

NEW SOUTH WALES

# EFFECTIVE SHARK MANAGEMENT FOR YOUR COMMUNITY





## Table of contents

<b>Introduction</b>	<b>1</b>
<b>What does an effective shark management program look like?</b>	<b>2</b>
<b>Effective management measures</b>	<b>3</b>
Drone surveillance	3
Shark listening stations and tagging program	5
Shark smart education and Sharksmart app	7
Shark management alert in real time (SMART) drumlines	8
Personal deterrent devices	9
<b>Ineffective management measures</b>	<b>11</b>
Shark nets	11
<b>Other measures that have been trialled but not deployed</b>	<b>13</b>
Clever buoys	13
Shark barriers	13
<b>Maps of current program</b>	<b>14</b>
<b>Effective shark management proposals</b>	<b>22</b>

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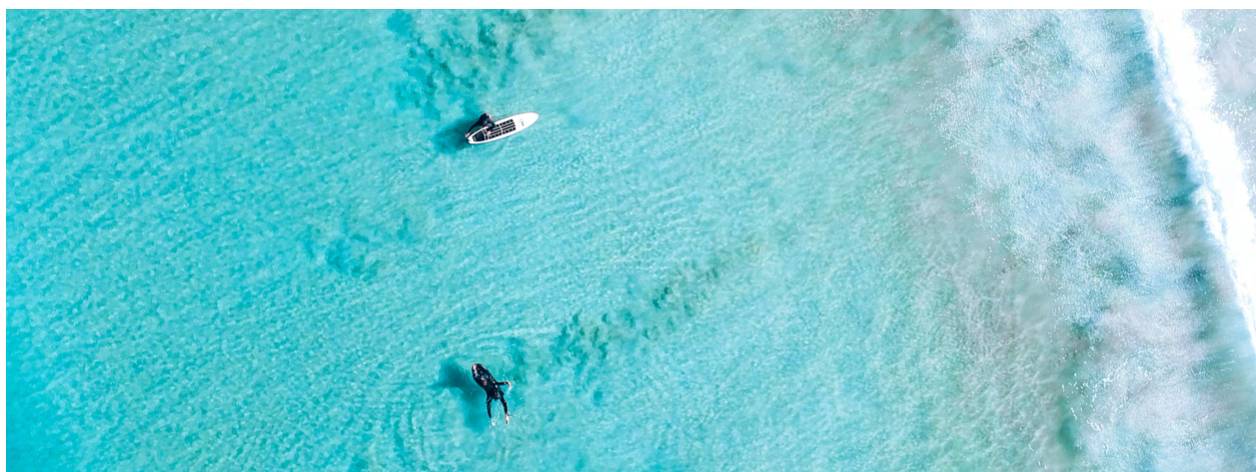
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July 2023



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## INTRODUCTION

The NSW Shark Management Program includes effective, scientifically supported shark management measures that protect people while minimising harm to marine animals. These measures include drone surveillance programs, shark listening stations to notify people of tagged sharks in the area, community education programs, and research into deterrent devices.

However, the NSW Shark Management Program has one key deficiency – the continued use of outdated shark nets. Scientific research tells us shark nets are ineffective at reducing the risk of shark bites.

**We recommend the NSW Government remove outdated shark nets and continue enhancing the deployment of scientifically supported shark management measures in NSW.**

