HORNSBY SHIRE COUNCIL

Estuary Management

2015 Annual Report

HORNSBY SHIRE COUNCIL
Hawkesbury Estuary Program
2014 - 2015 Annual Report

Acknowledgements

The Hawkesbury Estuary Program 2014-2015 Annual Report was produced by Dr Ana Rubio and Dr Peter Coad. Assistance with programs and report contributions were provided by staff from Council's Natural Resources Branch, Planning Division and Infrastructure and Recreation Division.

For further information contact:

Dr Ana Rubio
Environmental Scientist – Estuary Program
Natural Resources Branch
Environment and Human Services Division
Hornsby Shire Council
Tel: 02 9847 6899
Fax: 02 9847 6598
Email: arubio@hornsby.nsw.gov.au
Web: www.hornsby.nsw.gov.au/estuary and www.hornsby.nsw.gov.au/waterquality

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Berowra Creek at low tide looking north into Berowra Waters

Executive Summary

The Hawkesbury Estuary Program (HEP) is managed by the Natural Resources Branch within Council's Environment and Human Services Division. The program is implemented by both Hornsby Shire and Gosford City Councils, encompassing the estuarine reaches of the lower Hawkesbury River from Wisemans Ferry to Broken Bay. Successful implementation of the HEP requires frequent assistance from other Council divisions in particular Infrastructure and Recreation, and Planning.

Hornsby Shire Council's HEP provides an integrated and strategic approach to the management of estuarine assets in the lower Hawkesbury. This is achieved through the implementation of strategies contained within the Lower Hawkesbury Estuary Management Plan (2008). This plan was adopted by both Hornsby Shire and Gosford City Councils in 2009 to ensure a consistent local government approach to estuary management within the lower Hawkesbury River. Implementation of the plan is overseen by the Lower Hawkesbury Estuary Management Committee. Projects implemented during 2014/15 (Table 1) have focused on improving swimming conditions and healthy waterways. Significant effort has been directed towards the foreshore clean-up program, environmental monitoring of the waterways, oyster research into the Pacific Oyster Mortality Syndrome (POMS), vegetation rehabilitation of estuarine reserves, and the protection of seagrass beds through the deployment of signs and education campaigns.

Key projects, to a value of $255K, were implemented in 2014-15 (Table 2) in which funding support of $74K, was received externally from the NSW State Government towards two projects: 1) the on-going monitoring of the Lower Hawkesbury estuarine health through real-time water quality probes and 2) the rehabilitation and management of the riparian zone in Brooklyn Park, Salt Pan Reserve and Bar Island. In addition, $27,000 from Hornsby Shire Council's Catchment Remediation Program was allocated to support the Foreshore Clean4Shore Program that engaged more than 200 volunteers and removed over 6.5 tonnes of foreshore marine debris.

A number of funding applications have been secured for projects in 2014/15 which include a hydrological investigation of tidal regimes at One Tree Reach wetland to inform optimal weir management and enhancement of the wetland function in regards to vegetation, water quality and fish stocks. Funding has also been secured to continue the research on POMS in partnership with the University of Sydney to further understand the spatial distribution and random characteristics of the virus activity. This research will provide industry with tangible solutions to continue farming oysters in infected estuaries like the Hawkesbury River. Funding has also been secured for vegetation restoration work and community activities in Milsons Island and Passage, and Bar Island.

Three prestigious awards were received this year from NSW EPA, Landcare Australia and NSW Coastal Conference highlighting the significant outcomes achieved from programs like the Clean4Shore Program, Floating Landcare and the innovative autonomous real-time water quality monitoring network that Council manages to ensure safe swimming conditions and healthy waterways

Table 1 Hawkesbury Estuary Program projects undertaken during 2014-15

Category	Project Description
On-ground Works	Foreshore Clean Up – "Clean4Shore"
	Foreshore Rehabilitation
	Floating Landcare
	Mangrove Watch at Marlows Creek
	Kangaroo Point Vessel Pump out Facility
Compliance	Riverside Settlements Onsite Wastewater
	Seagrass Beds Protection
Planning	Comprehensive Local Environment Plan
	NSW Boating Plans
	Commercial Fishers reform
Research	Tailor Stocks in the Hawkesbury
	Real-time water quality monitoring: - Algal blooms - Swimming conditions - Estuarine health - Water Quality Monitoring
	Pacific Oyster Mortality Syndrome
Education	Events: Brooklyn Spring Fair Fenwicks Marina Open day Guided Bushwalks Program
	Marine Discovery Talks
	Seagrass Education Campaign
	HawkesburyWatch Webportal

The following outputs were achieved in 2014-15 through the implementation of the Hawkesbury Estuary Program:

- 7.2 tonnes of marine debris was removed from the Lower Hawkesbury foreshore by 408 volunteers as part of the Clean4Shore Program and Floating Landcare. Plastic items are still an issue on marine debris accounting for 50% of the overall waste collected.
- A total of 3640hrs were invested in bush rehabilitation work targeting 3.1ha of coastal native vegetation and 9.5ha of terrestrial native vegetation. 1300 plants were planted around Brooklyn Park, McKell Park and Kangaroo Point. This work was undertaken by Council staff, contractors and Floating Landcare.
- Mangrove health monitoring program was undertaken during 2014/15 as a result of unexpected dieback of a small pocket of mangroves south of Marlows Creek.
- 16.3ha of seagrass beds keep being protected by aqua buoys and navigational markers to encourage good boating habits near seagrasses
- A seagrass education campaign continues from last year with the delivery of 600 brochures and 150 stickers, including public and school talks delivered to 112 school kids and 25 community members
- A total of 150 community members took part in Council's Guided bushwalks around the estuary
- 2 community events were attended and 2 catchment tours were organised at which education material was disseminated in regards to water quality, stormwater treatment and seagrass protection
- Design and installation of two state-of-the-art signs to promote Dangar Island's foreshore as key area for migratory birds stopover grounds
- 16 riverside settlement onsite wastewater system were inspected and 255,600L of effluent was collected via Council's boat pump-out at Kangaroo Point
- On-going water quality monitoring via autonomous real-time monitoring stations at 6 locations along the salinity gradient between Wisemans Ferry and the estuary entrance. Slightly higher than usual incidence of algal blooms were observed this year in Berowra Creek with no causative agent identified
- Overall estuarine health levels, as per OEH scores, ranged between 'Good' and 'Fair' throughout the year with improved levels during winter when overall turbidity levels are low and with worse scores during summer when chlorophyll-a levels tend to be higher
- Research partnership with UNSW looking at tailor stocks across different sites within the estuary and the role they play in the estuary food web
- HawkesburyWatch tools freely available to inform community members about algal bloom monitoring, swimming conditions, estuarine health levels and real-time water quality data. This tool won the 2015 NSW Coastal Innovation Award
- The Clean4Shore program partly funded by Hornsby and Gosford City Council was also the winner of the 'Hey Tosser' Litter Reduction Award' by the NSW Environment Protection Authority and winner of the 'Environmental Protection Award' at the 2014 Keep Australia Beautiful NSW Clean Beaches Award in partnership with Greater Sydney Local Land Services' Floating Landcare Program

Table 2 Funding received for major projects in 2014/15 and secured funding for 2015/16

Organisation	Project Title	Funding
NSW Office of Environment and Heritage	Estuarine health monitoring of Hawkesbury's waterways	**$50,000** (HSC match funding $130k)
NSW Office of Environment and Heritage	Rehabilitation and management of riparian zones in Lower Hawkesbury Estuary	**$24,000** (HSC match funding $24K)
Hornsby Sire Council – Catchment Remediation and Waste programs	2015 Clean4Shore - Lower Hawkesbury Foreshore clean-up -	**$27,000**
	Total External Funding:	**$74,000**
Secured Funding for 2015/16 projects:		
NSW Recreational Fishing Trust	One Tree Reach weir management investigation to improve water quality and fish habitat	
Fisheries Research Development Corporation & University of Sydney	Aquatic Animal Health Subprogram: POMS - closing knowledge gaps to continue farming *Crassostrea gigas* in Australia	
Pending: NSW Office of Environment and Heritage	A review of harmful microalgal to improve management and response to NSW blooms	

Media coverage for the 2014-15 year associated with the HEP has been included in Appendix 1 and 2. The media coverage in Council's estuary program acknowledges the community interest in the program, project innovation and timely deliverable of on-ground works.

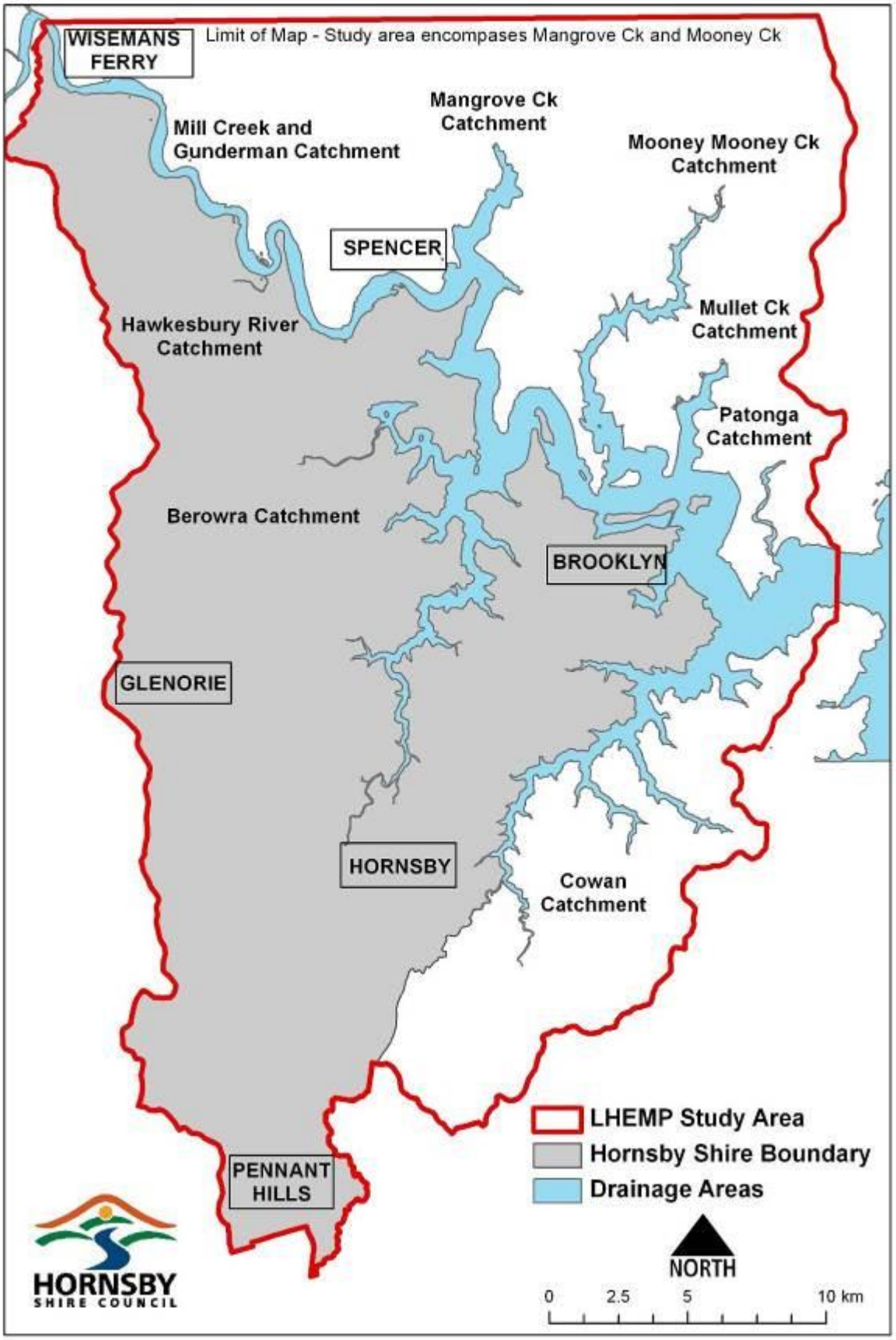

Figure 1 Lower Hawkesbury Estuary Management Plan study area (red line)

1 Hawkesbury Estuary Program

1.1 Approach

The management of estuarine areas in NSW is the joint responsibility of government agencies, commercial organisations and the community. The management framework in which the Hawkesbury Estuary Program (HEP) is implemented is directed by the NSW Government's guidelines for Preparing Coastal Zone Management Plans (2010), which supersede the Estuary Management Policy and Manual (1992). In accordance with these guidelines and policies, Hornsby Shire Council facilitates the Lower Hawkesbury Estuary Management Plan Committee (LHEMPC) which oversees the implementation of the Lower Hawkesbury Estuary Management Plan (LHEMP, 2008). The area in which this plan is applied is shown in Figure 1. This plan prioritises management recommendations for the Lower Hawkesbury in order to achieve the integrated, balanced, responsible and ecologically sustainable use of the estuary.

1.2 Goals

The LHEMP (2008) recognises that the risks to the sustainability of estuarine assets are a direct consequence of the health of the catchments within which it lies. To address these risks the LHEMP adopted a risk management approach to develop and prioritise future management actions and strategies in 2008. To set the strategic direction for the plan the following management goals were identified;

- Preserve and enhance the unique and diverse scenic and natural environment of the estuary through the integrated and holistic management of human and environmental interests;
- Conserve, protect and enhance sustainable economic, recreational and social issues without compromising the high quality and functional estuarine ecosystems upon which they rely;
- Preserve and foster the sense of belonging, culture and respect for the estuary amongst users and managers.

1.3 Implementation

The implementation of the plan is overseen by the Lower Hawkesbury Estuary Committee. The committee meets quarterly to discuss issues related to the Lower Hawkesbury and to receive a progress update on the various projects being undertaken as part of the implementation of the Lower Hawkesbury Estuary Management Plan. The minutes from this group are publically available at http://www.hornsby.nsw.gov.au/environment/water-catchments/hawkesbury-estuary/lower-hawkesbury-estuary-management-committee-meetings

The committee consists of representatives from:

- Community – Hornsby Shire and Gosford City Council residents, Local Progress Associations, Ocean Watch Australia, Boat Owners Association, NSW Water Ski Federation.
- Commercial - Sydney Water Corporation, Marina Association, Hawkesbury River District Fishermans Co-operative, Broken Bay Oysters.
- Local Government - Gosford City Council and Hornsby Shire Council
- NSW State Government - Hawkesbury Nepean Catchment Management Authority, Office of Environment and Heritage, NSW Roads and Maritime, Industry and Investment, Land and Property Management Authority.

Collaboration with other government agencies, universities, local industry and the community are important to ensure successful implementation of the HEP. Of particular note are the partnerships with the Greater Sydney Local Land Services and Universities (Macquarie University, University of New South Wales, University of Sydney and University of Technology, Sydney). Support from local marinas, community bush regeneration groups, progress associations, commercial fishers and Broken Bay Oyster Association is also gratefully acknowledged.

2 On-Ground Works

2.1 Clean4Shore program

The Clean4Shore program has now been running for 4 years. This program is coordinated by Graham Johnston from Macmasters Beach Surf Life Saving Club and has the support of a large number of volunteers who continue to remove rubbish from the foreshores of the Lower Hawkesbury River and Brisbane Waters as part of the Australian Marine Debris Initiative managed by Tangaroa Blue (http://www.tangaroablue.org/).

Hornsby Shire Council has provided a significant financial contribution to the program to cover clean-up activities in the Lower Hawkesbury during 2014-15 through council's Catchment Remediation Program whilst Greater Sydney Local Land Services is managing the program with the assistance of the Community Environment Network. Key partners in this program who have provided funding and logistical support include Greater Sydney Local Land Services, Hornsby Shire Council, Gosford City Council, NSW Office of Environment and Heritage (National Parks and Wildlife), Oceanwatch, Community Environment Network and oyster farmers. Notable oyster farmers who have contributed include Rob Moxham (Oyster Farmer - Lower Hawkesbury) and Simon Funnell (Wild Harvest Oysters - Brisbane Water).

In 2014/15 Clean4Shore organised 12 clean-up field trips covering most of the hotspots for litter accumulation after weather and flood events in the Lower Hawkesbury. During this period a total of approximately 6.2 tonnes of marine debris was collected by more than 200 volunteers. After each clean-up, the debris collected is quantified and data is being sent to the Tangaroa Blue Foundation to be included in the Australia Marine Debris Initiative. The breakdown of the rubbish items collected through the program remains comparable to previous years. Almost 50% of the litter are plastic items in particular drinking bottles, bags, food containers and packaging. Almost 15% of the litter are items made of glass or ceramic and another 15% is foam (Figure 2).

As part of the 2015 Hawkesbury Clean4Shore Program a number of school education talks are being organised with schools in the Hornsby Shire area in order to disseminate the goals and the achievements of the program. The aim is to engage more local schools within the Hornsby Shire in this program so that they can participate in some of the clean-up events and assist in raising community awareness on litter and the potential threat that it poses to the health of estuarine ecosystems.

Overall the program has demonstrated that litter in Hornsby Shire is still an issue but there seem to have been a reduction (3.5 tonnes) in the overall bulk of litter in comparison with last year. However, the source of pollution is still the same – light and buoyant materials made of plastic, glass and foam.

Hornsby Shire Council would like to acknowledge and thank volunteers from the following organisations who play a key role in this program: Brisbane Waters Secondary College, The Glen Aboriginal Mens Rehabilitation Centre, North Gosford Learning Centre, Umina Police Citizens Youth Club (PCYC), Rolland Hassall School, Macmasters Beach Surf Life Saving Club, Response Training, and The Croft. Many of these organisations involve young people with disabilities. These clients utilise the program for life and educational experience, together with community programs including the Duke of Edinburgh's Award and NSW Premiers Award.

During 2014/15 Clean4Shore program received a number of prestigious awards:

- Winner of the 'Hey Tosser'! Litter Reduction Award in NSW Environment Protection Authority, Clean Beaches Connecting our Coast Awards 2014 part of the Clen4Shore program
- Winner of the 'Environment Protection Award' at the 2014 Keep Australia Beautiful NSW Clean Beaches Awards in partnership with Greater Sydney Local Land Services' Floating Landcare program

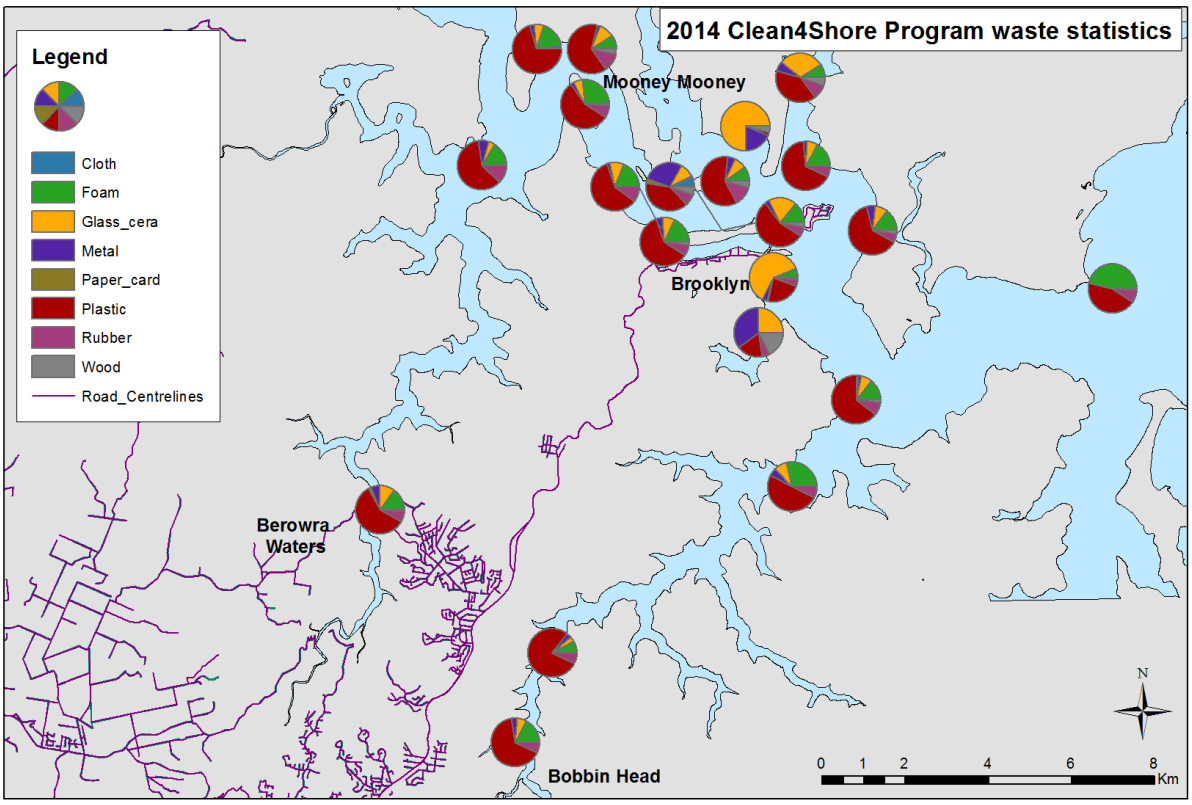

Figure 2: Location of Clean4Shore clean-up field trips including the breakdown of the type of litter (%) collected during 2014-15. (data collated and provided by Tangaroa Blue)

Figure 3: Some of Clean4Shore program volunteers heading off for a day-out collecting litter from the Hawkesbury foreshore

2.2 Foreshore Rehabilitation

Councils' Bushland Operations Team has continued vegetation restoration in the reserves along the foreshore of the Hawkesbury River. Works at these sites comprised of weed removal, riparian vegetation planting and bank stabilisation at these sites. A total of 1740 hours were invested in enhancing and rehabilitating 2.32ha of coastal native vegetation and 9.52ha of terrestrial native vegetation. Grant funding was obtained from Office of Environment & Heritage (OEH) for works at Bar Island, Brooklyn Park and Cole St, Brooklyn during 2014/15 and 2015/16.

2.2.1 Wisemans Ferry Recreation Reserve

Within the Wisemans Ferry Recreation Reserve works were undertaken to restore significant riparian vegetation communities of Swamp Reedplain, Swamp Oak Floodplain Forest & Mangrove, which included;

- Bush restoration works and target weeding of woody, vine and herbaceous weeds. These included privet, camphor laurel, senna, moth vine, acetosa, morning glory and tradescantia. All previously worked areas were maintained during the contract.
- Total of 167 hours of contract bush regeneration undertaken across site.
- Outputs: 1.0ha of coastal native vegetation enhanced /rehabilitated. 0.06ha of terrestrial native vegetation enhanced/rehabilitated.

