issues in testing methodology and rectify.

The value of Waterwatch as a program, and the data that it contributes is further reinforced by case studies demonstrating that Waterwatch testing has been effective in identifying anomalies that have lead to investigations and actions by local authorities.

Case Study: Erina High School

Each year, the Waterwatch program conducts Phosphorous Awareness Week by encouraging all groups to monitor phosphorous levels in their local waterway.

During P-Week in November 2007 students from Erina High School tested Nunns Creek, a tributary of Erina Creek. Their testing found very high available phosphate readings in a stormwater drain coming from a business area on the opposite side of the creek to their school.

The Erina High Waterwatch Group contacted the Waterwatch coordinator to verify these high results and after further testing Gosford Council's Environment Officer was contacted and came out to test again with the students.

The results were again high so further investigations and audits of nearby businesses were undertaken by the council. A car wash business was suspected of polluting the stormwater drain with high phosphate detergents and they were issued warnings. The students continued to monitor Nunns Creek and the stormwater entering from the business area and found normal phosphate levels return.

Case Study: Spring Creek Catchment, Wyong

Although not identified in water quality data, a dedicated Waterwatch volunteer noticed a change in the colour of the water in a local creek. This was only detected as the volunteer had been testing the creek on a long term basis and was observant of changes in the creek.

The volunteer found milky coloured water on several occasions whilst doing Waterwatch testing and was able to report it to the local Council who then notified the Environmental Protection Authority (EPA).

Investigation showed that a local manufacturing operation further upstream was discharging pollution into the stream and exceeding their license conditions.

Case Study: Hallards Creek

Waterwatch monitoring is being adopted as a tool by local residents along Ourimbah Creek who are wanting to actively participate in natural resource management within their local catchment.

In August 2015, community members became concerned about a change in the appearance of their local creek, Hallards Creek, a tributary of Ourimbah Creek. Ourimbah Creek is one of the four waterways that contributes to the drinking water supply for the Central Coast population.

Local residents contacted the Waterwatch Coordinator after the pollution event was observed. The pollution was traced by a local Council Officer to a landfill site higher in the catchment and is the subject of investigation by the EPA.

Community members have subsequently joined the Waterwatch program to give themselves the tools to keep monitoring the creek and identify quickly if the problem occurs again. Local residents have become active participants in the management of their local catchment through the Waterwatch program. As a result they have increased their understanding and knowledge of water quality issues, parameters, guidelines and who to contact if a water quality issue is detected.

Case Study: Long Jetty

Long Jetty is located in Wyong Shire and borders Tuggerah Lake. The Long Jetty Waterwatch group consist of five local community volunteers with broad life experiences.

The water quality of 35 drains on Tuggerah Lakes foreshore has been monitored and tested since 2010 (Figure 2). Six to eight drains are monitored monthly. Data is uploaded to the NSW Waterwatch database and reported to Wyong Shire Council.

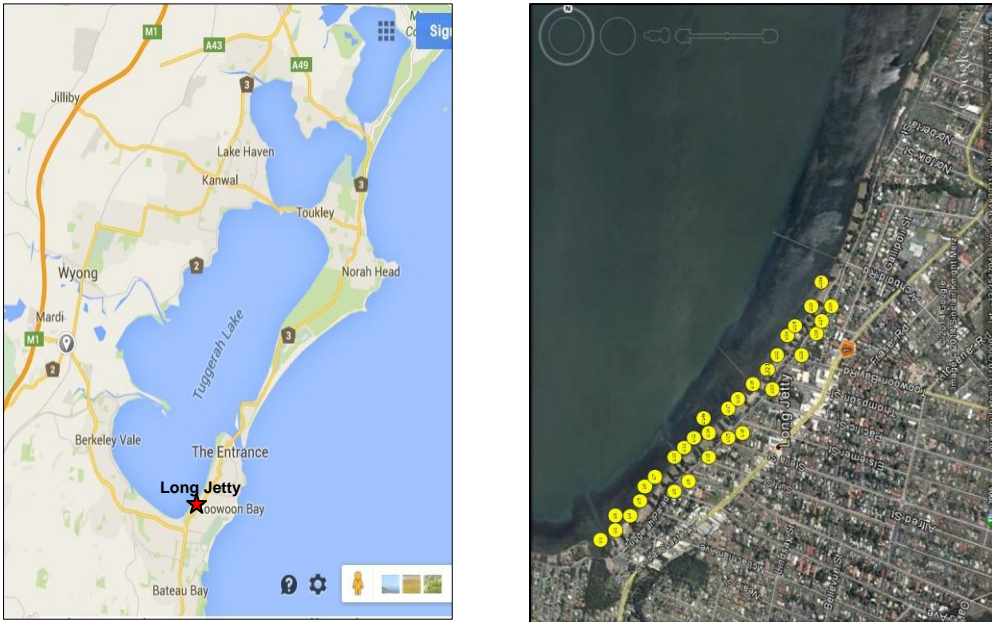


Figure 2: Location of Long Jetty and drains tested by Long Jetty Waterwatch Group

High levels of phosphate were detected over several months including during dry weather events. This alerted Waterwatch volunteers of potential problems. Observations also included duck weed flowing down the drain (not normally found in the Tuggerah Lakes system). The group contacted the Waterwatch coordinator with their concerns. A plan for further testing in the catchment was devised to verify the unusual results.

The Waterwatch group traced the problem upstream and suspected the source may be a holding dam of a local golf course. Approaches were made to Wyong Council and the golf course management and together investigations were carried out which confirmed the source of the problem.

Further meetings with golf course management achieved agreements to lower dam water levels to avoid overflow into drains except during high rain fall events. This partially solves the problem. The golf course has initiated change however more solutions are required. The integrity of the dam needs continued improvement to stop leakage into the stormwater drain and to eliminate high rainfall overflow. Other drains along the Long Jetty foreshore have recorded high phosphate levels, low oxygen, diesel odours and large amounts of rubbish.

Wyong Shire Council has begun a stormwater quality improvement program along the foreshore. Four drains identified through Waterwatch monitoring have a high priority. At present these four drains run directly into Tuggerah Lake with no filtration. The drains will be redirected into two constructed wetlands and planted with macrophytes where nutrients will be absorbed before the stormwater enters Tuggerah Lake.

Waterwatch in the Future

Waterwatch has proven itself to be a successful citizen science program that engages and educates both schools and community groups in monitoring water quality in local

waterways. The program increases the knowledge, skills and understanding of participants in terms of catchment management and broader natural resource management issues.

In addition to the education benefits provided by the program, Waterwatch also contributes valuable long term data to allow decision makers to better manage local catchments. The investment of funding bodies and governments in supporting citizen science programs such as Waterwatch achieve significant returns in terms of community participation.

As local Councils and government agencies implement processes to manage estuaries and coastal environments, particularly with the predicted consequences of climate change, an informed and engaged community is essential to improve environmental, social and economic outcomes. The ability of a broad cross section of the community to actively participate in water quality monitoring and catchment management will increase understanding, participation and acceptance of management decisions as they are implemented.

Acknowledgements

The Community Environment Network (CEN) would like to acknowledge the current funding provided by the Australian government and NSW government through the Greater Sydney Local Land Services.

CEN also acknowledges previous funding support by:

- Hunter Local Land Services (formerly the Hunter Central Rivers Catchment Management Authority)
- Gosford City Council
- Wyong Shire Council

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