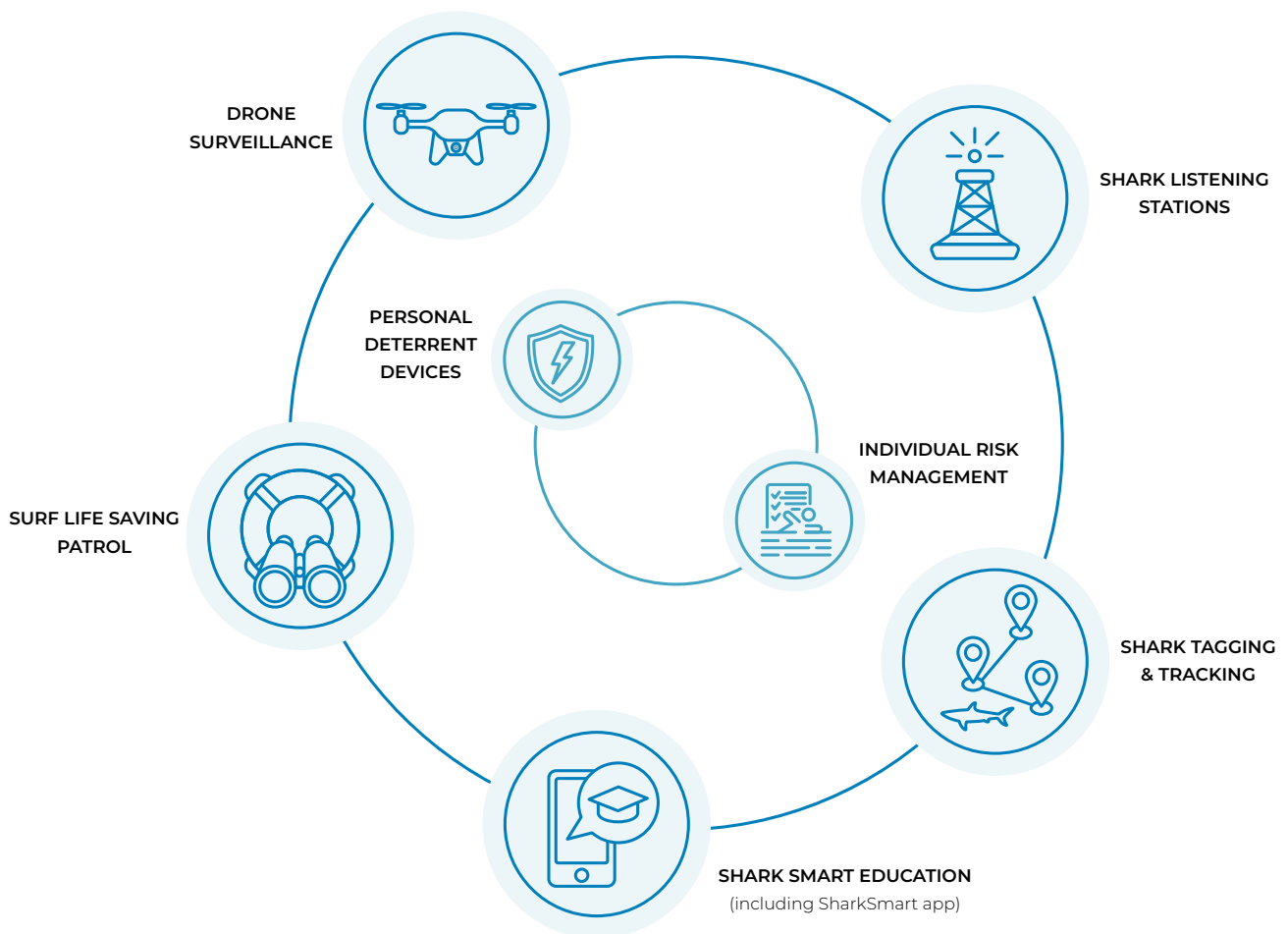
**This approach better protects people from the risk of a shark bite and minimises the harm caused to marine life.**

This report covers the following:

- An overview of the different shark management measures in New South Wales,
- A map showing the shark management measures being deployed in each local government area where shark nets are currently deployed, and
- A proposal for an evidence-based shark management program in each local government area where shark nets are currently deployed, which involves removing shark nets and enhancing effective shark management measures.

# WHAT DOES AN EFFECTIVE SHARK MANAGEMENT PROGRAM LOOK LIKE?

An effective shark management program includes a combination of each of the following measures. All of these measures are already being used in NSW.



# EFFECTIVE MANAGEMENT MEASURES



## Drone surveillance

### What are drones?

Drones are aerial vehicles that are fitted with camera surveillance to monitor stretches of coastline. They are manned by Surf Life Saving patrollers. They are used to spot sharks in the water from the air and to determine whether beaches need to be evacuated based on the level of risk present. Drones mounted with telecommunication capabilities are able to provide real time alerts to people in the water regarding the presence of ocean hazards, including sharks.