2.2.2 Singleton Rd, Laughtondale

Between Singleton Road and the Hawkesbury River a significant strip of foreshore vegetation is present. Within this area important sandstone vegetation communities exist with pockets of weeds intermittently distributed throughout. The following works were undertaken within this area;

- Bush restoration which included treatment of woody weeds such as lantana, senna, camphor laurel, privet. Target weeding of herbaceous weeds and vines including arundo grass, balloon vine and morning glory was undertaken. All previously worked areas were maintained during the contract.
- Total of 125 hours of contract bush regeneration undertaken across site.
- Outputs: 0.5ha of coastal native vegetation enhanced /rehabilitated. 0.9ha of terrestrial native vegetation enhanced/rehabilitated.

2.2.3 Bar Island and Fishermans Point

Bar Island and Fishermans Point are located in the lower Hawkesbury Estuary opposite Bar Point. It contains significant vegetation such as Saltmarsh and Mangrove. Various locally significant sandstone vegetation communities are present across the Island. Works undertaken at Bar Island include 7 visits by Floating Landcare/Bushcare volunteers to assist with weed removal and debris clean up around the Island. This program was partly by the Greater Sydney LLS and OEH grant funding.

- Bush restoration works focussed on the reduction of invasive species including vinca, elastic grass, buffalo grass, lantana, asparagus fern and verbena.
- Total of 567 hours undertaken across the site includes
    - 219 hours of contract bush regeneration undertaken across site
    - 348 hours of volunteer bush regeneration under the Floating Landcare/Bushcare Program
- Outputs: 0.10ha of coastal native vegetation enhanced/rehabilitated. 3.2ha of terrestrial native vegetation enhanced/rehabilitated.

2.2.4 Brooklyn Park & Cole St Brooklyn

Bushland located near Brooklyn Park and adjacent to Cole Street contains significant foreshore vegetation comprising Saltmarsh, Mangrove, Swamp Oak Floodplain Forest and Swamp Mahogany Forest communities. Regeneration activities undertaken in this area include:

- Main weeds in this area were noxious vines and woody weeds. Priority was given to the reduction and prevention of seeding weeds & propagules. Target weeds included morning glory, acestosa, ochna, camphor laurel and privet.
- 400 hours of contract bush regeneration undertaken across both sites
- 800 plants installed along creeklines within Brooklyn Park
- Outputs: 0.6 of coastal foreshore and riparian vegetation enhanced/rehabilitated. 3.0ha of terrestrial native vegetation enhanced/rehabilitated

2.2.5 McKell Park, Brooklyn

McKell Park at Brooklyn contains the sandstone vegetation communities of Angophora Woodland on the south side and Rough barked Apple-Forest Oak Forest on the northern side. At this site restoration works included;

- Bush restoration to target woody, herbaceous and grass weeds such as lantana, privet, ochna, senna, exotic succulents, trad, and African lovegrass
- Total of 273 hours of contract bush regeneration undertaken across site
- Outputs: 0.07ha of coastal native vegetation enhanced/rehabilitated. 2.3ha of terrestrial native vegetation enhanced/rehabilitated
- Installation of 200 native plants

2.2.6 Kangaroo Point, Brooklyn

Foreshore bushland at Kangaroo Point is located west of the marina and public wharf. This bushland contains significant vegetation communities of Mangrove, Swamp Oak Floodplain Forest and Swamp Mahogany Forest. Restoration works include:

- Target weeds include privet, senna, trad, lantana, african lovegrass, asparagus fern, mother of millions
- Total of 154 hours of contract bush regeneration undertaken across site
- Outputs 0.05ha of coastal native vegetation enhanced/rehabilitated
- Installation of 300 native plants along foreshore

2.2.7 Brooklyn Road, Brooklyn

Woody weed control along roadside edge at Old Dairy Site 4 Brooklyn Rd

- Woody weeds such as privet, senna and lantana were treated
- Total of 54 hours of contract bush regeneration undertaken at this site .
- Outputs: 0.06ha of terrestrial native vegetation enhanced/rehabilitated

Future work (2015/16) on estuary vegetation restoration will be undertaken in conjunction with National Parks and Wildlife Service. Council was successful in obtaining funding for vegetation restoration and community activities from the Greater Sydney Local Land Services. The work will be undertaken in the following locations:

Milson Island – Working with the Department of Education and Milson Island staff, Contractors will map and treat *Juncus acutus* on the Island to reduce the spread within the estuary. Once treated revegetation will occur with the native *Juncus kraussii* to stabilise foreshore.

Milsons Passage – Contractors will treat woody weeds at the rear of private properties to minimise spread to bushland. A community awareness day will be held by NPWS staff for Milson Passage residents to identify and treat weeds on private property.

Bar Island – Contractors will be engaged to treat woody and herbaceous weeds on the Island, Funds will support volunteer Bushcare visits to the Island.

Figure 4: Council staff undertaking bush regeneration on one of Council's reserves

2.3 Floating Landcare

Floating Landcare Australia was set up to engage corporate volunteers in activities that support the protection and revitalisation of our waterways aimed at improving water quality, coastal and marine habitat. This initiative has been running for over twenty years. Hornsby Shire Council is one of the partner organisations assisting the Greater Sydney LLS with the management and work undertaken at the Floating Landcare sites within the Lower Hawkesbury. Volunteers visit locations that are only accessible by boat and carry out bush regeneration activities and undertake marine debris clean-ups.

Floating Landcare volunteers have participated in a total of 9 activities along the Lower Hawkesbury (Table 3).

Outputs achieved during 2014/15 include:

- 204 volunteers who invested 1180 hours in marine debris collection and bush regeneration
- 17 staff from partner agencies have supported the project with 565 hours in-kind
- 8039 m^2 of bushland weeded
- 780Kg of waste removed from 2773 m^2 of public land

http://www.hornsby.nsw.gov.au/environment/bushland-and-biodiversity/floating-landcare

Table 3: Calendar dates for Floating Landcare events during 2014/15

Date	Floating Landcare Location	Activity
17/Aug/2014	Peats Bight, Mougamarra Nature Reserve	Bush regeneration
9/Dec/2014	Lion Island Nature Reserve – cancelled due to bad weather	Lantana management/ Penguin count
10/Dec/2014	Lion Island Nature Reserve – cancelled due to bad weather	Lantana management/ Penguin count
1/Mar/2015	Gentlemans Halt, Marramarra National Park	Marine debris Clean up
17/Mar/2015	Bar Island	Marine debris Clean up/ Bush regeneration
16/Apr/2015	Long Island Nature Reserve	Bush Regeneration Day
2/May/2015	Bar Point	Marine debris Clean up/ Bush regeneration
14/May/2015	Spectacle Island Nature Reserve	Bush Regeneration Day
4/June/2015	Marramarra Beach and Bar Point	Marine debris Clean up/ Bush regeneration

2.4 Mangrove watch at Marlows Creek

In early August 2014 a small patch of unhealthy riverbank mangroves (*Avicennia marina*) on the southern side of Marlows Creek were found suddenly. A closer inspection showed that only two mangrove trees were severely affected and there was no obvious signs of any agent causing the impact. Leaves were found curled and dry. This area has been monitored in a monthly basis since August 2014. The extent of the dieback has not increased. The affected trees have lost the leaves and some branches have fallen on to the ground.

Advice was received from a number of mangrove experts including researchers from MangroveWatch and TropWATER – Centre for Tropical Water and Aquatic Ecosystem Research. The dieback was believed to be caused by a lightning strike based on the size of the area being impacted and as a result of the quick death of the trees. Hence it appears that these trees were electrocuted. This is a common enough feature for mangroves in the north coast of NSW. Experts believe this is to do with the salty wet mud the trees are rooted in. Recovery will take place naturally, starting a year or so. Then it will be 15-25 years before the gap is largely filled in.

Council keeps monitoring the recovery of these mangroves by taking photographs and videos in order to quantify the slow recovery process. These images will be uploaded and shared with MangroveWatch (http://www.mangrovewatch.org.au), which is a program that has been established to address the urgent need to preserve and protect threatened tidal wetland ecosystems as well as addressing both scientific and environmental management needs. MangroveWatch is a new monitoring program that partners mangrove scientists and community participants. The program provides a standardized method to assess shoreline mangrove condition and change over time.

Mangrove dieback on 6th Aug 2014

Monitoring of dieback mangrove recovery a year later (9th Sept 2015)

Curly leaves found soon after mangroves were electrocuted

Patchy area of mangroves impacted

Figure 5: Monitoring of mangrove dieback at Marlows Creek

2.5 Kangaroo Point Vessel Pump-out Facility

Hornsby Shire Council has been managing the Kangaroo Point pump-out facility for 13 years. The facility was installed so boat users can dispose of effluent in an environmentally acceptable manner and as a practical solution to help restore water quality within the lower Hawkesbury estuary. The facility has been partially upgraded during 2014/15 with the installation of a dual flow switch pump system in order to minimise interruptions in the service. Annual pump-out volumes keep increasing. During this financial year 2014/15 the facility recorded a total of 255,600L, the largest volume recorded since Council started recorded usage levels. The summer months and public holidays continue to be the busiest periods. Council and NSW Roads and Maritime are continuously working to raise awareness of the facility and compliance amongst boat owners to protect the estuary from the illegal discharge of effluent

Facility specifications:

- Boats require a 40mm (or 1 1/2") camlock coupling to connect to the facility with operation instructions located on the pontoon.

-It is a self-serve facility that is free to all users

-The facility was connected to the Brooklyn and Dangar Island STP in 2007, which has reduced the need for a regular pump out service and on site storage of effluent.

-The Kangaroo Point pump out facility, funded by the (then) NSW Department of Land and Water Conservation, was officially opened in November 2002, by the new premier Hon Bob Carr.

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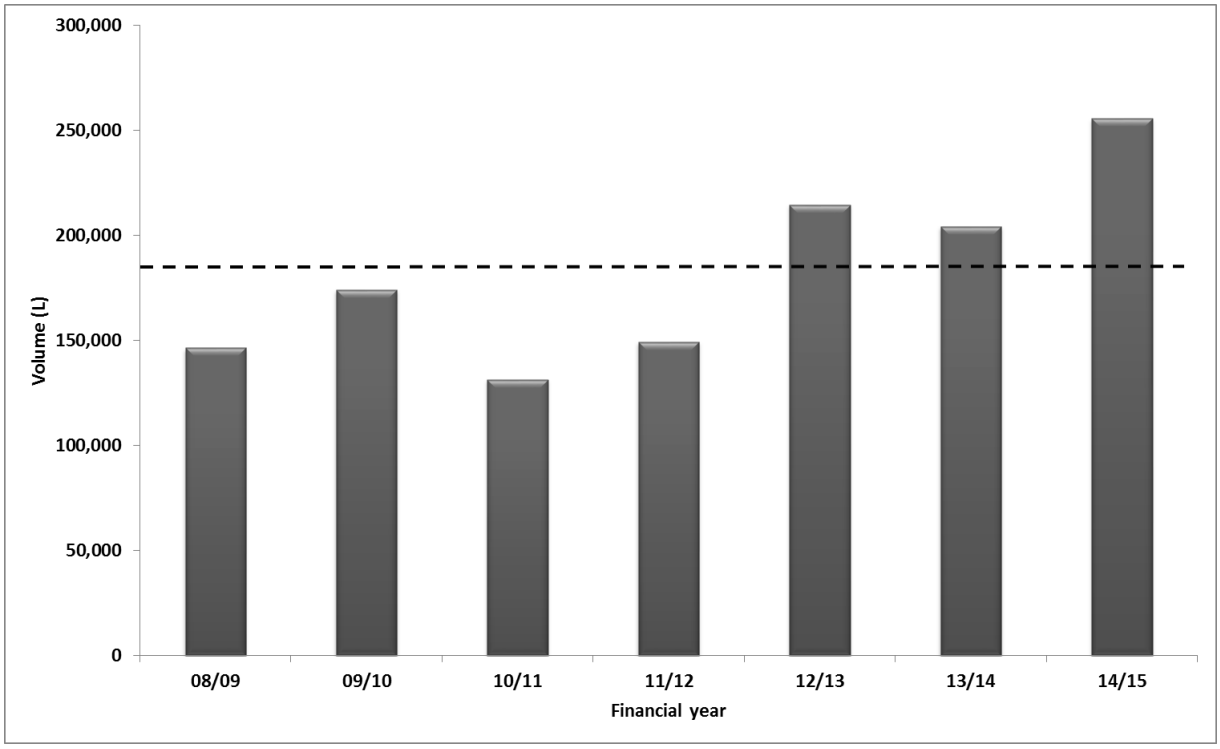

Figure 6 Kangaroo Point pump-out yearly volumes since 2008-09.

Dotted line represents the yearly averaged pump out volume (182,264L) since 2008/09 to current

3 Compliance

3.1 Riverside Settlement Onsite Wastewater Management Inspections

Compliance surveys of onsite wastewater management systems associated with riverside settlements on the Lower Hawkesbury continued in 2014-2015. These surveys aim to:

- increase community awareness of compliance issues
- support residents in selecting and maintaining appropriate onsite systems
- promote alternative technologies for waste treatment as they become available

During 2014-15, 16 riverside properties were randomly inspected (Table 4). All inspections undertaken had working onsite wastewater management systems. Additional inspections were undertaken in new dwellings as part of DA approval.

Riverside settlements are inspected once every 3 years.

Please visit Council's website for:

- General information on common types of onsite sewage treatment types
- best practice management of onsite wastewater management systems

http://www.hornsby.nsw.gov.au/property/common-enquiries/sewerage-management

An electronic request can now be made for Council to investigate a property should any community member have concerns regarding an onsite sewage management system at a neighboring or nearby property (https://eservices.hornsby.nsw.gov.au/ePathway/Hornsby/Web/Mobility/CityWatch/index.html?Module=ECRREQT&Class=&Type=DP)

Table 4 Riverside Onsite Sewage Management System Inspections in 2014/15

Inspections undertaken during 2014/15	
Suburb	**No. of Inspections for river properties**
Calabash Point, Berowra Creek	9
Singleton Road – Wisemans Ferry; Laughtondale; Singletons Mill	7
TOTAL	**16- inspections**

Figure 7: Riverside settlements along Berowra Creek

3.2 Seagrass beds protection

The Hawkesbury estuary has limited areas of seagrass beds in comparison with other NSW estuaries. There is a total of 16.3ha of dense seagrass meadows in Lower Hawkesbury. In addition, along the estuary there are patchy areas with seagrasses but these have not formed dense beds as yet.

A number of strategies have been used to minimise boating impacts on the larger areas of seagrasses showed in map below (Figure 8), which include:

- Marker buoys around the edge of seagrass beds indicating shallow areas with seagrasses
- Navigational markers re-directing boats away from seagrass areas
- Education initiatives such as: overlaying the seagrass layer on RMS boating maps, providing stickers with the location of the seagrass beds and with key messages about the importance of the seagrass ecosystems, educational brochures, public talks and school talks

Funding has been secured from the NSW Office of Environment and Heritage and Hornsby Shire Council to implement some of these initiatives. These approaches have minimised the impact of boaters on seagrasses in some areas. However, continued seagrass marking and education is needed to remediate and protect these highly important ecological areas.

Seagrass beds are important estuarine habitats to protect. They provide (i) habitat for fish and other aquatic fauna, (ii) protection reducing erosion and improving water quality and, (iii) a source of food for fish and other aquatic fauna. Seagrass beds are extremely fragile habitats that are easily damaged directly from boating related activities such as anchoring and boating across the beds, in particular at low tide which results in propeller scarring.

The continued protection of seagrass beds from boating activity is required to ensure their long term survival and to maintain their important role in contributing to a healthy estuarine ecosystem within the Lower Hawkesbury Estuary.

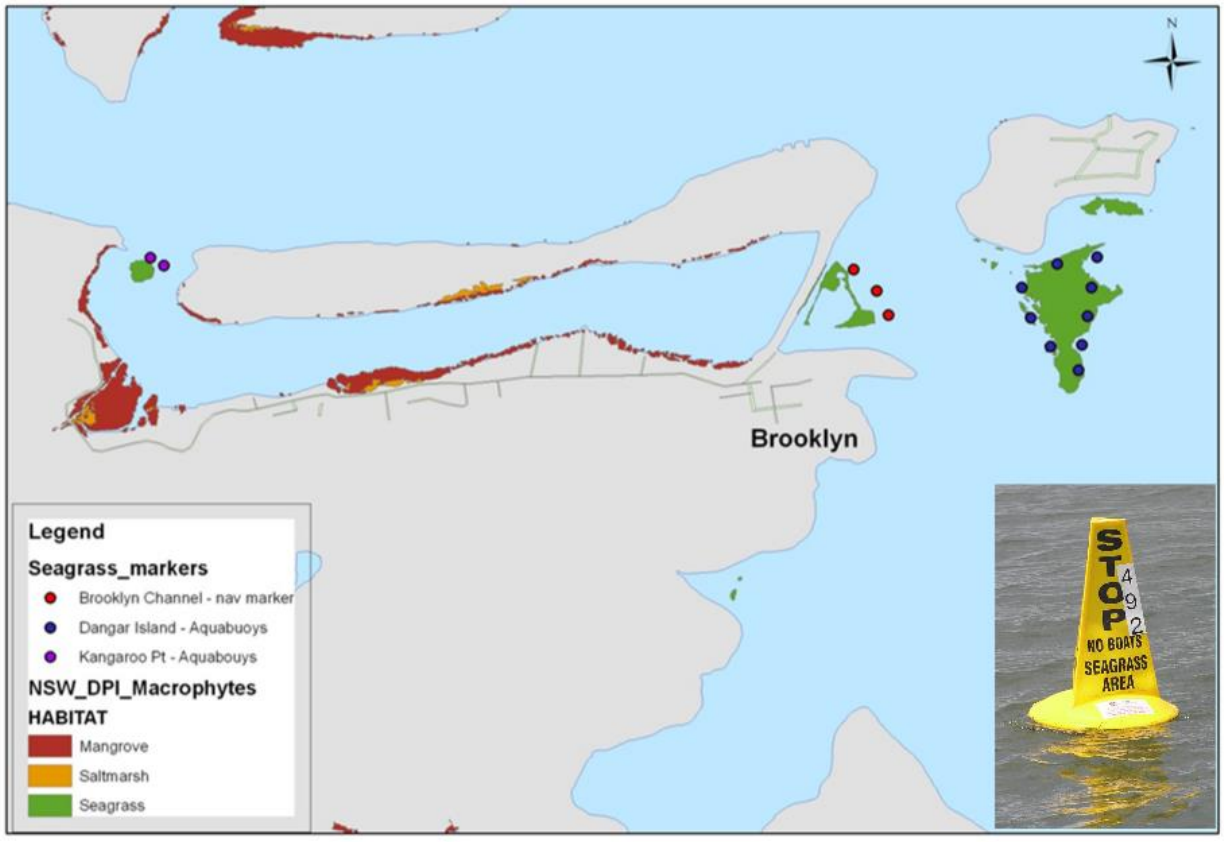

Figure 8 Map of the location of the seagrass buoys and cardinal markers directing boaters away from seagrass beds

4 Planning

4.1 Comprehensive Local Environment Plan

The Hornsby Local Environmental Plan (HLEP) 2013 came into effect on 11 October 2013 and has subsequently been amended. The preparation of the new HLEP was guided by endorsed planning studies, including the Waterways Review (SJB, 2005 and 2006).

The HLEP 2013 is Council's principal governing environmental planning instrument. The HLEP 2013 determines what can be developed and where, and how much development can occur. The current version of the HLEP 2013 can be viewed on the NSW Legislation website. Supporting documents of the HLEP 2013 can be downloaded from the council's website
http://www.hornsby.nsw.gov.au/property/development-applications/hornsby-local-environment-plan

A web based mapping tool exist to assist the community to identify all the planning controls that apply to any property at glance. The new CLEP will afford greater planning protection to estuarine assets. The CLEP includes the following zoning strategy for the Shire's waterways to implement the recommendations of the Waterways Review:

- W1 Natural Waterways - applied to the majority of the lower Hawkesbury River to restrict uses consistent with the scenic and environmental qualities of the area;
- W2 Recreational Waterways - applied to areas in Brooklyn and Berowra Waters to permit a broader range of uses consistent with the use of these areas for recreational pursuits;
- E2 Environmental Conservation - applied to mangrove, saltmarsh, seagrass and other important aquatic communities below the MHWM;
- E1 National Parks and Nature Reserves - applied to areas where National Parks extend over the water.

4.2 NSW Boating Plans

A review of existing boating infrastructure, facilities and safety measures was undertaken by the Maritime Management Centre within Transport for NSW (TfNSW) together with Roads and Maritime Services to ensure our waterways remain safe and accessible into the future. In early 2015 the Maritime Management Centre (MMC) released eleven Regional Boating Plans identifying priority boating safety, access and infrastructure actions needed to improve the boating experience in NSW. The plans were developed following an extensive consultation process in 2014 involving local councils, boating stakeholders and waterway users in each region.

A total of 192 Priority Regional Projects have been identified across NSW. MMC and the NSW Maritime Division of Roads and Maritime Services are now working with Councils to finalise details of how these projects will be delivered.

'NSW Boating Now' is a five year boating infrastructure to support the delivery of new and improved boating facilities through partnerships with local councils and other organisations.

The objectives of 'NSW Boating Now' are to:

- enhance the boating experience in NSW by improving the overall capacity and amenity of boating infrastructure on NSW waterways, informed by direct engagement with local boaters.
- ensure local boaters see a greater return from their registration and licence fees through improvements to local boating facilities.
- deliver projects through effective partnership arrangements with Councils and other organisations.
- deliver important projects identified through the Regional Boating Plans, not just wait for Councils to apply for funding grants.

4.3 NSW Commercial fishers reform

The wild-catch commercial fishing industry in NSW has faced a range of challenges in recent times, including increasing pressure over access to resources, and pervasive beliefs among sectors of the public that the industry does not operate in a sustainable manner and that it does not play a key role in our society. However, the NSW commercial fishing industry has a value of $90 million annually at the first point of sale – the industry also supports related jobs in the seafood processing, wholesalers, exporters, the transport sector as well as supplying fresh seafood to local cooperatives, restaurants and retail outlets (NSW DPI website). The NSW commercial fisheries are carefully managed. The resource is shared amongst over 1,000 commercial fishers. In the Hawkesbury estuary the primary species caught by the Hawkesbury trawl fishery consist of School prawns and calamari, followed by eel and lobster.

The NSW Commercial Fisheries reform program resulted in changes in the management of shares and offered exit grants which industry believes does not benefit them. Some of the Hawkesbury trawlers believe that if the reform is to go ahead, only one of 55 prawn trawlers on the Hawkesbury will be able to fish in the estuary. Ministerial decisions on the reform packages were postponed last year in order to take into consideration the numerous feedbacks received on the reform. The Structural Adjustment Review Committee (SARC) released in August 2015 its draft recommendations and has now completed its targeted consultation over the recommendations with industry and other key stakeholder groups. SARC is collating all feedback received before sending its final recommendations to the minister in the upcoming months.

In the meantime a socio-economic study of the NSW wild catch fishing industry is being undertaken by researchers from UTS and funded by the Fisheries Research and Development Corporation (FRDC). There is a lack of sophisticated information about the economic contributions of commercial fishing that puts commercial fishers as a group at a disadvantage compared to competing resource users in negotiations over access to fishing grounds. Equally, there is also a range of social impacts that have not been systematically evaluated in NSW. The project has already undertaken an economic study directed to fishermen. Currently researchers are drafting social surveys that are going to be directed to: 1) the wide community (phone survey) to gain consumer preferences in regards to seafood and the perception of industry; 2) fish receivers and co-ops focusing on consumer preferences in regards to seafood, importance of the local industry to these businesses and community contributions of these businesses through sponsorship, donations, employment and training and 3) tourism operators (internet survey) focusing on the value of the seafood industry as a tourism product.

Figure 9 Trawler at the mouth of the Hawkesbury Estuary catching prawns

5 Research

5.1 Tailor stocks in the Hawkesbury – research partnership with UNSW

The School of Biological, Earth and Environmental Sciences of the University of NSW is undertaking a research project on tailor stocks along the NSW coastal including the Hawkesbury River with support of Hornsby Shire Council.

Tailor (*Pomatomus saltatrix)* are the only recreationally and commercially important fish species with a distinct estuarine juvenile phase in their life cycle. The age-growth curve and dietary analysis of juvenile tailor will provide insight into regional growth rates and diets of a key estuarine predator. This research will provide a quantitative assessment of the contribution of the Hawkesbury River to the NSW east coast population of Tailor and considers the following questions:

Are juvenile Tailor the same across the estuary?

Do some tributaries or areas lead to faster/slower growth due to differing prey availability?

Due to the vastness of the Hawkesbury, the microchemistry between various sites may also answer these questions highlighting areas that are important for fish production within the Hawkesbury.

The objectives of this research project are:

1. Determine the age-growth curve for Tailor in eastern Australia and identify any regional differences and provide insight into the apparent declining stock of tailor in eastern Australia.
2. Use microchemistry to calculate the contribution of specific estuaries to the spawning biomass of Tailor.
3. Investigate the diets of juvenile estuarine Tailor to estimate the consumption of baitfish as an underestimated yet key estuarine ecosystem component.

So far 11 NSW estuaries were sampled for juvenile Tailor in 2015. The goal is to repeat the sampling in 2016. Commercially caught coastal fish are also being collected via monthly market sampling.

Juvenile Tailor from 6 estuaries contained parasitic isopods in their mouths and juvenile tailor from 4 estuaries contained parasitic nematodes. Coastal caught fish did not contain any parasitic isopods but did occasionally contain nematode parasites.

Preliminary diet analysis shows that juvenile tailor eat a variety of foods, dominated by crustaceans and small fish while the diet of adult tailor is predominately fish.

This research project will continue next year and will benefit the management of the Hawkesbury River by:

1. Identifying whether any areas within the Hawkesbury are particularly important for fish production or that promote faster growth.
2. Calculating the growth rates of Tailor in the Hawkesbury River, and allow better management of the declining stock.
3. Identifying the food web linkages involving Tailor in the Hawkesbury River ecosystem and increase understanding of the often understudied pelagic food web.
4. Quantifying the contribution of the Hawkesbury River (as a nursery) to the commercial and recreational fishing industries in coastal NSW.

Figure 10 Juvenile Tailor caught in the Hawkesbury for research purpuses

5.2 Water quality monitoring network

Hornsby Shire Council has established a comprehensive water quality monitoring network within the Hawkesbury Estuary to manage estuarine algal blooms and advice on water quality conditions suitable for swimming, recreational boating and commercial harvesting of seafood. This monitoring network was established in 2004 in partnership with NSW Public Works - Manly Hydraulics Laboratory (MHL).

The network is comprised of a series of buoys that house autonomous, extremely accurate water quality probes which collect high frequency data (every 15 minutes) on water temperature, salinity, chlorophyll-a and turbidity. Data collected is transmitted to Council's publically accessible webpage and app every 6 hours using telemetry. The probes are calibrated and replaced every 3 weeks in summer and 4 weeks in winter to maintain the systems accuracy and reliability. Quality control checks are performed at probe changeovers to ensure data quality. In addition to the probe network, water quality sampling takes place at the probe locations during the probe changeover to collect phytoplankton species, density and diversity and a range of other biological (including bacteria), physical and chemical data.

Deployment of this technology provides a high frequency, near real time understanding of key estuarine processes which assists in a rapid management response to important changes to estuarine health (e.g. flood and algal events) (refer to http://mhl.nsw.gov.au/projects/berowra/latest.php and http://mhl.nsw.gov.au/projects/hscsal/). This data is coupled with a 3D hydrodynamic model of the Lower Hawkesbury, which is run daily by Manly Hydraulics Laboratory (MHL) and interpolates data between the buoys. The model incorporates the probe data together with environmental data sourced from Bureau of Meteorology, MHL, Sydney Catchment Authority, Office of Environment and Heritage and NSW Office of Water.

Probe data and model outputs are collated in a user-friendly webportal called HawkesburyWatch which is used in the management of algal blooms, to inform community members of swimming conditions and estuarine health conditions and, to display spatially resolved model data for temperature and salinity which is of use to recreational and commercial estuarine users (further information on section 6.5).

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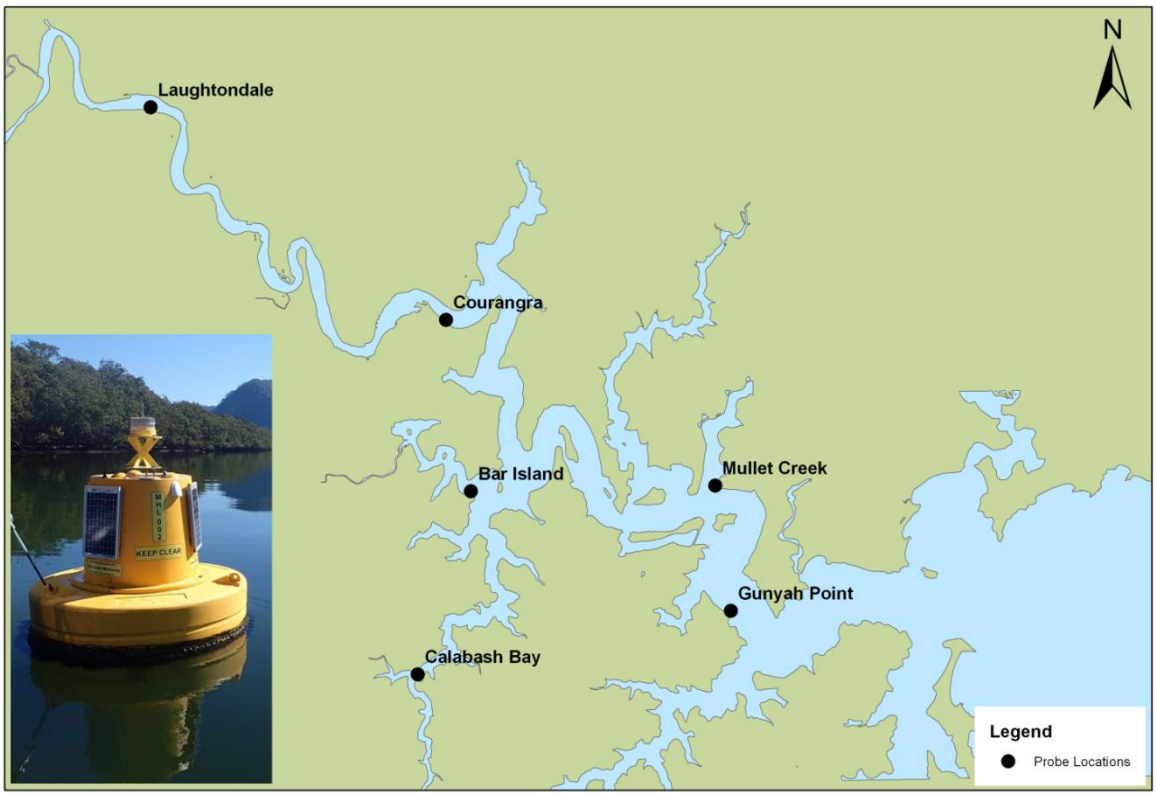


- **Figure 11** Location of remote water quality probes in the lower Hawkesbury River.

Data from the real-time probes has been collated in a whole year around time-series plots to show a number of processes that occurred in the estuary during 2014/15. Two major rain events occurred in the last year at the end of August 2014 (25mm + 15mm) and at the end of April 2015 (250mm). The April storm was exacerbated with strong winds which resulted in significant floods. Salinity levels in the whole estuary dropped to close to zero even at Gunyah Point, the most oceanic monitoring station. At all monitoring sites, an increase in turbidity followed by the drop in salinity was eminent. Weeks later, as turbidity levels dropped, there was a significant increase in chlorophyll-a levels. During the April severe storm the Laughtondale upstream monitoring buoy got damaged and broke loose from its mooring drifting slightly downstream. Large tree debris floating down the estuary pushed the buoy under water (Figure 12) damaging the electronics and probe components. Courangra buoy moved slightly downstream with the upstream flooding waters but did not break the connection to the mooring.

Markedly higher levels of chlorophyll-a were seen at Calabash probe versus the other 5 probes. This is consistent throughout the years as Calabash Point is known to be more prone to algal blooms.

Figure 12 Laughtondale monitoring station buoy half submerged as a result of vegetation debris being collected on the mooring

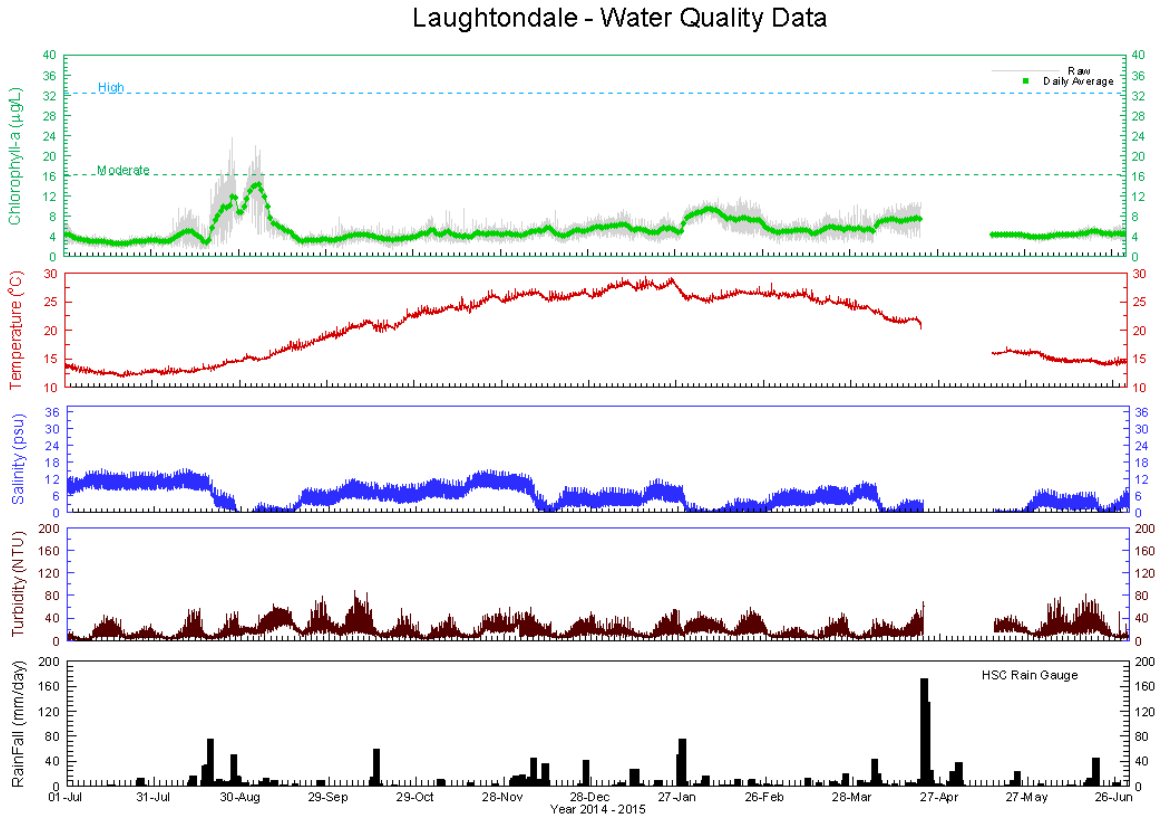


Figure 13 2014-15 Water quality summary data for upstream probe at Laughtondale. Data was not collected during the first 3 weeks of May as the buoy was severely impacted by the extreme weather and storms

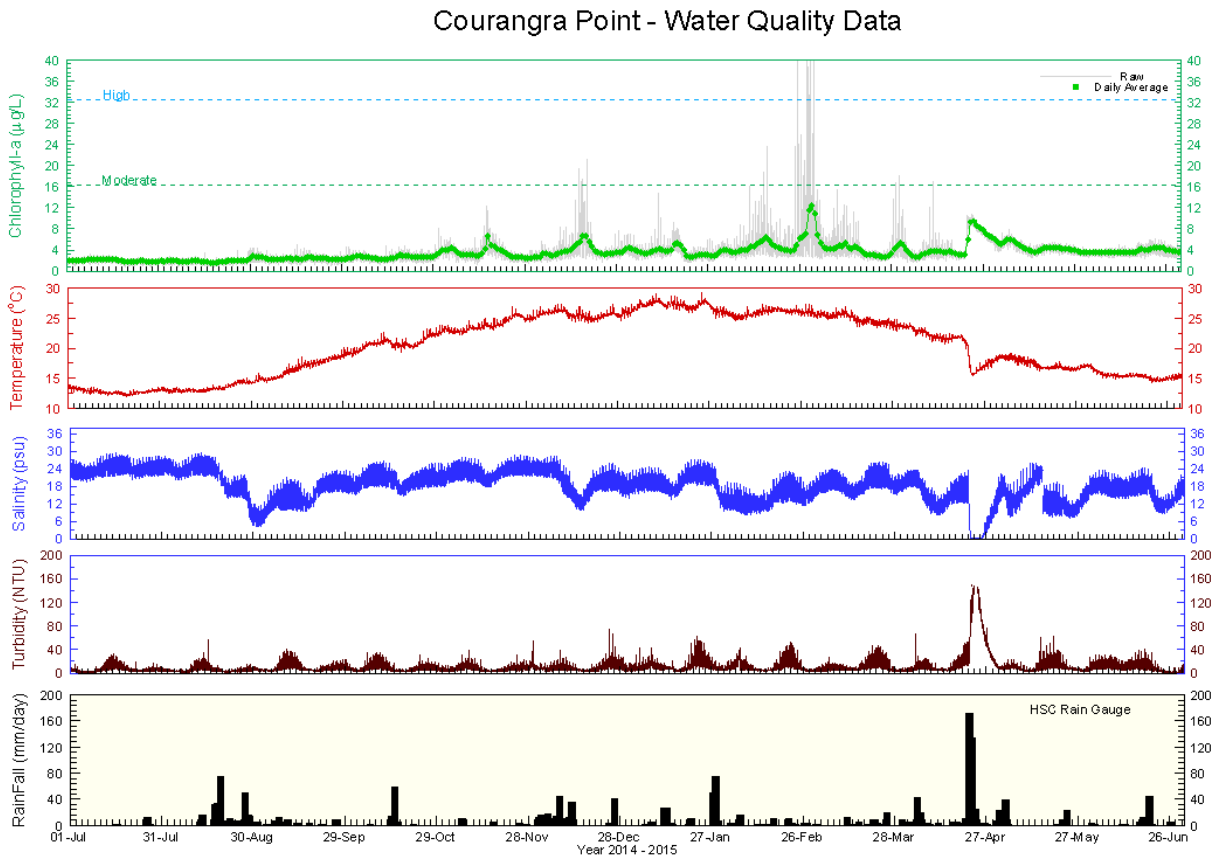


Figure 14 2014-15 Water quality summary data for mid-upstream probe at Courangra Point