Drone surveillance is run in partnership with Surf Life Saving NSW and local Surf Life Saving clubs. They are used during normal patrol hours by Surf Life Saving patrollers. They have a minimum of 2 flights per hour with each flight lasting 10-15 minutes.



**Credit:** Josh Sorenson on Unsplash

### Do drones effectively minimise the risk of a shark bite?

Yes. Drones have proven to be an extremely effective tool in the detection of large sharks and other marine risks close to local beaches.<sup>1</sup>

<sup>1</sup> Cormac Purcell et al, 'Assessing the ability of deep learning techniques to perform real-time identification of shark species in live streaming video from drones' (October 2022) *Frontier in Marine Science*, pg 2, available at: <https://www.frontiersin.org/articles/10.3389/fmars.2022.981897/full>.



Drone surveillance enables Surf Life Saving patrollers to evacuate beaches when large bull, tiger and white sharks are within 200m of the beach. Drones are the main detection device that can be used in the right environment to prevent human/shark interactions before they occur.

#### **How much do drones cost to run?**

~\$3m per year to provide Surf Life Saving NSW with drones at up to 50 locations during peak swimming seasons.<sup>2</sup>

#### **What else is important to know about drones?**

Drones are used across 50 locations in NSW throughout the year, but this number could readily be expanded. Community sentiment surveys show that drones are one of the most popular forms of shark management,<sup>3</sup> and provide real-time surveillance and additional beach monitoring for Surf Life Saving patrollers. Further developments in drone technology and surveillance detection can continually improve the way this technology can be used for shark mitigation (e.g. through artificial intelligence).

**A 2020 study found that the use of drones on coastal beaches was accepted by the majority of people surveyed (88%) due to perceptions of reduced impact on sharks, and the relatively low cost.<sup>4</sup>**

<sup>2</sup> Information provided by the Department of Primary Industries on 25 November 2022 in an informal response to a GIPA application.

<sup>3</sup> Debra Stokes et al, 'Beach-user perceptions and attitudes towards drone surveillance as a shark-bite mitigation tool' (October 2020) *Marine Policy*, available at: [https://www.researchgate.net/publication/343038975\\_Beach-user\\_perceptions\\_and\\_attitudes\\_towards\\_drone\\_surveillance\\_as\\_a\\_shark-bite\\_mitigation\\_tool](https://www.researchgate.net/publication/343038975_Beach-user_perceptions_and_attitudes_towards_drone_surveillance_as_a_shark-bite_mitigation_tool); NSW Government, Department of Primary Industries and University of Wollongong Australia (June 2021), Preferred Shark Mitigation Measures of NSW coastal councils and their communities, available at [https://www.sharksmart.nsw.gov.au/\\_data/assets/pdf\\_file/0015/1327200/preferred-shark-mitigation-measures-of-NSW-Coastal-Councils-and-Communities-2021.pdf](https://www.sharksmart.nsw.gov.au/_data/assets/pdf_file/0015/1327200/preferred-shark-mitigation-measures-of-NSW-Coastal-Councils-and-Communities-2021.pdf).

<sup>4</sup> Debra Stokes et al, 'Beach-user perceptions and attitudes towards drone surveillance as a shark-bite mitigation tool' (October 2020) *Marine Policy*, available at: [https://www.researchgate.net/publication/343038975\\_Beach-user\\_perceptions\\_and\\_attitudes\\_towards\\_drone\\_surveillance\\_as\\_a\\_shark-bite\\_mitigation\\_tool](https://www.researchgate.net/publication/343038975_Beach-user_perceptions_and_attitudes_towards_drone_surveillance_as_a_shark-bite_mitigation_tool).



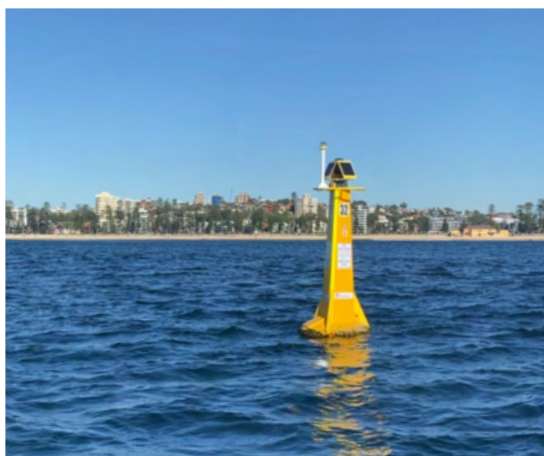
## Shark listening stations and tagging program