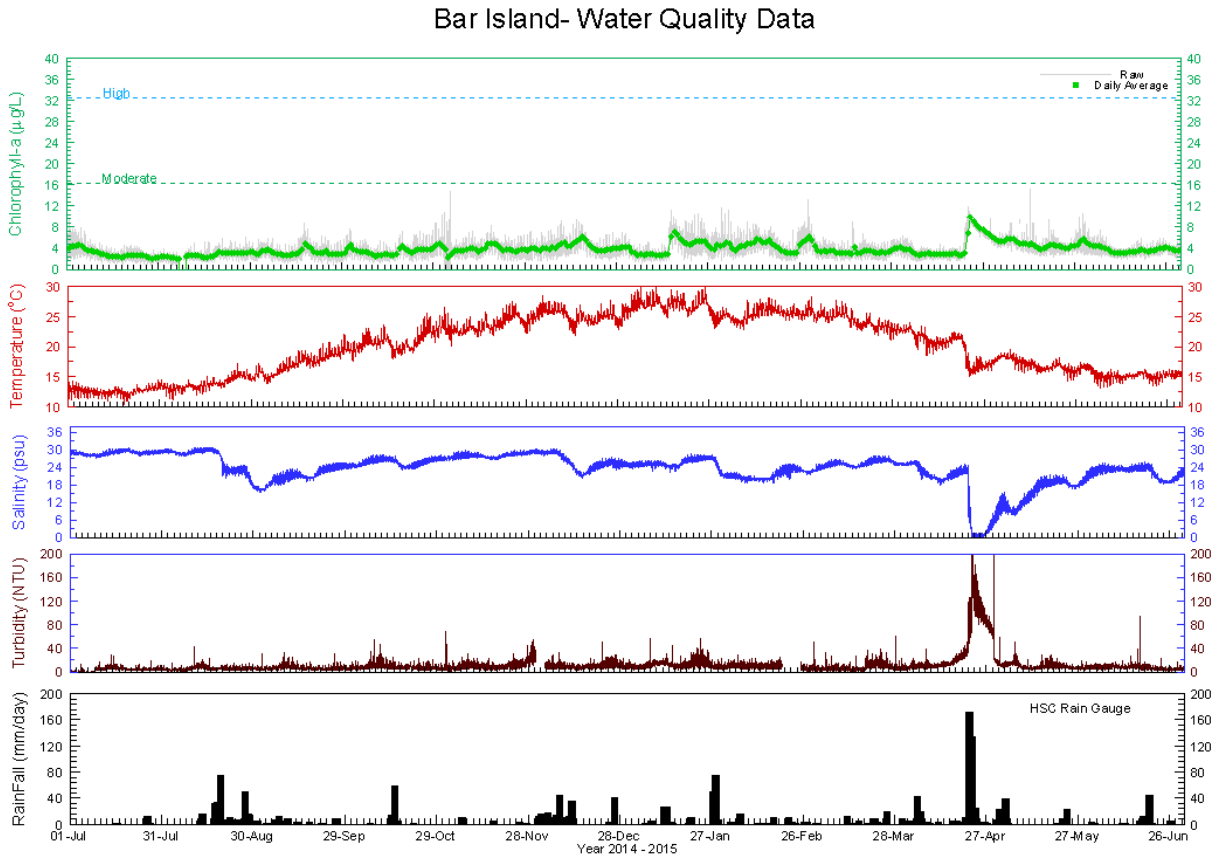


Figure 15 2014-15 Water quality summary data for probe at Bar Island

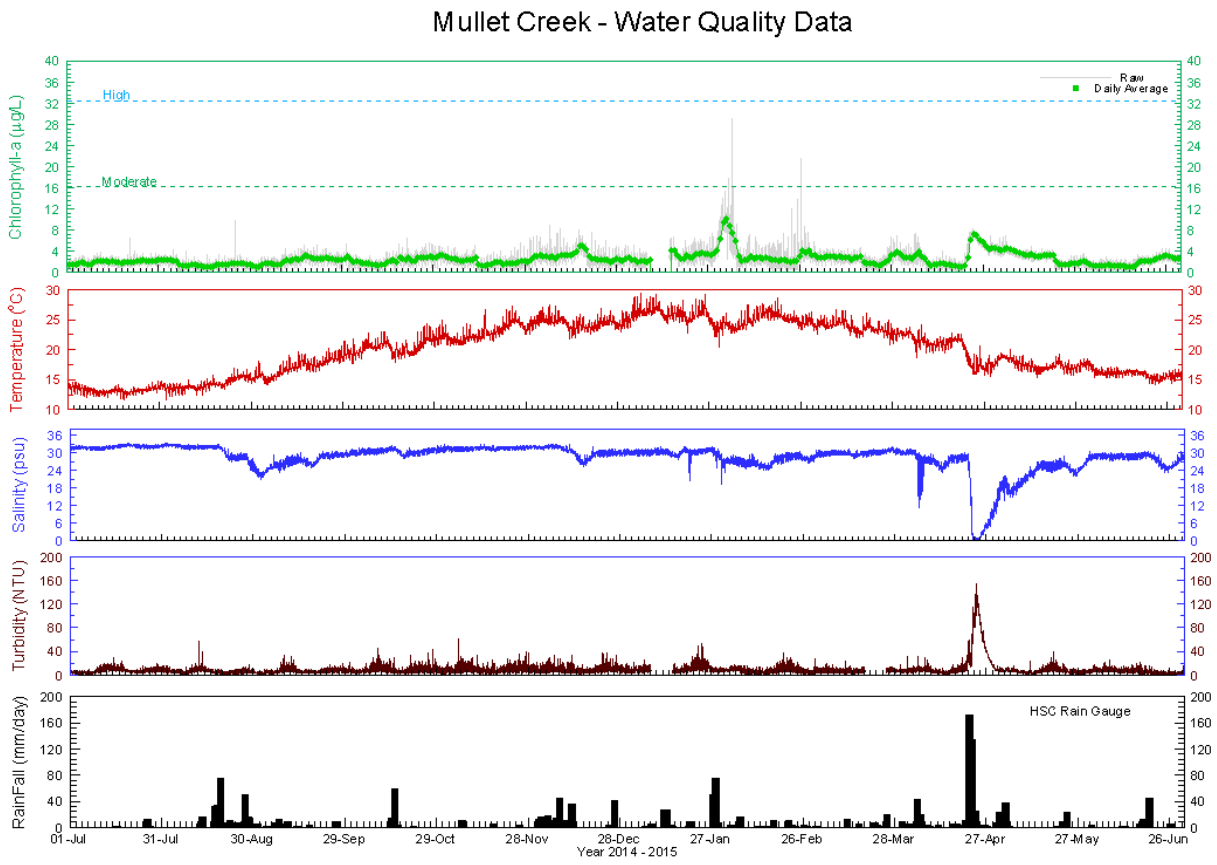


Figure 16 2014/15 Water quality summary for probe Mullet Creek

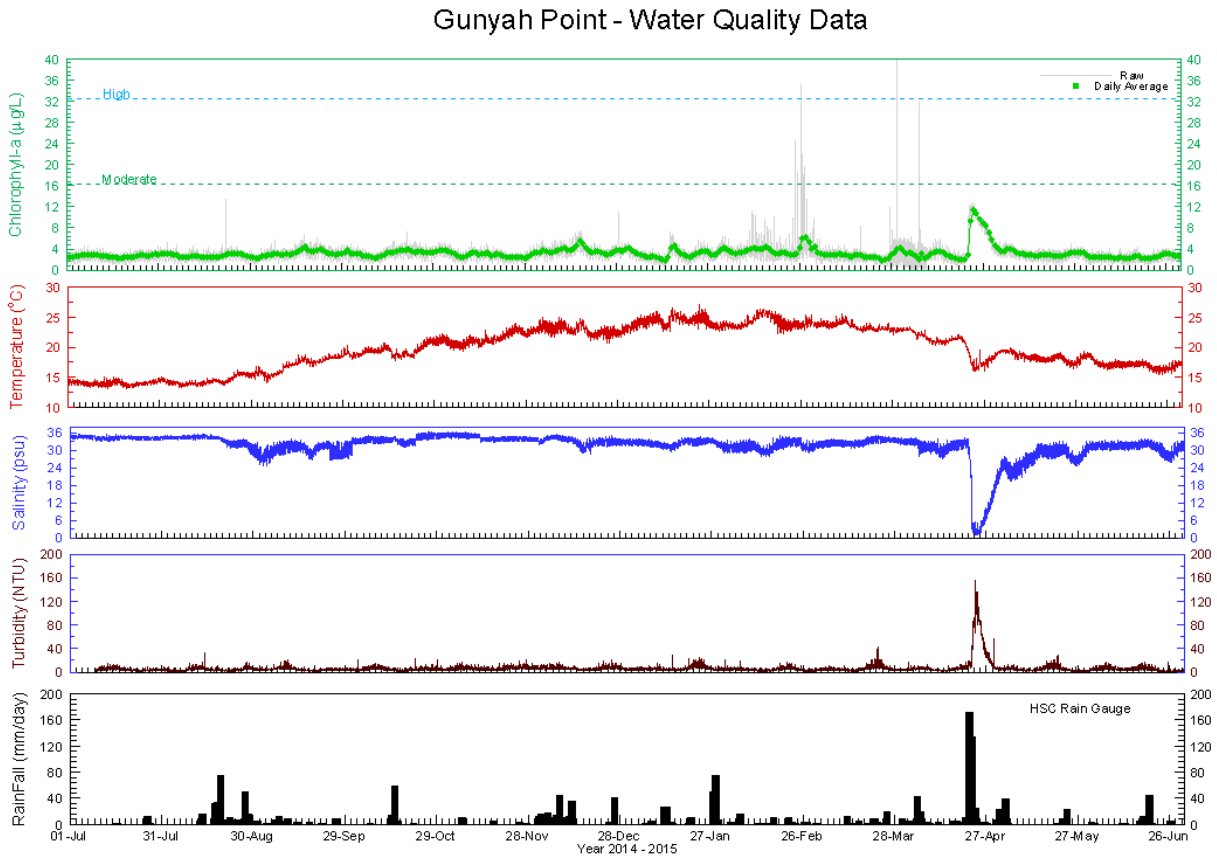


Figure 17 2014-15 Water quality summary data for downstream probe at Gunyah Point

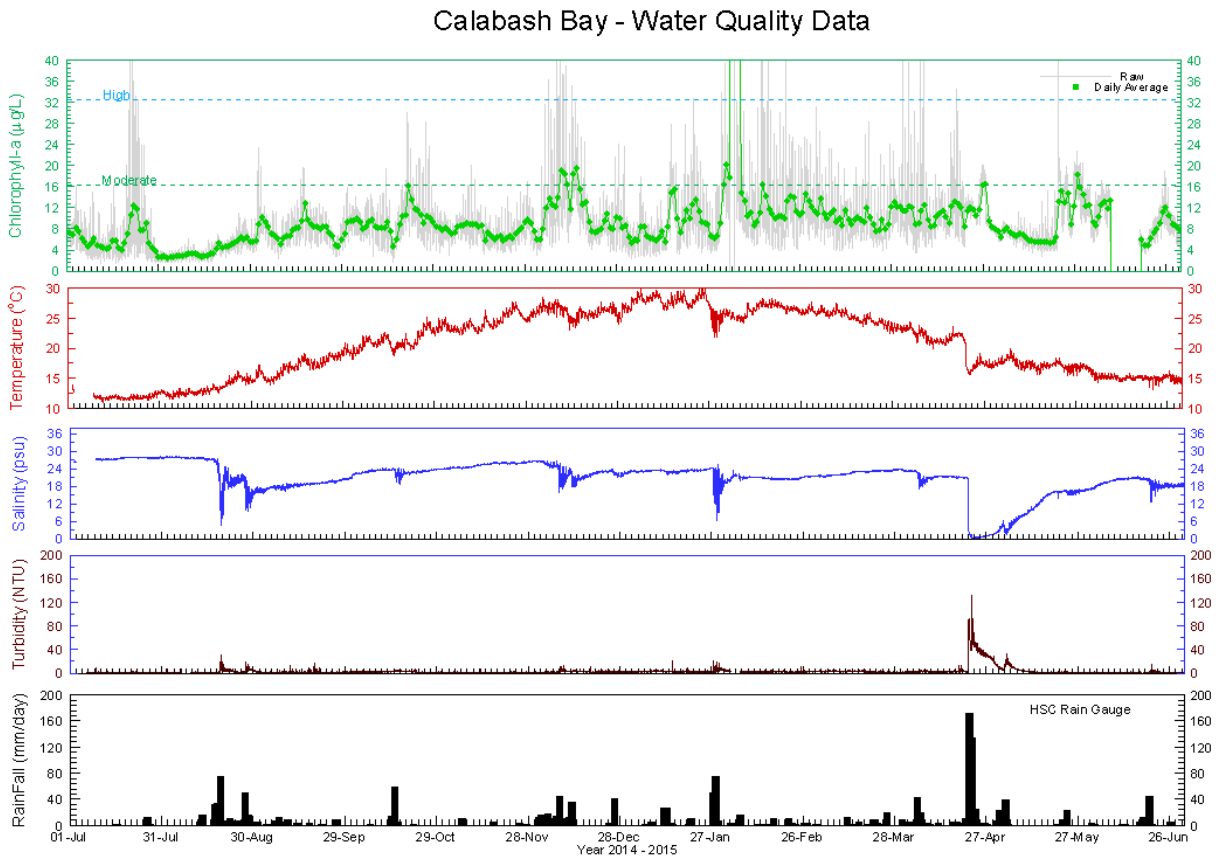


Figure 18 2014-2015 Water quality summary data for probe at Calabash Bay in Berowra Creek

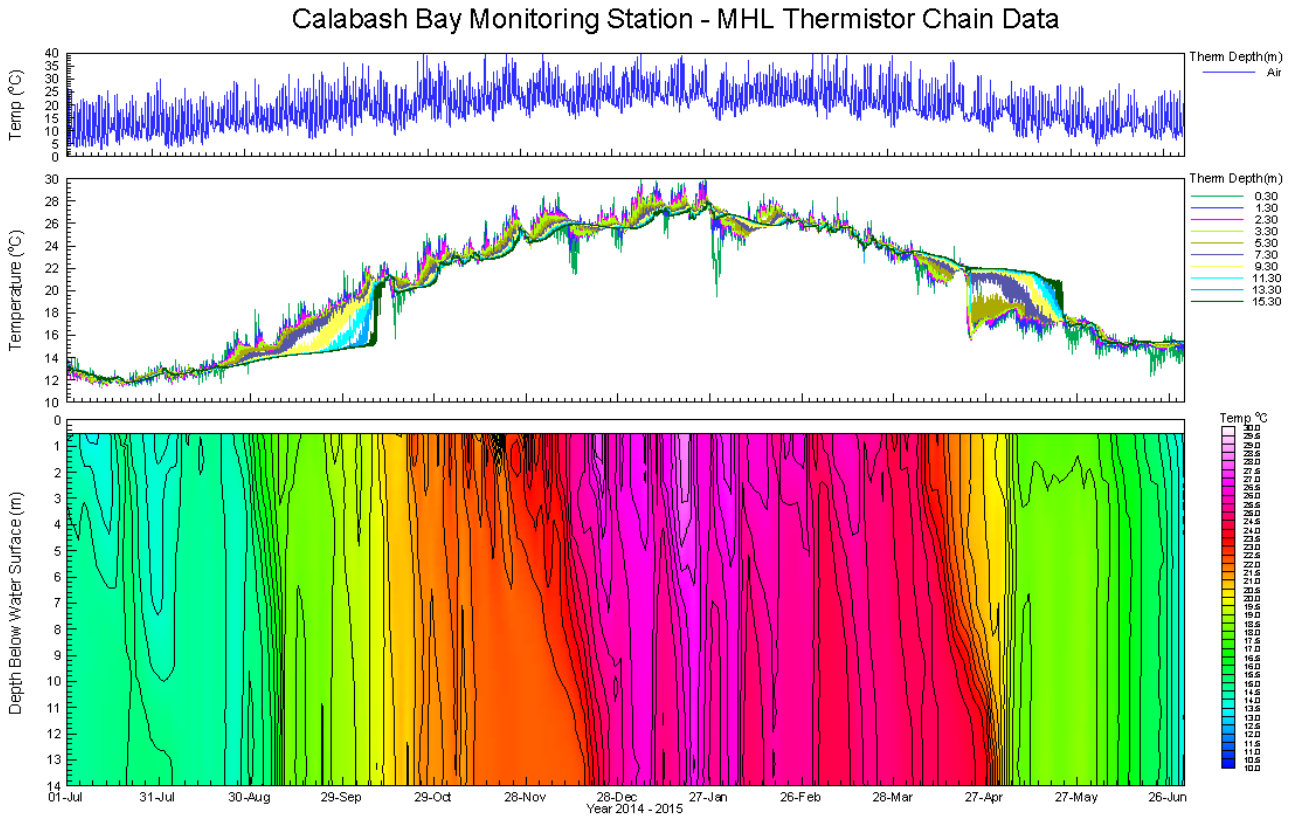


Figure 19 2014-15 Thermistor chain data at Calabash Bay in Berowra Creek

5.2.1 Algal bloom management

Algal blooms are one of the most challenging issues to manage in an estuary. In most cases algal bloom management programs monitor sites at a low frequency (usually weekly to monthly) and/or rely on reactive monitoring whereby monitoring takes place once a bloom has been detected or observed. Council's system, however, provides real-time assessment of any problems together with a means to quickly disseminate the information to swimmers, recreational users, etc. Real time monitoring of chlorophyll-a levels can also be used by oyster farmers and commercial fishers to determine productivity levels. This can be determined as the growth of oysters and prawns is faster during periods of high productivity, which is indicated by high levels of chlorophyll-a. Researchers also use the high frequency data to understand environmental conditions that trigger harmful algal blooms.

The occurrence of algal blooms and the potential threats from the introduction of non-indigenous phytoplankton species can be a problem in the lower Hawkesbury River. These blooms can potentially discolour the water and cause fish kills, particularly around the deep waters of Calabash Bay in Berowra Creek. Depending on the algae species present, these blooms pose a threat to local biota, the aquaculture and fishing industry, recreational pursuits and public health.

To monitor algal blooms all 6 water quality probes have a chlorophyll-a sensor. These sensors are used as an indicator of the amount of pelagic micro-algae (phytoplankton) present in the water column which in turn respond to concentrations of nutrients, water temperature, predation and sunlight within the water. Consequently chlorophyll-a levels act as an integrative proxy for nutrient levels, catchment loads and productivity levels in the estuary.

The data from the probes indicates algal blooms generally occur during periods of warm weather and after rainfall. A specific management response is followed when a harmful species dominates the sample. During periods of harmful algal blooms, Council works in collaboration with the Metropolitan and South Coast Regional Algal Coordinating Committee (MSCRACC), administered by the NSW Office of Water, to monitor the bloom and inform the community of possible risks or estuary closures.

Higher than usual algal blooms incidents were observed during 2014/15. In particular one of the algal blooms resulted in the temporary closure of Berowra Waters prior to the Christmas period. Warning signs indicating the presence of toxic algal species as part of a public health warning were used for a period of 12 days (Figure 20). During this period we had high diversity and high abundance of a number of toxic algal species.

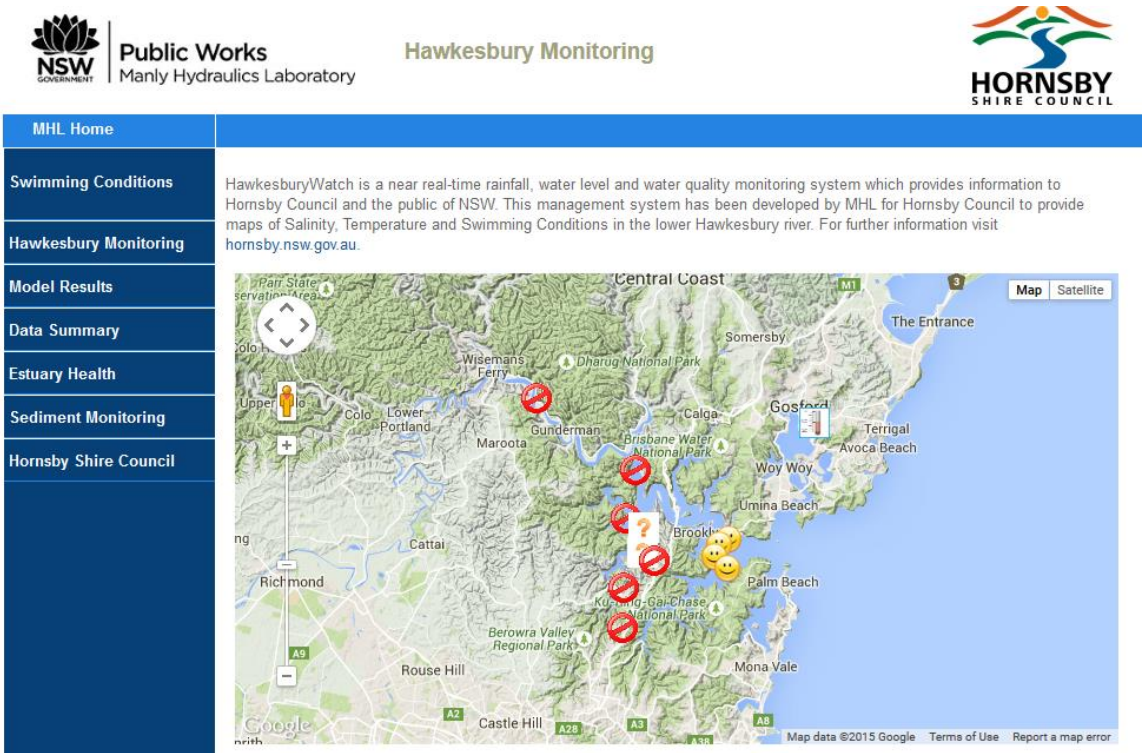
During the year, when elevated levels of toxic species are found they are normally attributed to 1 or 2 key species. Berowra Waters is the only area in the Hawkesbury estuary where certain toxic algal species tend to bloom. These algal species relate to *Alexandrium, Karenia*, *Pseudo-nitzschia pungens/multiseries* (130,000 to 200,000 cells/L), *Dinophysis acuminata* (4,500 cells/L), *Ceratium furca, Heterocapsa triquetra, Prorocentrum* and some *Cochlodinium* and *Chattonella*.

Figure 20: Location of signs displaying warning of the presence of harmful algal in the close by waterways

5.2.2 Swimming condition maps

Analysis of the probe data with field data has identified a strong relationship between bacterial levels and salinity in the estuary. Based on this relationship, bacterial levels are estimated daily using salinity data from the probes. Alert levels are based on guidelines from the National Health and Medical Research Council (NHMRC, 2008) for Managing Risks in Recreational Waters. Notably, rain events, which lower salinity due to the presence of stormwater, increase the likelihood of pollutants and harmful bacteria in areas of the estuary close to urbanisation.

Model estimates high levels of pollution, using the probe data to inform swimmers who may be at increased risk of contracting illness by swimming in the estuary following rain events. The Council's website presents daily updates on the swimming conditions at popular recreational sites in the Lower Hawkesbury (http://new.mhl.nsw.gov.au/users/HSC/). Further Council is reporting on statistics about the number of times that a certain swimming site was scored as 'Pollution unlikely' in the last 12 months. Overall sites at the downstream sites of the estuary tend to be safe for swimming in 90% of the cases.



Swimming Conditions

Pollution is likely | Swim at own risk | Pollution unlikely

Swimming Site	Salinity *Parts per 1000*	Latest data	Status	% 'Pollution unlikely' in the last 12 months
Bar Island	21.9 ppt	13 Sep 22:15	?	52.6
Calabash Bay	16.8 ppt	13 Sep 06:00	⛔	13.7
Courangra Point	18.2 ppt	13 Sep 22:00	⛔	3.56
Laughtondale	1.0 ppt	13 Sep 14:15	⛔	0
Gunyah Point	32.3 ppt	13 Sep 22:00	☺	96.16
Brooklyn Baths	26.0 ppt	09 Sep 01:59	☺	92.63
Dangar Island	29.4 ppt	12 Sep 01:59	☺	95.42
Deadhorse Bay	28.6 ppt	12 Sep 01:59	☺	92.31
Marramarra Creek	19.7 ppt	08 Sep 01:59	⛔	83
Bennetts Bay	19.5 ppt	12 Sep 01:59	⛔	62.6
Crosslands Reserve	15.0 ppt	12 Sep 01:59	⛔	0
Twin Beaches	21.5 ppt	12 Sep 01:59	?	80.15

Figure 21 Swimming scores for 14th September 2015

5.2.3 Estuarine health levels

Estuaries are important natural places that sustain key aquatic species and provide habitat, cultural, social, economic and ecological services that are important to a region. Estuarine health is directly influenced by the quantity and quality of water entering the estuary from the upper catchment and at the estuary mouth through oceanic tidal interchange. The collection and interpretation of water quality data collected through time is essential to understand climate variability and the impact of development on the Shire's natural environment.