Also referred to as VR4Gs

### What are shark listening stations and tagging programs?

Shark listening stations are receivers deployed from the coastline that record and send out an alert in real-time when a tagged shark swims within 500m of the device. This alert is instantly sent out to nearby beach authorities (e.g. Surf Life Saving patrollers), and to anyone who receives the SharkSmart app or twitter alerts. Shark listening stations provide 24 hour active surveillance for tagged sharks in the area.<sup>5</sup>

Currently, any white, tiger or bull sharks that are caught and released alive are tagged and relocated. Shark listening



A shark listening station at Manly Beach

stations work in partnership with an effective tagging program, as only tagged sharks are detected.

### Do shark listening stations and tagging programs effectively minimise the risk of a shark bite?

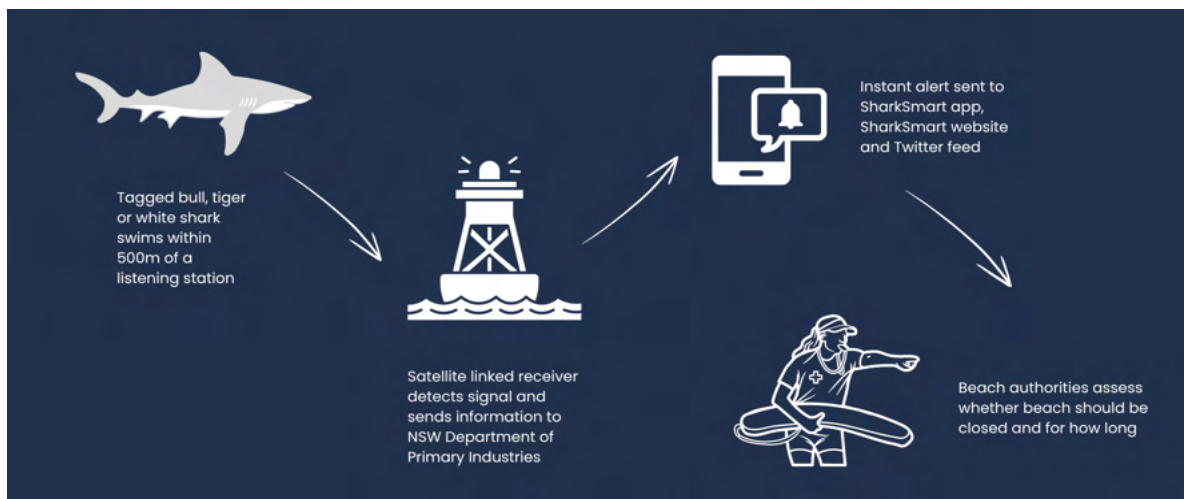
Yes. Shark listening stations enable people to reduce the chance of encountering a shark up close and enable beach authorities to make better informed decisions about when to close a beach because a large shark is present.

An effective tagging program plays a key role in this measure. In NSW, target sharks are tagged if they are found alive after being caught in shark nets or SMART drumlines. It takes an average of 74 days to re-detect a target shark that has previously been tagged and relocated, at a distance on average of 165 km from where they were first tagged.<sup>6</sup> An effective tagging program requires a science-first directive, where scientists,

<sup>5</sup> Department of Primary Industries, SharkSmart, Tagged shark listening stations, <https://www.sharksmart.nsw.gov.au/technology-trials-and-research#listening>.

<sup>6</sup> Department of Primary Industries, SharkSmart, SMART Drumlines, <https://www.sharksmart.nsw.gov.au/technology-trials-and-research/smart-drumlines>.





How shark listening stations operate

not contractors, coordinate tagging activities. This is run in Western Australia where target sharks' feeding opportunities (such as a whale carcass) are monitored by scientists for the opportunity to tag feeding sharks.<sup>7</sup> Western Australia does not use shark nets or SMART drumlines. As such, Western Australia run an effective tagging program using different measures.