Chlorophyll-a and turbidity data collected by Council's network of real-time probes is applied to the NSW Office of Environment and Heritage's estuarine health assessment guidelines to provide daily health status of the estuary at 5 probe locations (Figure 21). Trigger values (80th percentile of all data available for reference estuaries in NSW as defined by OEH) are calculated to highlight when an indicator is outside the expected range. The level of compliance against the trigger values are reported based on the level and frequency of exceedance. Results showing poor grades will trigger further investigation or a management action. This information is also provided to community members via the HawkesburyWatch webportal (http://new.mhl.nsw.gov.au/users/HSC-EstuaryHealth). Additional information is currently being developed to provide users with statistics on the frequency of the different health scores that each locations gets over the previous 12 months. Overall estuarine health levels ranged between 'Good' and 'Fair' throughout the year at all locations with improved levels during winter when overall turbidity levels are low. The poorest health scores are recorded during summer when chlorophyll-a levels tend to be higher (Figure 23)

5.2.4 Water quality monitoring

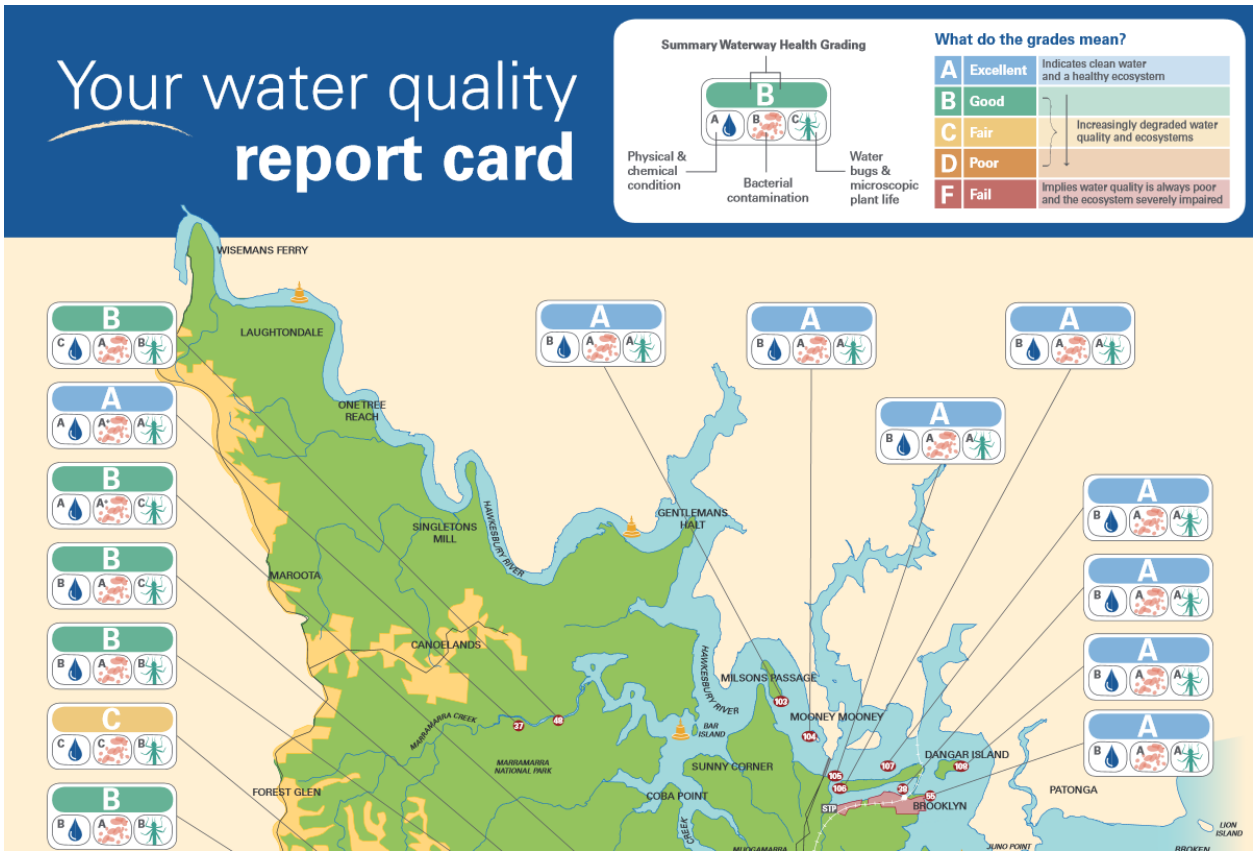


Figure 22 Snapshot of Hornsby Shire Council Water Quality Report Card

Hornsby Shire Council has an extensive monthly water quality monitoring program. This data is analysed and summarised in Council's 2014-2015 Water Quality Monitoring Annual Report (HSC, 2015), available at www.hornsby.nsw.gov.au/waterquality. Data from the monthly water quality monitoring program is presented in a report health card to make the data more accessible to community members. Results are shown in a summary brochure and a companion technical report that explains the grading process used in the report health card. Further information is available from www.hornsby.nsw.gov.au/waterquality

Public Works
Manly Hydraulics Laboratory

Hawkesbury Monitoring

HORNSBY SHIRE COUNCIL

MHL Home

Swimming Conditions

Hawkesbury Monitoring

Model Results

Data Summary

Estuary Health

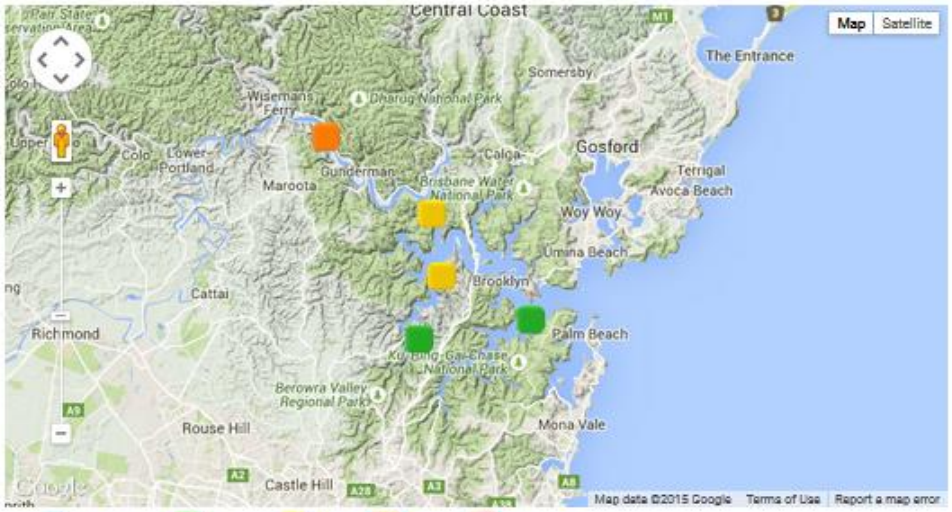
Sediment Monitoring

Hornsby Shire Council

Estuary Health / Condition

Estuaries are important natural places that sustain key aquatic species and, provide good habitat and cultural, social, economic and ecological services that are important to a region. Estuaries managed in sustainable ways, they support a variety of ongoing economic benefits to communities and industry.

The map below shows daily health/condition scores derived from real-time environmental data collected via water quality probes deployed at 5 locations along the Lower Hawkesbury Estuary. These probes take measurements every 15 min of water temperature, salinity, chlorophyll-a and turbidity and are calibrated every 3 weeks in summer and every 5 weeks in winter. The estuary health/condition grades shown on the map are calculated based on chlororophyll-a and turbidity daily data which is compared to baseline conditions/levels. Trigger values (80th percentile of all data available for reference estuaries as defined by OEH *) are calculated to highlight when an indicator is outside the expected range. The level of compliance against the trigger values are reported based on the level and frequency of exceedance. Results showing poor grades will trigger further investigation or a management action. For information on the analysis used to calculate the estuarine health scores/grades, please refer to OEH guidelines and protocols*.



Excellent Good Fair Poor Fail

Location	Grade	% for Each Grade in Last 12 Months				
		Excellent	Good	Fair	Poor	Fail
Bar Island : Fair		0.28	15.15	69.15	9.37	6.06
Calabash Bay : Good		0.82	41.64	49.32	4.66	3.56
Courangra Point : Fair		6.03	26.3	55.89	9.59	2.19
Laughtondale : Poor			3.19	33.47	46.61	16.73
Gunyah Point : Good		9.89	59.07	28.85	0.55	1.65

Report cards grades, definitions and descriptions

Grade	Result	Definition (example)	Description
	Excellent	The indicators measured meet all of the benchmark values for almost all of the time period.	Equivalent to the best 20% of scores in the state
	Good	The indicators measured meet all of the benchmark values for most of the time period.	Equivalent to the next 30% of good scores
	Fair	The indicators measured meet some of the benchmark values for some of the time period.	Equivalent to the middle 30% of scores
	Poor	The indicators measured meet few of the benchmark values for some of the time period.	Equivalent to the next 15% of poorer scores
	Fail	The indicators measured meet none of the benchmark values for almost all of the time period.	Equivalent to the worst 5% of scores in the state

Figure 23 Estuary Health scores for 14th September 2014 based on NSW OEH protocols for estuary health reporting

5.3 Pacific Oyster Mortality Syndrome (POMS) research in the Hawkesbury

Pacific oyster mortality syndrome (POMS), which appeared in NSW in 2010, is an internationally significant disease that has severely impacted Pacific oyster production in Europe and New Zealand. On January 21st 2013 the Hawkesbury River oyster growers were severely affected by an outbreak of POMS (OsHV-1 uvar virus) that wiped out the entire Pacific Oyster industry in the Hawkesbury (Paul-Pont et al 2014). POMS has had a significant social impact and reduced the economic viability of the local industry. The economic loss from POMS for the Hawkesbury growers is estimated to be more than $3 million. 30% of Hawkesbury growers sold their businesses within six months after the disease outbreak. A few others are relying on other businesses for income or have sought employment elsewhere. Currently there are only 3 out of 12 businesses remaining trying to make a living out of cultivating oysters. These growers are farming oysters in other estuaries in NSW when POMS is present and finishing off oysters when POMS is absent in the Hawkesbury. This strategy is risky as major rainfall events, pollution events or extreme environmental conditions can occur reducing even further the window during which the virus is inactive.

Extensive R&D work has been undertaken since the appearance of POMS by researchers from the School of Veterinary at the University of Sydney (Camden campus). The research project is conducted in partnership with oyster farmers whose businesses had been wiped out, by working in real-time on affected oyster leases in the Georges and Hawkesbury Rivers, and with Hornsby Shire Council. It is the first study in Australia, and one of the few worldwide, to involve very intensive long term field work to find a solution for an oyster disease. The project addresses nationally agreed priorities and complemented research to develop a genetically resistant oyster. The solution to POMS will require both genetic improvement and science-based modifications to husbandry.

Current research aims to confirm the identity of the virus, determine the mechanism(s) of transmission of disease, determine the major factors that contribute to outbreaks thereby identifying potential risk-mitigation management practices, to identify the natural reservoir(s) for the virus, its stability in the environment and disinfection guidelines, to develop a laboratory infection model to study the disease and to address future shortages of technical expertise through training a PhD student.

Based on the research undertaken so far it is known that the distribution of the disease is non uniform, clustered, highly variable in time and space, and clearly dependent on the age of oysters and their growing height or position in the water column. The virus does not appear to be transmitted free in water. There has been considerable epidemiological evidence that its distribution is clustered, and that it behaves as if it is moving together with, still to be defined, planktonic particles.

Outbreaks occur in summer preferentially in sheltered habitats, rising to 80-100% especially in younger stages of oysters. Based on 2 years of monitoring at two affected estuaries, the window of infection appears to starts at the end of October/start of November and ends by the end of May.

Water temperatures in NSW when POMS occurred were about 4 °C warmer (i.e. 20°C) than those observed in France when the disease occurs there (i.e. 16°C). This is a very significant difference in disease behaviour between Europe and Australia. It was confirmed in an experimental infection trial at the University of Sydney where mortality was minimal at temperatures less than 18°C.

Analysis of long term weather and environmental records revealed that the outbreaks in the Georges and Hawkesbury Rivers were not associated with anomalies in air temperature, water temperature, salinity, or chlorophyll-a levels in water. Harmful algae were variably present and did not explain disease occurrence either.

The major factors determining the extent of mortalities during an outbreak were found to be the age of oysters (spat are highly susceptible, adults relatively resistant); growing height/immersion time (raising growing height of oyster trays by 300 mm in the intertidal zone reduced mortalities of adults by 50%); and location (some sites within and infected river were not affected at all). The type of cultivation system and the presence of non-susceptible bivalve species on adjacent leases were not important factors. Host energy status (feeding) and cultivation density were not able to be investigated and could be important.

POMS disease expression can be variable and the replication of trials over sites and over time was critically important to reveal risk factors.

Wild oysters, both Pacific and Sydney rock, tested positive for the virus, as did other mollusc species and other marine organisms. However, the levels of virus in their tissues were low, and their potential role in storing virus and amplifying and releasing it to

infect farmed oysters is debatable. Further study is required.

The virus appears to remain stable in seawater for less than 48 hours. This was confirmed in laboratory experiments and in field trails with spat in upwellers in the Hawkesbury River. Water treatments based on ageing water for 48 hours and filtration to 5 µm were successful and can be used to protect hatcheries (Whittington et al 2015). Several disinfectants were effective and will be useful for decontamination of equipment. Chlorine is commonly available but was not effective in the presence of organic matter.

Significant knowledge learning has occurred in the last 2 years as a result of this research project. However further research is required to identify strategies to enable spat to survive in infected estuaries during the danger period. There is a need to understand the role of wild molluscs in outbreaks, the environmental conditions triggering the outbreaks and the capacity to predict outbreaks in a spatial and temporal context.

These episodes of POMS mass oyster mortality have highlighted the complexity of disease management in the marine environment. Oyster farmers' management decisions may have played a role in the extent of the OsHV-1 mortality outbreaks. But neither their perceptions of disease risk nor their management decisions have been documented within the context of biosecurity preparedness and operational risk. Hence a socio-policy project was undertaken by researchers from Cawthron, New Zealand, in collaboration with researchers from the University of Sydney and Hornsby Shire Council.

A survey of oyster farmers in NSW Australia and New Zealand was conducted with the aim of capturing oyster farmers' views on disease risk and on strategies to prevent or manage OsHV-1 and other disease outbreaks on their farm. Participants were selected to maximise diversity of views and practices in the Pacific oyster farming industry in both countries. The questionnaire focused on; (1) experience with OsHV-1 mortalities (POMS); (2) support during the disease crisis; (3) risk management strategies; and (4) risk and preparedness. Overall, 22 farmers agreed to share their experience with POMS and other oyster diseases.

Based on the findings from the survey, this report identifies potential strategic directions for an industry facing increasing environmental challenges in both countries. Disease prevention and control strategies should be included in business risk management plans for the shellfish farming industry. Farmers, scientists and government will be more effective if they work in partnership to develop practical and effective measures to manage diseases as well as pests in the aquatic environment. Bilateral collaborations to optimise resources, expert skills and knowledge should be actively encouraged and enabled at all levels including industry, research and regulating bodies (Castinel et al 2015)

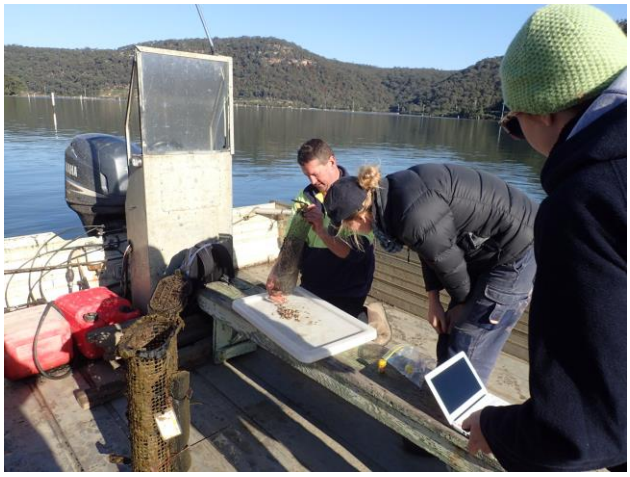


Figure 24. University of Sydney researchers and oyster grower from Hawkesbury checking oyster spat

Figure 25. Oyster spat from window of infection experiment

6 Education

6.1 Community events

As part of the Estuary Program, two community events in Brooklyn, two catchment tours and eleven guided bushwalks within the Hornsby Shire were organised to promote catchment remediation and estuary health. A total of 150 community members took part of the tours and bushwalks.

Catchment tours focused on the devices that Council installs and manages in order to remediate and protect our local waterways. The devices assist with the improvement of stormwater quality run-off reaching the Shire's four major catchment areas: Hawkesbury River, Berowra Creek, Cowan Creek and Upper Lane Cove River.

A series of estuary themed walks were included in Council's Guided Bushwalks Program during 2014-15 to promote the lower Hawkesbury River estuary to residents and visitors. The walks focused on areas which included: Berowra to Berowra Waters, Deep Bay Creek, Djarra Ridge, Jerusalem Bay, Waratah Bay, Cowan to Brooklyn, Crosslands, Laughtondale and Wisemans Ferry. These bushwalks make Hornsby's unique bushland and estuary accessible to the wider community and provides education and information on the importance of native flora and fauna, threatened species and significant habitats.

Two community events were organised in the Brooklyn area: Brooklyn Spring Fair and Fenwicks Marina Open Day. At these events Council promoted projects related to the implementation of the Lower Hawkesbury Estuary Management Plan including topics such as seagrasses, water quality monitoring, foreshore clean-ups and riparian vegetation.

Figure 26: HSC Natural Resource Branch's stall at Brooklyn Spring Fair

6.2 Marine Discovery Talks

A series of 8 public seminars were organised by the Community Environmental Network (CEN) and the Central Coast Marine Discovery Centre on topics related to aquatic ecosystems protection and monitoring, estuarine commercial industries and protected aquatic fauna. The following topics were covered in the series of marine talks:

- Seagrasses ecology and protection
- Sustainable seafood
- Oyster Industry
- Commercial Fishing Industry
- Reef life survey and sea dragons
- Redmap – monitoring changes in our marine environment
- Grey White Sharks
- Penguins

Seminars were funded by the Greater Sydney Local Land Services and were all well attended, on average 25 community members participated in the talks.

Hornsby Shire Council participated in the first talk organised at the Hornsby Council Public Library on seagrasses. The talk was co-presented by Professor David Booth, a marine ecologist from the Uuniversity of Technology Sydney, and Council staff from the Estuary Program who discussed the strategies used by Council on protecting seagrass beds in the Lower Hawkesbury.

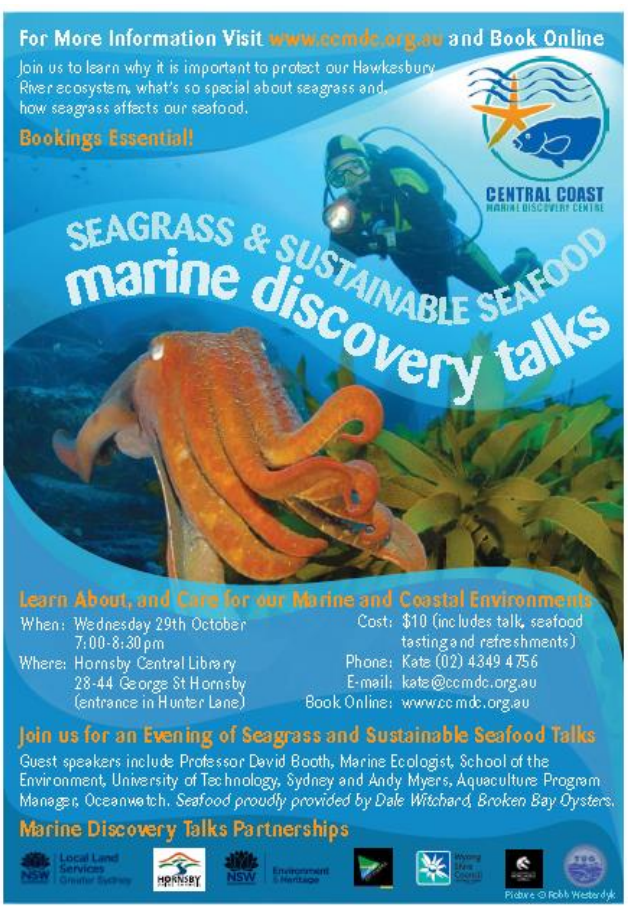


Figure 27: Promotional posters used for the Marine Discovery Talks

6.3 Migratory birds

Local and migratory waterbirds are an integral part of the ecosystem of the lower Hawkesbury estuary. It is recognised that waterbirds are dependent on functioning estuaries, and are therefore vulnerable to human impacts and degradative processes including climate change and sea level rise. Council undertook an extensive estuarine bird survey in 2011/12 which noted the highest numbers of waterbird species have been recorded at Brooklyn/Dangar Island and Laughtondale. Dangar Island was identified as one of the most important sites in the Hornsby Shire for migratory shorebirds, who briefly stopover during migrations. The study concluded that the numbers of shorebirds have been declining in recent years.

As a result of the findings of this study, Council funded two educational signs highlighting the need to protect shorebirds, in particular migratory species using the rock spit off the southern side of the island. The signs have been installed at the ferry terminal and at the end of the beach path leading on to Dangar Beach and the rock spit.

One of the main impacts on Dangar's shorebirds is from unleashed dogs chasing the birds despite the signs prohibiting dogs on the beach. It is hoped the new signs will generate greater awareness of the presence and the importance of migratory birds in the area. It is anticipated that Dangar Island will remain an important resting site for the birds and continue to be a popular destination for visitors and residents of the Island to observe.

Figure 28: Dangar Island signs promoting migratory birds and significant areas of stopover during migrations

6.4 Seagrass education campaign

A number of education items (Figure 28) have been developed in order to promote the protection of seagrasses. The NSW Office of Environment and Heritage assisted Council in 2013/14 with the funding towards an education campaign to raise awareness of the location and ecological importance of seagrasses in the Lower Hawkesbury. The campaign had a specific aim to change attitudes of boaters who know that the seagrass buoys exist in the Lower Hawkesbury but continue to take shortcuts across the seagrass beds. Commercial operators like boat rentals and bait shops within the Brooklyn and Berowra areas were engaged in the campaign. A total of 600 brochures, 150 outboard waterproof stickers and 10 ceiling information panels were given to local businesses and shops.

In addition school talks were also given to disseminate key messages of the campaign to school students. A total of 112 school students from Brooklyn Public School attended the educational talks.

Key messages of the campaign are:

- Seagrasses are essential for healthy fish habitat & water quality
- Avoid shallow waters
- Observe signs & marker buoys
- Don't anchor on seagrass

.

Figure 29: Council's seagrass awareness campaign items: brochure, boat and bait fridge stickers, ceiling dangling panel and aquabuoy used to highlight seagrass bed areas

6.5 HawkesburyWatch webportal

By using a combination of predictive models and real-time in situ environmental monitoring Hornsby Council has put in place a system to proactively manage the Hawkesbury River, benefiting public health , sustainable fishing, ecosystem health and estuary aesthetics. An easy-to-use public web interface and app have been developed to provide access to a number of tools that inform waterway users about estuarine conditions, information on swimming conditions, estuarine health grades, sediment quality, location of oyster leases, macrophytes (mangroves, saltmarsh and seagrasses), and popular swimming spots.

There is a wide range of users that frequently use the information from the estuary web interface and Council app. These include; swimmers, kayakers, recreational fishers, commercial fishers, oyster growers, government agencies managing waterways and industries based on estuaries, and researchers. Different users require different information. As such Hornsby Shire Council has developed a number of tools targeted for use by the different user groups.

The data collected is of a quality suitable for scientific research, in particular helping to understand how changes to the physical environment can affect water quality and estuarine ecology.

The data collection can assist decision making and estuarine management at a range of timescales: short-term (including daily farming/fishing management decisions, selection of fishing and safe swimming areas, etc); medium-term (providing information on the relationships between local environmental variability and fish stocks / oyster performance / algal blooms / swimming conditions); and long-term: to link climate indices and estuarine conditions with a view of ultimately developing seasonal forecasts or to provide baseline conditions to help identify inter-annual variations and long-term trends.

Real-time monitoring, integration of data through modelling and simple dissemination of outputs is an innovative approach that Hornsby Shire Council has established over the last 10 years to provide proactive management of the Lower Hawkesbury and ensure protection of the estuarine resources. This innovative approach was recognised at the 2014 NSW Coastal Conference during which the HawkesburyWatch webportal was awarded the 2014 NSW Coastal Management Innovation Award (Figure 30.

Figure 30: NSW Minister Rob Stokes with staff from Hornsby Shire Council Estuary Program and Manly Hydraulics Laboratory after being awarded the 2014 NSW Coastal Management Innovation Award

7 2014-2015 Estuary management actions implemented

During 2014-2015 the Lower Hawkesbury Estuary Program has implemented the actions outlined in Table 5. These actions have contributed to reducing the risks facing estuarine assets as described within the Lower Hawkesbury Estuary Management Plan (2008).

Table 5 Hornsby Shire Councils Hawkesbury Estuary Program projects 2014-15

Strategy Number	Action	Date
16e	3-year socio-economic study on commercial wild fisheries undertaken by researchers from UTS and funded by FRDC. Trawlers from the Hawkesbury Estuary are part of this research project. Council staff has offered support to the technical reference group in a number of occassions	01-Jul-14
2s	7 Participants from Rolland Hassall School working with Macmasters Beach Saving Club involved in foreshore clean-up around Milsons Passage - 140kg rubbish removed	23-Jul-14
2m	Media on seagrass awareness stickers have been delivered to boat hire and bait shops in Brooklyn - Council Facebook media and Hornsby Advocate	30-Jul-14
2s	8 Participants from 'Bushcraft' Brisbane Waters Secondary College working with Macmasters Beach Saving Club involved in Hawkesbury River foreshore clean-up program around Sandbrook - 580kg waste removed	01-Aug-14
2m	Seagrass presentation and promotion of seagrass campaign to 112 school students at Brooklyn Public School. Main topics covered what seagrasses are, the role of seagrasses in estuaries, threats and its protection.	12-Aug-14
2s	10 Participants from Umina and Bateau PCYC working with Macmasters Beach Saving Club involved in Hawkesbury foreshore clean-up program around Sandbrook Inlet - 1.4 tonnes rubbish removed	14-Aug-14
2s	Award nomination submitted for 2014 Keep NSW beautiful in conjunction with Gosford Shire Council for the Hawkesbury Foreshore clean-up program Clean4Shore by Macmasters Beach Saving Club	22-Aug-14
2s	4 Participants from Rolland Hassall School working with Macmasters Beach Saving Club involved in foreshore clean-up around Long Island- 160kg rubbish removed	17-Sep-14
15f	Council's Estuary program team attended the 2014 Brooklyn Spring Fair promoting its recent seagrass campaign and water quality monitoring in the Lower Hawkesbury. A display of seagrass and mangrove species was used including stickers, brochures and hanging panels promoting seagrass protection	21-Sep-14
2o	Mangrove health monitoring program was undertaken during 2014/15 as a result of unexpected dieback of a small pocket of mangroves south of Marlows Creek	07-Oct-14
15g	Hornsby Shire Council receives the 2014 NSW Coastal Management Awards for the category 'Innovation'. “Hawkesbury Watch” – daily swimming conditions, estuarine health grades and real time data at your fingertips	10-Oct-14

Strategy Number	Action	Date
2s	7 Participants from Response Training Gosford with Macmasters Beach Saving Club involved in Brisbane Waters foreshore clean-up around Erina Bay - removed 308 kilos of waste	16-Oct-14
15f	Hornsby Shire Council took part of a community workshop on 'Staying Safe when fishing and swimming' in conjunction with other groups like NSW Recreational Fishing Alliance, NSW DPI, NSW Police, Office of Environment and Heritage, and National Parks Wildlife Service	19-Oct-14
12k	Regional Algal Coordinating Committee informed of elevated algal concentrations of *Dinophysis acuminata* (4,500 cells/L) at Calabash Point, Berowra creek	22-Oct-14
2s	19 Participants from Brisbane Waters Secondary College "Bushcraft" working with Macmasters Beach Saving Club and local oyster growers involved in the Hawkesbury foreshore clean-up program around Spectacle Island - 1.2 tonne of bulk pick-up	24-Oct-14
15f	Council's Estuary program team attended the 2014 Fenwicks Marina Open day to promote projects implemented in the estuary and meet local boat owners	25-Oct-14
2m	Public talk on 'Seagrasses and Sustainable Seafood' organised by the Central Coast Marine Discovery Centre at the Hornsby Council library and funded by the Greater Sydney Local Land Services. Council's seagrass campaign was promoted at this event. 29 people attended	29-Oct-14
2s	6 Participants from The Croft working with Macmasters Beach Saving Club involved in the Hawkesbury foreshore clean-up program around Parsley Bay, Juno Point and Little Wobby - removed 40kg of rubbish	30-Oct-14
2s	15 Participants from The Glen working with Macmasters Beach Saving Club and local oyster growers involved in the Hawkesbury foreshore clean-up program dismantled a derelict old oyster shed in Porto Bay - removed 2.5 tonnes of materials	04-Nov-14
2s	21 Participants from Brisbane Waters Secondary College "Bushcraft" working with Macmasters Beach Saving Club and local oyster growers involved in the Hawkesbury foreshore clean-up program around Cowan Creek - 250kg waste collected	07-Nov-14
15g	Oral Presentation given at the 2014 NSW Coastal Conference by the Natural Resources Strategy Manager on "Combining autonomous monitoring with condition indicators to assess estuarine health"	11-Nov-14
2s	4 Participants from Rolland Hassall School working with Macmasters Beach Saving Club and Kuring-Gai Chase Parks and Wildlife involved in Hawkesbury foreshore clean-up around Bobbin Head to Smith creek - remove 30kg of rubbish	12-Nov-14
2s	8 Participants from Brisbane Waters Secondary College "The Croft" working with Macmasters Beach Saving Club involved in the Hawkesbury foreshore clean-up program - removal of large block of concrete reinforced polystyrene from Hungry Beach	13-Nov-14

Strategy Number	Action	Date
13a	Hornsby Shire Council was successful in securing NSW Office of Environment and Heritage funding ($24K) for the rehabilitation and management of riparian zones in Lower Hawkesbury Estuary. Project will be implemented during 2 years starting on 2014/15	17-Nov-14
12hh	Hornsby Shire Council was successful in securing NSW Office of Environment and Heritage funding ($50K) for one year of Estuarine health monitoring of Hawkesbury's waterways.	17-Nov-14
2s	11 participants from Father Chris O'Riley's "Youth off the Streets' working with Macmasters Beach Saving Club around the southern Foreshore adjacent to the Hawkesbury Freeway Bridge & Big Bay - remove 85kg	17-Nov-14
2m	Seagrass buoy in Brooklyn Channel relocated by Road and Maritime Services	17-Nov-14
5e	Notification by researchers from University of Sydney of the start of the 2014 window of infection for the Pacific Oyster Mortality Syndrome (POMS) in the Hawkesbury at the land bases in Mooney Mooney	18-Nov-14
5e	Notification by researchers from University of Sydney of second Pacific Oyster Mortality Syndrome (POMS) outbreak in Porto on 27th November 2014	27-Nov-14
12k	Hornsby Shire Council participated in the annual Metropolitan/South Coast Regional Algal Coordinating Committee meeting	02-Dec-14
10a	The Hornsby Shire Council Natural Resources Estuary program attended the AdaptNSW workshop organised by the NSW Office of Environment & Heritage at which it was presented the AdaptNSW website and the latest NSW & ACT Regional Climate Model projections (NARCLIM)	08-Dec-14
2s	4 Participants from Brisbane Waters Secondary College “The Croft” working with Macmasters Beach Life Saving Club involved in the Hawkesbury River foreshore clean-up program - Bar Island and Milsons Passage - 60kg waste removed	09-Dec-14
12k	Elevated levels of toxic species *Alexandrium, Dinophysis, Karenia, Prorocentrum* and some *Cochlodinium* and *Chattonella* were found at Calabash. Warning signs were put in place. RACC advisory process started as threshold exceeded public health warning	09-Dec-14
2s	7 Participants from Rolland Hassall School working with Macmasters Beach Life Saving Club in the Hawkesbury River Foreshore Clean-up program around Sandbrood Inlet - 250kg rubbish removed	10-Dec-14
2s	7 Participants from Rolland Hassall School working with Macmasters Beach Life Saving Club and Kuring-Gai Chase Parks and Wildlife involved in Hawkesbury foreshore clean-up around Sandbrook Channel - 250kg of litter removed	10-Dec-14
13a	Greater Sydney Local Land Services were winners of the 2014 Keep Australia Beautiful - Clean Beaches award for Floating Landcare activities towards which Hornsby Council contributes to	12-Dec-14

Strategy Number	Action	Date
12k	Media release by Hornsby Council warning community about potential toxic algal presence in Berowra Waters. Media release posted in Council Facebook. Six warning signs were hung around boat ramps in the eastern and western side of Berowra Waters	12-Dec-14
2s	Gosford & Lower Hawkesbury Estuary in partnership with Clean4Shore Pty Ltd were winners of the 2014 Keep Australia Beautiful - Clean Beaches - Hey Tosser! Litter reduction award for the Clean4Shore Program	12-Dec-14
5f	Hornsby Shire Council staff attended a meeting organised by Oceanwatch Australia on the role of NRM on the NSW oyster industry	24-Dec-14
12k	Toxic algal bloom in Berowra Waters ended on 24th December after 3 series of sampling and public media releases via Council's Facebook and website. Council staff contact details were included in signs and media releases in order to keep public informed	24-Dec-14
12k	Elevated levels of *Pseudo-nitzschia pungens/multiseries* were found in Berowra Waters (200,000 cells/L) and Calabash Point (130,000 cells/L). None of these species or levels would pose a threat to recreational users of the waterway as advised by phytoplanton experts	20-Jan-15
2s	Floating Lancare marine debris clean up activity at Gentlemans Halt in Marramarra National Park	01-Mar-15
15f	Free guided bushwalk around Waratah Bay	01-Mar-15
2s	7 Participants from Youth off the Streets working with Macmasters Beach Life Saving Club in the Hornsby / Brisbane Waters Foreshore Clean-up program around the Parramatta Wreck - removal of 40kg	03-Mar-15
13a	Marramarra Creek Bushcare camp organised by National parks Wild Life Service and Greater Sydney LLS	14-Mar-15
13a	Floating Lancare marine debris clean up and bush regeneration activity at Bar island in the Hawkesbury River - 13 volunteers, 78 hours of bush regeneration and weeding. Target weeds included ochna, asparagus, verbena, lantana, African love grass	17-Mar-15
2s	18 Participants from Rolland Hassall School working with Macmasters Beach Life Saving Club in the Lower Hawkesbury Foreshore Clean-up program around Berowra - removal of 60kg and bulk items	18-Mar-15
12k	Regional Algal Coordinating Committee Notification of high levels of dinoflagellates *Ceratium furca* and *Heterocapsa triquetra* in Calabash. Levels of the potentially harmful dinoflagellate *Dinophysis caudata* were 4200 cells/L. Level could trigger closure. Further monitoring was required. Levels deacrease a couple of days later.	20-Mar-15
15f	Free guided bushwalk around Jerusalem Bay	22-Mar-15
15f	Free guided bushwalk around Deep Bay Creek loop	28-Mar-15
16d	Research partnership with UNSW looking at tailor stocks across different sites within the estuary and the role they play in the estuary food web	07-Apr-15

Strategy Number	Action	Date
2s	12 Participants from Dimension Data working with Macmasters Beach Life Saving Club in the Hornsby Council Foreshore Clean-up program around Long Island and Kangaroo Point - removal of 1 tonne of waste products	13-Apr-15
2s	10 Participants from Dimension Data working with Macmasters Beach Life Saving Club in the Hornsby Council Foreshore Clean-up program around the Lower Hawkesbury, Cowan and Jerusalem Bay - 400kg of waste removed	14-Apr-15
2s	13 Participants from Dimension Data working with Macmasters Beach Life Saving Club as part of Hornsby and Brisbane Waters Foreshore Clean-up program around Bar Point and Mooney Mooney - removal of 2 tonnes of waste including bulk items	15-Apr-15
13a	Floating Lancare bush regeneration activity at Long Island nature Reserve	16-Apr-15
15f	Free guided bushwalk around Whale Rock	18-Apr-15
15g	Results from the 2014 Sediment Monitoring Program have been made publically available via the swimming maps web portal http://new.mhl.nsw.gov.au/users/HSC-SedimentMonitoring	20-Apr-15
12hh	Severe weather conditions during the week with more than 250mm rainfall and strong winds- floods, debris in estuary. Courangra and Laughtondale probe drifted still attached to moorings. Buoys were refurbish within 3 weeks and relocated to the original position	22-Apr-15
2s	Floating Lancare marine debris clean up and bush regeneration activity at Bar island in the Hawkesbury River	02-May-15
15i	Free guided estuarine activity - Estuary Walk and Talk - to promote the oyster industry, water monitoring program, biofilters, seagrass beds and foreshore clean-ups. As a result of severe weather, the educational activity had to be cancelled. It will be re-advertised in spring	03-May-15
9a	Invitation for Estuary Program staff to participate in the Trans-Tasman Oyster Knowledge Exchange organised by the New Zealand Ministry of Foreign Affairs and Trade	04-May-15
13a	Floating Lancare bush regeneration activity at Spectacle Island nature Reserve	14-May-15
15f	Free guided bushwalk from Cowan to Brooklyn	24-May-15
15j	Design and installation of two state-of-the-art signs to promote Dangar Island's foreshore as key area for migratory birds stopover grounds	26-May-15
2m	500 x "seagrass rocks" icon embedded in water bottles as educational promotion items to give away in events	29-May-15
12aa	500 x "Help Keep Creeks Clean" icons embedded in water bottles as educational promotion items to give away in events	29-May-15
13a	Floating Lancare marine debris clean up and bush regeneration activity at Bar island in the Hawkesbury River	04-Jun-15
15f	Free guided bushwalk around Muogamarra Nature Reserve as part of World Environment Day	05-Jun-15

Strategy Number	Action	Date
15i	Free guided bushwalk- theme Estuary Walk to promote estuarine values, habitat and local flora and fauna	18-Jun-15
2s	3 Participants from The Croft Brisbane Waters Secondary School working with Macmasters Beach Life Saving Club in the Hawkesbury Foreshore Clean-up program around Dangar, Milsons and Bar Point - waste removed 300kg	18-Jun-15
15i	A total of 150 community members took part of Council's 2014/15 Guided bushwalks around estuarine sites	30-Jun-15
12o	16 riverside settlement onsite wastewater system were inspected in 2014/15	30-Jun-15
13a	A total of 3640hrs were invested in bush rehabilitation work targeting 3.1ha of coastal native vegetation and 9.5ha of terrestrial native vegetation. 1300 plants were planted around Brooklyn Park, McKell Park and Kangaroo Point. This work was undertaken by Council staff, Bushcare and Floating Landcare volunteers	30-Jun-15
5e	Overall estuarine health levels in 2014/15, as per OEH scores, ranged between 'Good' and 'Fair' throughout the year with improved levels during winter when overall turbidity levels are low and with worse scores during summer when chlorophyll-a levels tend	30-Jun-15
12hh	On-going water quality monitoring via autonomous real-time monitoring stations at 6 locations along the salinity gradient between Wisemans Ferry and the estuary entrance	30-Jun-15

8 For further reading

8.1 Reports

Castinel, A; Fletcher, L; Dhand, N; Rubio, A, Whittington, RJ, Taylor, M (2015) OsHV-1 mortalities in Pacific Oysters in Australia and New Zeland: the farmer's story. Prepared by the Ministry of Business, Innovation and Employment (MBIE). Cawthron Report No. 2567, 48p plus appendices

Hornsby Shire Council (HSC), 2008. Lower Hawkesbury Estuary Management Plan. BMT WBM.

Hornsby Shire Council (HSC), 2015. Annual Water Quality Report 2014-2015. Hornsby Shire Council

OEH (2013) Assessing estuary ecosystem health: sampling, data analysis and reporting protocols. NSW Natural Resources Monitoring, Evaluation and Reporting Program. NSW Office of Environment and Heritage.

Paul-Pont, I., O. Evans, NK. Dhand, A. Rubio, P. Coad, RJ. Whittington (2014). "Descriptive epidemiology of mass mortality due to Ostreid herpesvirus-1 (OsHV-1) in commercially farmed Pacific oysters (*Crassostrea gigas*) in the Hawkesbury River estuary, Australia." Aquaculture 422-423: 146-159

SJB Planning Pty Ltd, 2005. Hornsby Shire Waterways Review- Version A. SJB Planning.

SJB Planning Pty Ltd, 2006. Review of Draft Waterways Local Environmental Plan. SJB Planning

Whittington, RJ, Paul M. Hick, Olivia Evans, Ana Rubio, Bruce Alford, Navneet Dhand, Ika Paul-Pont (2015) Protection of Pacific oyster (*Crassostrea gigas*) spat from mortality due to ostreid herpesvirus 1 (OsHV-1 µVar) using simple treatments of incoming seawater in land-based upwellers. Aquaculture 437: 10–20

Whittington, R., I. Paul-Pont, & N. Dhand. (2013). Aquatic Animal Health Subprogram: Pacific oyster mortality syndrome (POMS) - understanding biotic and abiotic environmental and husbandry effects to reduce economic losses Technical Report for the Fisheries Research and Development Corporation (FRDC) F2011/053, University of Sydney: 95 pages.

8.2 Relevant websites

Hornsby Shire Council - Hawkesbury Estuary Program

http://www.hornsby.nsw.gov.au/estuary

Hornsby Shire Council – Water Quality Program

http://www.hornsby.nsw.gov.au/waterquality

Hornsby Shire Council – Facebook

https://www.facebook.com/HornsbyCouncil

Hornsby Shire Council – Twitter

https://twitter.com/HornsbyCouncil

Oyster Health Sydney Blog

http://oysterhealthsydney.wordpress.com/

Appendix- 1 Internet videos

Hornsby Shire Council Youtube channel:

River Watch – water testing: https://www.youtube.com/watch?v=TSKmXgdiMNo

Award submission, focussing on the water testing: https://www.youtube.com/watch?v=LJctistdkzo

Hawkesbury River clean-up: https://www.youtube.com/watch?v=6LAnHPkYFuw

Yellow submarine water testing: https://www.youtube.com/watch?v=PGNYJ-Ulg5c

Catchment Remediation Rate history: https://www.youtube.com/watch?v=GC8jB6FxZ28

HawkesburyWatch- swimming conditions app: https://www.youtube.com/watch?v=LwJtcoepNtQ

Appendix- 2 Print media Coverage

NEWSLOCAL
Hornsby Advocate
& UPPER NORTH SHORE
Thursday, July 17, 2014 | hornsbyadvocate.com.au

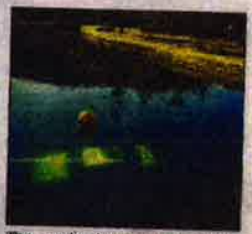

Picture: MARK SCOTT

Last of the oyster men

Rob Moxham is one of just three oyster farmers left on the Hawkesbury River - and the future of an industry with a proud history looks bleak. Full report, Page 7

BOBBIN HEAD

Man saved after car takes dive


The car in the water at Bobbin Head. Picture: SIMON KANE/TWITTER

Rohan Smith

A YOUNG man was rescued from Apple Tree Bay at Bobbin Head on Friday after his Toyota sedan veered off an embankment and into the water.

Police from Kuring-gai Local Area Command said a member of the public, a man aged 55, witnessed the car plunge into the water about 5pm on Friday afternoon and responded immediately.

Police and ambulance services were contacted and he was treated at the scene before being transported to hospital to receive treatment.

Ghada Metri said she came across the vehicle on Saturday morning when walking with her children.

She said an attempt was being made to remove the vehicle but without success.

"We went there on Saturday around 11am when we saw people on the bridge watching a big truck and a diver and someone on a jet ski trying to pull the car," she said.

The vehicle will be towed out of the water in the coming days.

INSIDE: THE 3000-PAGE NORTHCONNEX ENVIRONMENTAL IMPACT STATEMENT RELEASED

NORTHCONNEX

Tunnels' light still unclear

ENVIRONMENTAL IMPACT STATEMENT FOR PROJECT RELEASED

Rohan Smith

AUSTRALIA'S longest road tunnels drew nearer to planning approval this week but Transurban and the State Government will have a hard time convincing the public it is all good news.

The environmental impact statement (EIS) for the 9km NorthConnex project was released on Tuesday after a month-long delay.

It details environmental, economic and social impacts of the tunnel linking the M1 Pacific Motorway and the Hills M2 Motorway.

The 3000-page document includes hundreds of pages of information about air quality around proposed exhaust stacks at Wahroonga and West Pennant Hills, which project director Steve Cornish admitted had been difficult for people to come to grips with.

He said the science "is very hard for people to get" but "if people read the facts with an open mind, the science is clear".

He said the project would not be able to continue without adhering to stringent guidelines.

Founder of Community Against Polluting Stacks Elizabeth Johnson said she remained concerned about the pollution caused by ventilation outlets.

"No one has been able to prove what a safe level (of pollution) would be, or a level where bad health effects would not occur," she said.

Hornsby state Liberal MP Matt Kean, who helped open the project's new information drop-in centre on Monday, said the release of the EIS was another important step towards removing trucks from Pennant Hills Rd.

"This project has been talked about for decades and now this government is finally delivering on that vision," Mr Kean said.

What do you think? Join the conversation on our Facebook page.

HAVE YOUR SAY

- A number of EIS community drop-in sessions are being held, beginning on Wednesday, July 23, from 6-9pm at Pennant Hills Golf Club
- An air quality forum is being held on Tuesday, July 29, from 7-9pm
- View the EIS at the information centre on the corner of Pennant Hills Rd and Yarrara Rd, Pennant Hills
- northconnex.com.au

HAWKESBURY/ MOONEY MOONEY

Oyster industry racked with economic pain

Tracey Findley

THE Hawkesbury River oyster industry is barely afloat and the future looks bleak.

Last year's outbreak of Pacific mortality syndrome (POMS) devastated the industry at a time when it was only just getting back on its feet after the deadly QX parasite struck in 2004.

Fourth-generation oyster farmer John Stubbs, now living in Oberon, is among those who could no longer see a future in the industry.

"Not a commercial future," Mr Stubbs said.

"A hobby farm, yeah, but you would need another income to keep going."

Oyster farmers have operated along the river for 142 years. Prior to the POMS disaster there were 15 oyster businesses operating in the area with $2.4 million worth of oysters sold annually, according to the Department of Primary Industries.

Rob Moxham, 56, is one of just three farmers left. He said production was down to 1 per cent – "just little pockets (of oysters) here and there".

"These are some of the last few we have got," Mr Moxham said, gesturing to a rack of oysters. Empty racks are stacked all around the site.

Mr Moxham is a fourth-generation oyster farmer. He used to employ 13 people; now it's down to two. His brothers, Paul and James, also had businesses but they have walked away.

To make ends meet the father of four finds casual work outside the industry.

He is hopeful that science will come up with a solution in the form of a disease-resistant Pacific oyster but it could be some years off.

Mr Moxham said that he felt let down by the State Government.

"They come up with things like: 'You should have diversified'," he said.

"We are trying to get an industry back on its feet, that is all we want."

A department spokeswoman said government agencies and councils met farmers a week after POMS hit "to provide immediate short-term social and economic support".

She said subsequent support had been provided.

Fourth-generation oyster farmer Rob Moxham among the empty racks at Mooney Mooney. Picture: MARK SCOTT

PROUD HISTORY

BROOKLYN historian Tom Richmond's great-grandfather, Bill Seymour, was one of the first Hawkesbury River oyster farmers.

He and another man, Dick Lloyd, managed the Hawkesbury's first oyster lease, which was granted to a Mr Gibbons in 1872.

"From 1887 when the railway arrived (at Brooklyn) through to 1970, virtually everyone who had a waterfront property was basically an oysterman," Mr Richmond said.

He said some of the farmers would sell their oysters to people at the railway station and at Kangaroo Point where the ferries came in.

"Over the years it (the industry) has been extremely important," he said.

"It's sad to see the water industries disappearing. Up until about 1970 if you walked into the pub at Brooklyn you would see nothing but oystermen."

HAWKESBURY

'Don't tangle with the seagrass'

A NEW campaign has been launched to protect fragile seagrass beds in the Hawkesbury Estuary.

Hornsby Council has launched the campaign urging boat users to take care around seagrass.

Pamphlets and stickers are being distributed around the shire and Hornsby Mayor Steve Russell said the message is simple: "Don't tangle with seagrass."

"Boat propellers, anchors and mooring chains can very easily damage them – even small scars reduce resistance to erosion," he said.

Visit hornsby.nsw.gov.au.

ABC Rural

NSW commercial fisherman to assist in study of their economic and social contribution to the communities they live in

NSW Country Hour Michael Cavanagh

Updated Wed 1 Oct 2014, 12:39pm

PHOTO: The value of commercial fishing to communities is the subject of a study along the NSW coast. (Michael Cavanagh)

It is not just economic benefits that commercial fisherman provide to their communities - that's becoming apparent in initial research into their contributions.

AUDIO: Economic and social value of fishing to regional communities(ABC Rural)

MAP: Bega 2550

New South Wales commercial fisherman are being asked to answer what one of the researchers admits are at times 'intrusive questions'.

It's hoped the survey will provide greater information than just the landed value of fish and people directly involved in the industry.

A team headed by University Technology Sydney (UTS) academic Dr Kate Barclay is travelling along the eastern seaboard carrying out the two year study.

"Something that has struck me is how many rescues commercial fishermen do, of boats that's engines have failed or have turned over and they take people back to shore," noted Dr Barclay.

"I hadn't heard of that before, but when you start asking fisherman about that, they tell you how they do a lot of that work."

Questions deal with the incomes of the fishermen, and how their families spend it, which Dr Barclay admits could make people uncomfortable. However, their responses are anonymous.

The study, commissioned by the Australian Fisheries Research and Development Corporation, comes as the New South Wales Government is determined to push through reforms which will affect licences and the amount of fish that can be caught in the different fisheries.

The proposed changes have been opposed at meetings of fishermen up and down the coast.

This has resulted in a coalition of different fishing bodies, including the Professional Fisherman Association and the Australian Marine Authority, joining forces to fight the scheme.

Sydney commercial fisherman Paul Sullivan has been at the vanguard opposing the reforms.

He states any 'erosion of their current fishing rights' will not be accepted by his colleagues.

While he backs the study, he still has reservations and questions the timing.

"We definitely need an economic and social survey to see what effects these reforms would have particularly on the regional communities which rely on the fishing industry," Mr Sullivan said.

"But there are so many fishermen out there that are sceptical and not trusting. We are trying to overcome that.

"We are trying to get the Coalition more involved in the survey, so we can go along and allay the fears of the fisherman and say to them 'Come on fellas ,we need to fill this out'. It's bit of a struggle at the moment."

Dr Barclay and her team are not just talking to those directly involved in commercial fishing, but also to bodies such as Chambers of Commerce dotted along the coast.

Topics:agribusiness, fishing-aquaculture, community-development, community-and-society, business-economics-and-finance, bega-2550, university-of-technology-sydney-2007

First posted Wed 1 Oct 2014, 11:44am

HAWKESBURY RIVER

Shoring up our future

GRAHAM JOHNSTON DEVOTED TO CLEANING UP WATERWAYS

Rohan Smith

Daily Telegraph Sunday Telegraph NEWS LOCAL

PRIDE OF AUSTRALIA MEDAL 2014

GRAHAM Johnston's tireless efforts to keep clean Sydney's pristine waterways – and reputation – is finally being recognised.

The 61-year-old, who has dedicated the past three years to cleaning up Brisbane Waters and the Hawkesbury River, has been nominated for an Environental Medal as part of the Pride of Australia awards.

Mr Johnston, assisted by volunteers and school groups, last year removed more than 41 tonnes of rubbish from waterways in Sydney's north. Among the litter were hundreds of tyres, oyster trays, old boats and even fridges.

Mr Johnston said he dedicated his time to the environment after witnessing the state of the waterways first-hand during a kayaking trip a few years ago.

"People don't care; they'll discard rubbish anywhere," he said.

"We have to go in and find it and dig it out. Some of this stuff is 20 years old."

Mr Johnston has even taken out-of-work Hawkesbury oyster farmers under his wing. He said it was helpful to have people involved who "know the river".

His long-term goal is to introduce his program – Clean4Shore – into schools in the Hornsby Shire.

"We take kids from other areas on the river all the time and it would be good to get some of the local schools involved," he said.

The program receives funding from Hornsby and Gosford councils.

Mr Johnston recently returned from Indonesia, where he taught CPR and trekked the Kokoda Trail.

For details visit prideofaustralia.com.au.

Pride of Australia award nominee Graham Johnston cleans up Dead Horse Bay in Brooklyn with Hornsby Mayor Steve Russell.

Picture: ADAM WARD

THORNLEIGH

Handyman steps up to claim $10k

A MAN has come forward to claim a $10,000 inheritance after the *Advocate* published a story online explaining that a solicitor was looking for him to fulfil the last wishes of Margit Schroeder.

When Mrs Schroeder, of Thornleigh, died on Christmas Eve last year, her will included a $30,000 bequest to Royal North Shore Hospital and a $1 million bequest to Sydney University, both of which were executed in recent weeks.

It also included $10,000 for handyman Colin Hughes, who had helped Mrs Schroeder in the 14 years since her husband's death.

Executor Peter Engelbert said he needed to track down Mr Hughes to fulfil Mrs Schroeder's dying wish that he be provided for.

The *Advocate* published the story online on Tuesday morning.

One of Mr Hughes' friends saw it and in the afternoon Mr Hughes had called the solicitor who is doing the legal work on the case.

They were to meet as the *Advocate* went to print yesterday.

COASTAL INNOVATION AWARD ... Goes to Hornsby Council!

Hornsby Shire Council has received the 2014 Coastal Management Award for Innovation for its successful Hawkesbury Watch Program.

The program uses state-of-the-art technology to monitor the Hawkesbury Estuary and provide information on daily swimming conditions, estuarine health grades and real time data.

The public can access the information via a website and free mobile phone application, which benefits a wide range of people including industry workers, recreational users, waterway managers and researchers.

The information is gathered from a network of extremely accurate water quality probes, housed within buoys that collect data every 15 minutes measuring water temperature, salinity, chlorophyll-a and turbidity.

This innovative program was established by Hornsby Shire Council in partnership with NSW Public Works – Manly Hydraulics Laboratory and has been operating since 2004.

Hornsby Council's Natural Resources Strategy Manager Dr Peter Coad and Environmental Scientist Dr Ana Rubio recently attended the Coastal Conference to accept the award.

"This award is an excellent achievement for Hornsby Shire Council and demonstrates the strength of our water quality programs which use cutting edge technology and techniques to monitor the health of our waterways," Hornsby Mayor Steve Russell said.

"I would like to congratulate Dr Peter Coad, Dr Ana Rubio and their team in the Natural Resources department for all of their hard work in establishing the Hawkesbury Watch program."

Photo: Hornsby Shire Council's Natural Resources Manager Diane Campbell with Roman Kabluczka from NSW Public Works Manly Hydraulics.

PRICELESS PEARLS

Just like you, I am faced with a dilemma at Christmastime. No matter how large or small your family is, we are all faced with the challenge of buying the right gifts for the people in our personal worlds...

What do you buy the guy who has everything? What do you buy the girl who buys everything for herself? What do you buy that relative who has nothing whatsoever in common with you? What do you buy that close friend who deserves a new car but you can only afford a toy one?

I like buying gifts and I enjoy Christmas immensely - I see it as an opportunity to express my affection and appreciation for people who are sharing my journey: I like my gifts to be suitable, enjoyable but also meaningful.

Like you, I have received some dodgy gifts in my time; I have had more than my fair share of gaudy ties, novelly socks and inappropriate jocks! I have had items that I would never use; books I will never read; and trinkets that will never see the light of day - but I have also received significant gifts which have taken my breath away; small and meaningful items which have displayed thoughtfulness and affection; and simple things which have become among my most treasured possessions.

Gift giving can be a hard nut to crack and often people default to buying everyone the same thing – 'Soap on a Rope' for the men and 'Ferrero Roche Chocolates' for the ladies... Television adds suggest you buy everyone a 'gift card' but it seems impersonal and a bit of a cop-out.

No every teenager wants a 'One Direction Tee Shirt' and not every man wants an 'eight-draw tool chest' – we are all different and we deserve individual attention.

I want to try and make sure that my gifts this year have three attributes: I want them to be appropriate, meaningful and personal.

My reason for this is that I think that our gift giving should mirror the best gift that we have ever been given. Don't forget what this season represents at its very heart - the fact that Christ was given as the ultimate gift to the world.

Appropriate - because we all need a saviour

Meaningful - because He gives us guidance and direction

Personal - because He was given for you.

So when you give your gifts this year – **remember why we give and what message we are trying to convey!**

DO YOU HAVE A COMMENT OR A QUESTION?

ralph.estherby@gmail.com

'Breakthrough Church', meets at 9.30am Sundays at the Performing Arts Centre (Old Bowling Club) - Edgeworth David Ave Hornsby 9477 7222

Keep NSW Beautiful

CLEAN BEACHES
CONNECTING OUR COAST
AWARDS 2014

NSW Environment Protection Authority
Hey Tosser! Litter Reduction Award

WINNER

Brisbane Water & Lower Hawkesbury Estuary Foreshore

Clean4Shore

SPONSORED BY

NSW EPA

Hornsby Shire Council
Yesterday at

HORNSBY COUNCIL WINS COASTAL INNOVATION AWARD

Hornsby Shire Council has received the 2014 Coastal Management Award for Innovation for its successful Hawkesbury Watch Program.

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Hornsby Shire Council's Natural Resources Strategy Manager Dr Peter Coad and Environmental Scientist Dr Ana Rubio recently attended the Coastal Conference to accept the award.

"This award is an excellent achievement for Hornsby Shire Council and demonstrates the strength of our water quality programs, which use cutting edge technology and techniques to monitor the health of our waterways," Hornsby Mayor Steve Russell said.

"Our natural environment is our most valuable asset in Hornsby Shire, and this program helps to protect it for residents and future generations to enjoy.

"I would like to congratulate Dr Peter Coad, Dr Ana Rubio and their team in the Natural Resources department for all of their hard work in establishing the Hawkesbury Watch program."

IMAGE: Hornsby Shire Council's Natural Resources Manager Diane Campbell with Roman Kabluczka from NSW Public Works Manly Hydraulics.

Like Comment Share

Facebook 3rd Dec 2014

Hornsby Shire Council

December 17, 2014 at 4:46pm

BEROWRA WATERS HARMFUL ALGAL BLOOM UPDATE

Hornsby Shire Council has received limited advice from NSW Government agencies regarding the harmful algae that have been recorded at Calabash Bay and Berowra Waters.

The Regional Algal Coordinating Committee and NSW Fisheries support the precautionary advice issued by Council last Friday.

NSW Food Authority, who are responsible for safe consumption of commercial oysters, have not detected harmful algae in or near the lease areas.

Commercial oyster production is stringently monitored to ensure oysters harvested are safe to eat.

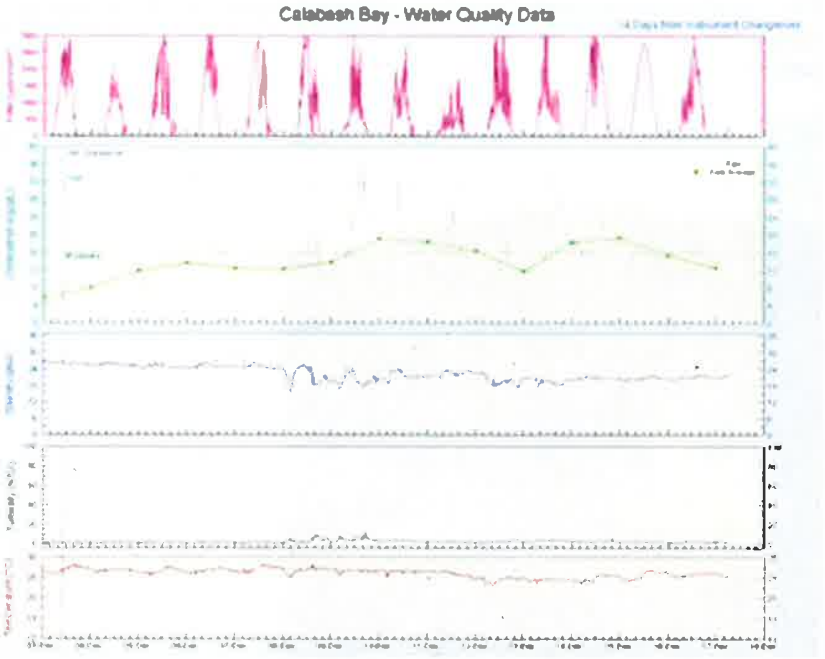
Council is monitoring the situation at Berowra Waters and is collecting further samples.

General algal activity is decreasing in the Berowra Waters area.

This activity is recorded by water quality probes that monitor the concentration of the green pigment, known as Chlorophyll-a (which is responsible for light absorption in algae).

Council advises that until harmful algae concentrations are at safe levels then contact with estuarine water should be minimised and shellfish, including oysters and mussels, collected from the local area should not be eaten.

For further information, please contact Dr Peter Coad from Hornsby Shire Council on 0438 103 146.



Hornsby Shire Council

December 23, 2014 at 3:08pm

HARMFUL ALGAE RECORDED AT BEROWRA WATERS - UPDATE

Hornsby Shire Council is giving an update on precautionary advice regarding harmful algae at Berowra Waters for public awareness.

Highly elevated levels of potentially harmful algae have been recorded at Calabash Bay and Berowra Waters.

It is not known if the algae are present at Crosslands, which is 6 kilometres from the monitoring site in Calabash Bay.

These algae come from the genus Alexandrium, Dinophysis, Karenia, Prorocentrum and some Cochlodinium and Chattonella.

These algae can be harmful to human health when ingested and it is advised not to eat wild stocks of shellfish, which includes oysters and mussels, in this local area.

Commercially harvested oysters are stringently monitored by the NSW Food Authority and are safe for consumption.

Boating, swimming and other contact with water should be minimised to limit exposure to harmful algae.

Algal bloom alerts are issued by the Regional Algal Coordinating Committee, who are responsible for local management of algal blooms.

If an algal alert is issued, information will be available through the NSW Algal Hotline on 1800 999 457 or by visiting www.water.nsw.gov.au.

It is anticipated that this bloom will dissipate as natural conditions change.

Council will continue to monitor the estuary on a routine basis and will provide a further update in mid-January.

For further information on this precautionary advice, please contact Dr Peter Coad from Hornsby Shire Council on 0438 103 146.

Hornsby Shire Council
December 30, 2014 at 4:00pm

BEROWRA WATERS ALGAE AT SAFE LEVELS

New tests have revealed algae levels in Berowra Waters have dropped to safe levels.

Levels are at acceptable concentrations for all recreation including swimming, boating and wildstock shellfish collection.

Like · Comment · Share · 17 1

HORNSBY ADVOCATE 8 JAN 2015

BEROWRA WATERS

Green light for swimming as danger passes

THE waters around Calabash Bay and Berowra Waters have been given clearance for swimming, weeks after elevated levels of harmful algae were reported.

These algae can be harmful to human health when ingested and it was advised not to eat wild shellfish, which includes oysters and mussels, in this area. The algae are from the genus Alexandrium, Dinophysis, Karenia, Prorocentrum and some Cochlodinium and Chattonella.

Algal bloom alerts are issued by the Regional Algal Coordinating Committee, which is responsible for local management of algal blooms. Hornsby Council commissioned a firm to monitor estuarine health between Wisemans Ferry and Broken Bay in 2013.

ABC Rural

New South Wales Country Hour

New South Wales Central Coast fishing campaign

NSW Country Hour By David Claughton

Posted Thu 12 Feb 2015, 3:50pm

Full page ads published in major newspapers in New South Wales this week are calling for and end to commercial fishing on the state's Central Coast.

PHOTO: Squid fishermen Dane Van der Neut says his sector is sustainable and proposals for reform threaten his livelihood.

MAP: Patonga 2256

00:00 00:00

AUDIO: Commercial and recreational fishermen debate a campaign to ban commercial fishing on the Central Coast of NSW(ABC Rural)

The ads are part of a campaign driven by advertising mogul John Singleton to improve the economy of the region.

The argument behind the campaign is that recreational fishing could generate a lot more jobs but commercial fishermen are taking all the fish.

Dane Van der Neut is one of those fishermen and he says his fishery is sustainable and should be left alone.

"Our commercial fishing industry is heavily restricted," he said.

"We have [limits] on net sizes, restrictions on the amount of days we are allowed to work and the times of day, we've got seasonal closures and...by-catch reduction devices in the trawl fishery."

He said some of those controls were agreed to by recreational fishers, but the national body; the Australian Recreational Fishers Foundation, wants to see commercial fishing removed from many areas around Australia.

"The ARFF have been hell-bent on removing commercial fishermen from other areas such as Port Phillip Bay and Moreton Bay and now they're commenting on the Hawkesbury and Tuggerah, saying there are too many fishermen and not enough fish."

Allan Hansard, from the Australian Fishing Trade Association, doesn't shy away from that view.

He said the ad campaign reflects the frustration felt by recreational fishers and the NSW Government has to deal with the over allocation of fishing licences all around the state.

"Fisheries, particularly in the estuaries, have too many commercial fishers chasing the fish."

He said the problem stems from the way the NSW Government has managed the commercial fishery and points to a 2012 review in NSW.

That found, he said, "an inflexible system burdened by an excess allocation of access rights (too many fishers for too few fish) continues to prevent industry self adjustment."

"Around 50 per cent of key species taken by NSW commercial fishers are considered uncertain or undefined with six species considered biologically over-fished."

The NSW Government has proposed significant reforms to commercial fishing but they have angered the commercial sector and a decision has been delayed until after the election.

Allan Hansard said the other reason commercial fishing should end is because the economic return from recreational fishing is considerably higher.

"The value of recreational fishing in NSW has been estimated at $3.4 billion," he said.

"There are about 14,000 people employed in the recreational fishing community.

"If you compare that with commercial fishing, it's worth about $94m and employs about 4,000 people."

ROUSE HILL Courier

Monday January 12, 2015

$74,000 boost for Hawkesbury River program

Jan 7, 2015, 6:30 p.m.

The Hawkesbury River. Photo: Rick Stevens

Hornsby MP Matt Kean has announced that Hornsby Council will be awarded $74,000 in its 2014-15 Estuary Management Program.

The state government funding will be split into two projects with $24,000 going towards the rehabilitation and management of riparian zones in the Lower Hawkesbury Estuary, and $50,000 will be spent on estuarine health monitoring of Hawkesbury's waterways.

Mr Kean said the funding would allow the council to continue to improve the health of estuaries along the Hawkesbury River.

The story $74,000 boost for Hawkesbury River program first appeared on Hills News.

Hornsby Shire Council

CLEAN4SHORE PROGRAM KEEPS HAWKESBURY RIVER BEAUTIFUL

The beautiful Hawkesbury River continues to be maintained with the Clean4Shore program, which is supported by Hornsby Shire Council and had excellent results last year.

The program conducts debris removal at foreshore locations in the Hawkesbury River, with Council funding and assisting with project management.

It is delivered by Graham Johnston with the assistance of volunteers who come from a wide variety of backgrounds to help keep the Hawkesbury River clean for the community to enjoy.

Last year, there were 26 clean-up outings on the Hawkesbury River as part of the Clean4Shore program, with 261 volunteers devoting 1079 hours.

Across the 42 kilometres of shoreline cleaned, there were 22, 112 items disposed of and 20 tonnes of rubbish removed that would otherwise be polluting one of Hornsby Shire's most valuable natural resources.

Hornsby Shire Council's Environmental Scientist Ana Rubio greatly contributed to the program by organising work plans, schedules and securing the budget for Clean4Shore.

"I am delighted to hear of the fabulous results that the Clean4Shore program achieved last year, and hope that the great work can be continued over 2015," Hornsby Shire Mayor Steve Russell said.

"The Hawkesbury River is an incredibly important and iconic part of Hornsby Shire's environment and I am proud to say that Council is helping to protect it for future generations to enjoy.

"I would like to thank Ana Rubio, Graham Johnston and of course all the volunteers for their ongoing work, and also acknowledge the support of the local oyster industry who helped with logistics."

Clean4Shore is also funded by Gosford Council and supported by the Greater Sydney Local Land Services and Community Environment Network.

Like · Comment · Share · 17 1 2

Facebook 30/3/2015

NEWS LOCAL

Hornsby Advocate

& UPPER NORTH SHORE

Thursday, March 5, 2015 | hornsbyadvocate.com.au

INSIDE THIS WEEK: CATHOLIC SCHOOLS WEEK LIFT-OUT MAGAZINE

End of an era?

They used to number in their thousands but Hawkesbury River fishermen fear they could be the last of their industry if the government gets its way.

Full report, page 5

Guy Witchard is one of the last fishermen on the Hawkesbury River

HAWKESBURY RIVER

Calls for fishing bans hit industry

REFORMS AFFECT FISHERMEN

Tracey Findlay

FISHING has been in their families for generations, but these days the Hawkesbury River's commercial fishermen struggle to stay afloat.

They are under attack on two fronts – the government is proposing reforms that the fishermen say will make it even tougher for them to survive; and there are calls by a Central Coast community group, backed by John Singleton, to restrict commercial fishing in the area.

It is having a devastating effect. Guy Witchard, 53, left school to become a fisherman at 14.

His family has been in the industry for 124 years. "I'm a nervous wreck," he said.

"I can't sleep at night with the uncertainty. I don't know if I will be working next week. We have got families to feed. These are the only jobs we know."

Jason Davidson, 34, is a fifth-generation fisherman who has seen the industry shrink from about 6000 commercial fisherman in the late 1990s to 1050 today.

He said access to waterways had diminished while restrictions had tightened.

"I have a lot invested in this industry ... time, money and skills that have taken years to learn," he said.

Those pushing for a ban on commercial fishing claim the Hawkesbury is being overfished, yet local fishermen argue this is untrue.

"It's all seasonal, it's sustainable," Mr Davidson said.

"The claims that are made are just slanderous."

Locals said banning fishing would lead to more imports and potential food contamination issues – as was recently experienced with imported berries and canned tuna.

A spokeswoman for the Department of Primary Industries said the State Government was "committed to securing a sustainable, viable and healthy fishery in NSW.

"In order to achieve this, the government proposed a series of essential changes to the way fisheries resources are managed, through the NSW commercial fisheries reform program."

The spokeswoman said as part of the proposed reforms "the NSW Government has developed a $16m structural adjustment package to provide for fishers to exit the industry, and to help others set up their businesses for the future".

What do you think of commercial fishing on Hawkesbury River?

HORNSBY

Seven-month-old Miguel Fahy, Eco Garden officer Tanya Mein, Hannah Kim, [illegible] enjoy the new community garden. Pictur[illegible]

Patch to cultivate love of garc[illegible]

LOCALS can pick a lime for their gin and tonic or some herbs for their pasta from a new community garden in Hornsby.

Willow Park, just a stone's throw from the CBD, now has a small fruit and herb garden, which was launched with a community barbecue.

Hornsby Council's Eco Garden officer Tanya Mein said she hoped residents would now step in to take care of the green oasis on Edgeworth David Ave. It is hoped it could be one of many across the area.

"The pocket garden is quite small. There are two dwarf citrus trees and a raised garden bed of herbs," she said.

"The idea is that people could come and take some herbs, limes or lemons and use it for their dinner. We will also be leaving a water can on-site [illegible] some owne[illegible] den and tak[illegible]

"We're tr[illegible] community have a disc[illegible] dents abou[illegible] and how th[illegible] see commu[illegible] happening [illegible] shire."

Local ch[illegible] Mein to offic[illegible] den off to a [illegible]

Gateway

Newsletter of the Brooklyn Community Association, Inc **April 2015**

President's Report

The election is well past, and the community and its representatives can again focus on the important improvements required to our area.

Congratulations to Matt Kean on his re-election to Parliament for the Hornsby Electorate, and his promotion to Parliamentary Secretary to the Treasurer.

Progress to the Brooklyn Master Plan continues. At its meeting in March 2015, Council received the Report from the Community Survey into Brooklyn's Future and resolved that:

- The Report be made available on Council's website to inform the community of the findings.
- A project brief for a planning strategy for Brooklyn be prepared that addresses the key findings of the survey as well as project scope, issues, resources and governance arrangements including, but not limited to, key stakeholder and community reference groups.
- The project brief be reported to Council by August 2015.
- All persons who completed a Community Survey be advised of Council's resolution.

The Brooklyn Community Association spoke at the Council meeting, and will continue to press the Council for more community participation.

Residents may have seen that Hornsby Council has a number of improvement and upgrade activities happening or planned in Brooklyn. These include Brooklyn Oval/Playground Upgrade, Parsley Bay Boat Ramp Upgrade, Road Works and work at the Old Dairy Site. Nathan Tilbury, Ward A Councillor, has provided a quick update of these works in his article later in the Gateway. Residents often ask the BCA for information about Council and other works, and we hope the Council update will become a regular item of the newsletter. Hornsby Council have kindly also provided more information of the upgrade to Brooklyn Park and the Playground, and residents can see those plans at the General Meeting on May 2nd.

BCA Members, and Brooklyn and River residents and friends are welcome to join us for the Brooklyn Community Association General Meeting on 2nd May 2015.

Robert Arnold, President president@brooklyncommunity.org.au

Brooklyn Community Association
General Meeting
Baden Powell Hall
(3 Baden Powell Ave, Brooklyn)
Saturday, 2nd May, 10am to 12noon

Special Guest Speaker: Dr Ross McPherson, Chief Environmental Scientist, Hornsby Council
Sydney Water Sewerage Systems and EPA Licencing.

General Meeting Dates for 2015

All meetings for 2015 will be held in the Baden Powell Community Hall, 3 Baden Powell Avenue, Brooklyn, commencing at 10am. Please make a note in your diaries so you don't miss any!

Saturdays 10am-12noon - 20 June, 22 August, 17 October, 5 December (AGM)

Written by members and friends of the Brooklyn Community Association Inc, PO Box 239, Brooklyn, NSW 2083.
Email: info@brooklyncommunity.org.au for information or to unsubscribe.
Printed by R W Corkery and delivered by Gary Robertson.

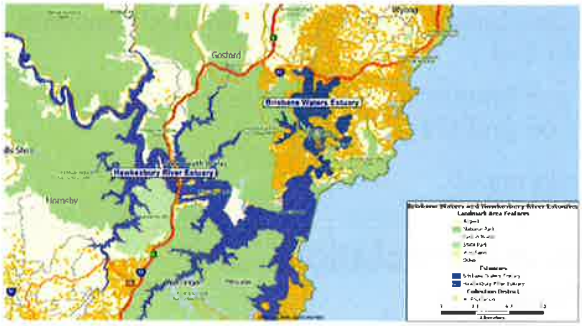
1079 Hours of Community effort to clean up 49km of estuarine coastline!

This report highlights last year's great Collaborative Community and Joint Council efforts in the clean-up of gross litter for the Hawkesbury and Brisbane Waters Estuaries. This commendable initiative was supported by 261 members of the Community volunteering their time and commitment to the Estuaries that we work and play in to make them a better place for us all.

This program success was reported to the members of the Lower Hawkesbury Estuary Management Committee, by Peter Coad, Natural Resources Strategy Manager, Hornsby Council. The initiative was funded by Hornsby and Gosford Council's and supported by the Greater Sydney Local Land Services and Community Environment Network. The Community Environment Network are to be also commended for their support to individuals and groups working in the environment in the Lake Macquarie, Wyong and Gosford districts.

The aim of the report to the Councils and Communities is to heighten awareness not only to the work of volunteers, Council officers and their commitment to the environment but also to the large volumes of gross litter collected during 2014 for the various clean-ups in the Brisbane Waters and Hawkesbury River estuaries and to present a statistical summary of that data with a focus on effort, impact of debris, and source reduction.

The initiative produced data on the litter collected that cannot adequately portray the level of effort, working conditions and enthusiasm of participants. The Clean4shore Programs' own clean -up reports and photos are well worth viewing to get a full sense of the task the program is tackling and achieving.



Map 1: Map of Brisbane Waters and Hawkesbury River estuaries (orange indicates main population)

2014 summary statistics for the Hawkesbury River include:

- 26 Clean-up outings
- 22,112 items disposed
- 19.7 tonnes of rubbish removed
- 41.9 kms of shoreline cleaned
- 261 volunteers involved for 1079 hours.

Article prepared by Jo Scarsbrick (Brooklyn Community Representative of the Lower Hawkesbury Estuary Management Committee) from a report prepared by Peter Coad from Hornsby Shire Council

The Sydney Morning Herald

The 10,000 people to thank for Sydney's improving rivers

Lucy Cormack
Published: May 23, 2015 - 12:15AM

When Diana Hill moved to Rhodes 40 years ago the smell was appalling.

Until its closure in 1986, the Union Carbide factory manufactured toxic chemicals, often overflowing uncontrolled releases of stormwater and wastewater into Homebush Bay.

"Since then it has all disappeared and the place has tidied up. It's just lovely to maintain the beautification of the area," said Ms Hill, a bushcare volunteer who has worked towards improving the health of the Parramatta River for the past 10 years.

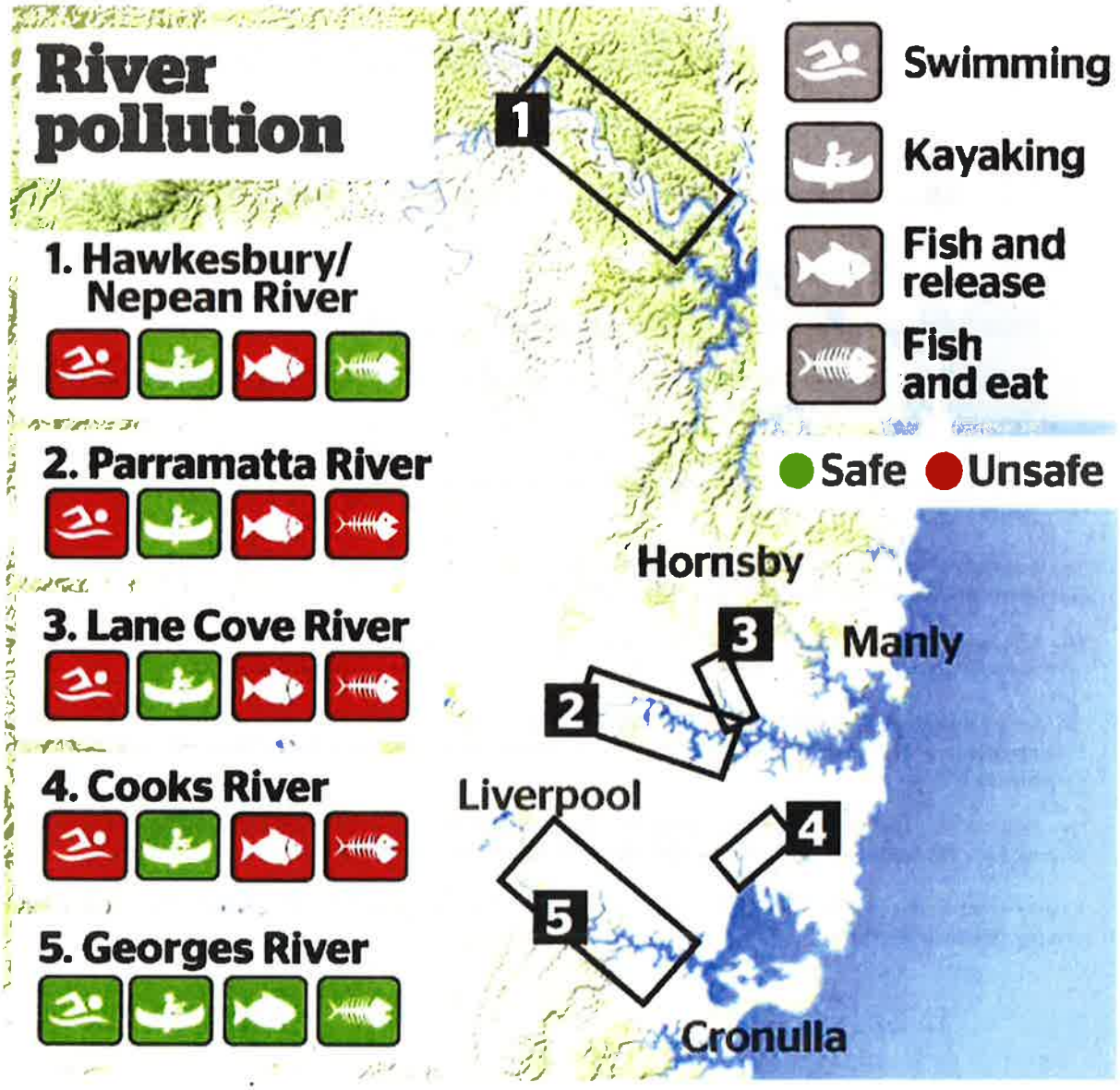
She is one of more than 10,000 volunteers making a splash along the banks of Sydney's rivers, returning swimmers and fishers to some of the city's best watering holes.

The work of Sydney's volunteers was celebrated last week as part of National Volunteer Week. It is one of a series of "Source to Sea" events to demonstrate the improvements made to rivers around Sydney.

On Sunday a group paddled from Emu Plains to Yellomundee Regional Park after meeting with the Bass Sydney Fishing Group, whose ongoing work has led to a restored stretch of river at Emu Plains and improved conditions for bass fishing.

"It's really about celebrating all those people who give their time to improve the health of our rivers," said Vanessa Keyzer, regional landcare facilitator with Greater Sydney Local Land Services.

Sydney's major rivers include the Hawkesbury Nepean, Parramatta, Lane Cove, Cooks and Georges and all have varying degrees of health.



Best in show would be the Hawkesbury, said Gavin Birch, environmental chemist and adjunct professor at the University of Sydney, pointing to the work of Hornsby Shire Council

"It is the least contaminated. Hornsby have done a lot of excellent productive scientific work, which is very advanced."

In 2002 Hornsby Shire Council deployed the first of five buoys with monitoring probes in the Hawkesbury estuary. The buoys hook into the mobile network to report real-time water conditions directly to the community.

Mr Birch said an equivalent system is "absolutely needed" in Sydney Harbour.

"The most iconic waterway we use and we've only got one or two, but we are desperate for funding. I've been struggling for 10 years to get this system up and running."

Along the Parramatta River many hands have made lighter work, in the community-wide effort to make the entire river swimmable again by 2025, starting with the opening of Lake Parramatta last summer.

Innovative Landcare program floats to the top

Landcare adventure conservation program, Floating Landcare, took out the Environmental Protection Award at the 2014 Keep Australia Beautiful NSW Clean Beaches Awards

A partnership project in the Hawkesbury Estuary, involving Greater Sydney Local Land Services, Landcare Australia, National Parks & Wildlife Service, and a number of local Councils, Floating Landcare brings volunteers and corporate teams to boat only access locations in the Hawkesbury estuary, to manage weed hotspots, collect litter and assist with the Lion Island Penguin Count.

Landcare Australia was brought into the partnership to encourage corporate support, and in FY2013/14, $7,000 of corporate sponsorship has been allocated to the program. Since its inception 33 Floating Landcare activities have taken place, resulting in 3.5 tonnes of marine litter removed, 2.5ha of native bushland regenerated, and 200 volunteers donating 565,000 of volunteer labour.

Landcare Australia CEO, Tessa Jakszewicz, was delighted to see the innovative program recognised.

"We have greatly enjoyed working on this program over the last number of years, and being able to engage corporate volunteers with such a unique type of Landcare activity. Congratulations to all partners and volunteers that have been part of Floating Landcare, and I hope this recognition helps the program grow from strength to strength."

Rebecca Mooy, Senior Land Services Officer at Greater Sydney Local Land Services has been working with Floating Landcare since its inception.

"It's a unique program, taking volunteers to these incredible boat-access only sites for bush regeneration and environmental repairs, including weeding. Floating Landcare gives them a unique wilderness land management experience, right on the edge of Sydney."

The Environmental Protection Award recognises projects which create, restore and sustain biodiversity of our native flora and fauna in coastal environments, creating wildlife corridors and encouraging habitat conservation.

For more information on how you can get involved in Floating Landcare, visit http://www.landcareonline.com.au/floatinglandcare

MORE INFORMATION: Ian Duthie, 0409 411 322, ian-duthie@bigpond.com
FRDC RESEARCH CODES: 2012/032, 2014/040

OYSTER GROWERS INVEST IN GENETIC POMS RESISTANCE

PHOTO: LILLY DUTHIE

DISEASE CONTROL

As a devastating disease spreads from French Pacific Oyster farms to the rest of the world, an Australian industry-based R&D company is preparing to defend against inevitable incursions

By Gio Braidotti

When infectious disease devastates human health, the world has sophisticated healthcare strategies on stand-by. But what happens when crops and animals in our food-producing farms are struck down by disease outbreaks that threaten entire sectors?

The Pacific Oyster (*Crassostrea gigas*) industry has faced that question since the arrival in New South Wales in late 2010 of Pacific Oyster Mortality Syndrome (POMS). The same disease has previously devastated oyster industries as it spread from France in 2008 to the UK, the Netherlands and New Zealand.

In NSW, the Georges River, Botany Bay, Port Jackson, Parramatta River and the Hawkesbury River were badly affected. Local research found that POMS reduced oyster survival to just one per cent when water temperature and environmental stresses conspired to assist the disease. At best, survival peaked at 40 per cent.

Some NSW operators have now left the oyster industry, unable to survive the dramatic economic impact of disease – first they were hit by QX disease, which affected Sydney Rock Oyster (*Saccostrea glomerata*) production, and then by POMS, which decimated the triploid Pacific Oysters used to rebuild some of those farms.

Research to find a solution to this devastating issue is happening all around the country and across the Tasman, with the University of Sydney, CSIRO, the NSW Department of Primary Industries, Hornsby Council (NSW), Tasmanian hatchery Shellfish Culture, Aglign Consulting and two groups in New Zealand working on POMS.

Tasmanian and South Australian growers – while currently unaffected by POMS – are facing a ticking bomb. It is generally accepted that the arrival of POMS in these areas is a matter of 'when' not 'if'.

Rather than present a sitting target, growers are acting pre-emptively to safeguard their farms. This includes agreeing to a specific research levy to support a program to breed POMS-resistant oysters. The program will be conducted by the industry-owned company Australian Seafood Industries Pty Ltd (ASI).

Research levy

Created in 2000, ASI has developed an applied breeding program for Pacific Oysters that has focused on breeding oysters with a balanced range of traits to improve productivity and marketability. These include gain in growth rate, shell width index, time to reach market condition, survivability and uniformity.

In the past, a premium has applied to spat produced from ASI's advanced broodstock, for those growers who chose to buy it. However, the significance of POMS to the industry as a whole – and the importance of breeding POMS-resistant stock – has resulted in a new approach.

With support from growers and the Australian Seafood Cooperative Research Centre (Seafood CRC), a compulsory levy of $2.80 per 1000 spat has been introduced on all hatchery-produced Pacific Oyster spat sold in Australia, whether it is produced from ASI broodstock or not.

The levy will be collected by ASI from growers and invested in an accelerated POMS-resistance breeding program. The levy was approved by the Australian Competition and Consumer Commission in late 2014 and will apply for the next decade, with industry to review progress after three and seven years, providing opportunity for "go/no-go" continuation of the levy.

Breeding program

ASI director Ian Duthie says the POMS resistance program is based on testing genetically diverse oyster families in which all pedigrees are known. The families are exposed to POMS in NSW (or in laboratory tests that correlate with field findings and better ensure exposure to POMS). Back in Tasmania, relatives of the best-performing families are bred.

"None of the ASI families possessed complete resistance to POMS," Ian Duthie says. "Some had none but others possessed various levels of partial immunity. With CSIRO assistance, we were able to devise crosses that will allow us to gradually increase resistance to commercially viable levels."

The program's goal is to achieve 70 per cent resistance to POMS in five years and

Making use of ASI breeding improvements: (from left) Ian, Anna and Thomas Duthie on the water at Pittwater, Tasmania.

the most recent trials in 2014 show the program is on track to achieve this.

This approach to POMS was adopted following a review of POMS' impact internationally and the efficacy of various disease-control strategies.

ASI general manager Matt Cunningham says two broad strategies exist. In France and New Zealand growers buy three to four times more spat than needed and harvest whatever POMS spares. This approach is not economically viable in Australia where spat prices are considerably higher.

Globally, the consensus is that breeding for resistance to POMS is the only practical solution. In response, ASI adapted its longstanding breeding program to include selection for disease resistance.

Ian Duthie explains that selection for one trait can inadvertently force unwanted changes in other desirable traits the ASI program has been focusing on, such as meat to shell ratio. This is true in all agricultural breeding programs, be it in crops, livestock, timber or fisheries.

He says this proved the case with the QX-resistance work in Sydney Rock Oyster and in ASI's earliest attempts to accelerate growth rates in Pacific Oyster. Today, ASI uses economically weighted values that balance productivity and marketability traits.

"The beauty of this strategy is that it achieves resistance without sacrificing gains made over many years in traits that improve farm-gate profitability," Ian Duthie says.

The other advantage for growers is the cost. "If each hatchery was to pursue applied breeding independently it would cost industry more overall and disadvantage the customers of smaller hatcheries," Matt Cunningham says.

Individual hatcheries have estimated that POMS-related breeding would result in costs of $5 per 1000 spat, compared with the $2.80 per 1000 spat for the industry-wide levy.

"That's a clear case of costs to growers being minimised," Matt Cunningham says. For a farm achieving 80 per cent recovery to sale, the levy represents less than one per cent of the oysters' farm-gate sales price (4.2 cents per dozen oyster sold).

Peter Kosmeyer, general manager of Southern Cross Marine Culture, manages the purchase of more than 15 million Pacific Oyster spat a year for farming in Tasmania, South Australia and NSW. He says that achieving POMS resistance is vitally important to industry and hatcheries.

"The consequences of not having something in place are too horrible to think about," he says. "Ditto SAMS [South Australian Mortality Syndrome] and whatever is next."

ASI's breeding model is being adopted by other nations, including New Zealand. But since Australia started accruing resistance earlier, ASI's program is leading the world.

"This approach is measurable, reproducible and, most importantly, can achieve genetic gains for POMS resistance," Matt Cunningham says.

Families most recently underwent a juvenile field challenge in late 2014 in the POMS-affected Georges River region, in NSW. As with previous trials, high levels of genetic variation in POMS resistance were observed.

"The results suggest that resistance is accumulating with successive generations of selection and we can remain confident that we will achieve our expected levels of resistance in the time frames predicted," Matt Cunningham says.

"The fundamentals and science we are using is held up as the model for other oyster breeding programs around the world, in the US, New Zealand and France."

Business changes

The levy provides greater stability for ASI's research program, but other changes to the business are also being made to further improve the sustainability of its operations. While the levy funds the POMS resistance program, other ASI projects are funded independently of this.

Since its inception as an industry-owned company, ASI has relied on dedicated volunteers as directors and a small, tightly focused budget. As the technical and business environment became more challenging, ASI recognised that this governance model needed to change.

Following a strategic review, ASI's new business plan incorporates an expansion of the board, with remuneration for directors. It will include an independent chair, two independent directors and two shareholder-nominated directors. Managing director of the Seafood CRC Len Stephens has been appointed as the new independent chair of the ASI board, and the process of appointing the other directors is being finalised. F