### How much do shark listening stations cost to run?

~\$360k per year for the network of 37 shark listening stations.<sup>8</sup>

### What else is important to know about shark listening stations and tagging programs?

The data from shark listening stations is collated and used to inform scientific understanding of shark movements and behaviour.

It is impossible to tag every shark in the ocean. As such, shark listening stations should not be relied on exclusively to determine whether sharks are in the vicinity of the nearby shore, nor should members of the public be led to believe that no alert equates to a shark free environment.

**In a 2021 shark management community preferences survey, the highest average score across NSW Coastal Councils was for shark listening stations linked to the SharkSmart app (with a score of 8.5/10).<sup>9</sup>**

<sup>7</sup> Western Australian Government's Shark Smart Program, Shark Tagging, <https://www.sharksmart.com.au/research/shark-tagging>.

<sup>8</sup> Information provided by the Department of Primary Industries on 25 November 2022 in an informal response to a GIPA application.

<sup>9</sup> NSW Government, Department of Primary Industries and University of Wollongong Australia (June 2021), Preferred Shark Mitigation Measures of NSW coastal councils and their communities, available at [https://www.sharksmart.nsw.gov.au/\\_data/assets/pdf\\_file/0015/1327200/preferred-shark-mitigation-measures-of-nsw-coastal-councils-and-communities-2021.pdf](https://www.sharksmart.nsw.gov.au/_data/assets/pdf_file/0015/1327200/preferred-shark-mitigation-measures-of-nsw-coastal-councils-and-communities-2021.pdf)





## Shark smart education and Sharksmart app

### What is shark smart education?

The Department of Primary Industries' (DPI) community education program involves a mobile trailer that travels to beach based events, schools, community meetings and other key events and a free to use SharkSmart app.<sup>10</sup>

The SharkSmart app provides real-time shark alerts, information and resources for people using NSW ocean beaches. People can customise alerts based on time, region, type of alert, or by beach.<sup>11</sup>

### Does shark smart education effectively minimise the risk of a shark bite?

Yes. Community education is considered the most effective form of shark bite risk reduction by shark management experts.<sup>12</sup>

### How much does the shark smart education program cost to run?

~\$3m per year for the SharkSmart app,

community awareness campaign, community mental health support and research and program delivery.<sup>13</sup>

### What else is important to know about shark smart education?

Community education remains one of the most popular means of shark management in NSW.<sup>14</sup>

In addition, DPI and Surfing NSW have partnered to improve shark identification and incident response. The partnership aims to increase the skills and capacity of 110 board rider clubs and 55 surf schools by providing training and equipment under the Surfers Rescue 24/7 program for treating trauma associated with shark bites.

The partnership also includes a fleet of ~20 drones used by Surfing NSW to patrol their events. The partnership costs \$500k.<sup>15</sup>

<sup>10</sup> Department of Primary Industries, SharkSmart, Education, <https://www.sharksmart.nsw.gov.au/education>;

Department of Primary Industries, NSW SharkSmart Community Education, <https://www.youtube.com/watch?v=L6W5kvZPO2w>.

<sup>11</sup> Department of Primary Industries, SharkSmart, SharkSmart app, <https://www.sharksmart.nsw.gov.au/sharksmart-app>.

<sup>12</sup> Ferretti et al, 'Reconciling predator conservation with public safety' (August 2015) *Frontiers in Ecology and the Environment*, available at [https://www.researchgate.net/publication/280979691\\_Reconciling\\_predator\\_conservation\\_with\\_public\\_safety](https://www.researchgate.net/publication/280979691_Reconciling_predator_conservation_with_public_safety).

<sup>13</sup> Information provided by the Department of Primary Industries on 25 November 2022 in an informal response to a GIPA application.

<sup>14</sup> NSW Government, Department of Primary Industries and University of Wollongong Australia (June 2021), Preferred Shark Mitigation Measures of NSW coastal councils and their communities, available at

[https://www.sharksmart.nsw.gov.au/\\_data/assets/pdf\\_file/0015/1327200/preferred-shark-mitigation-measures-of-NSW-Coastal-Councils-and-Communities-2021.pdf](https://www.sharksmart.nsw.gov.au/_data/assets/pdf_file/0015/1327200/preferred-shark-mitigation-measures-of-NSW-Coastal-Councils-and-Communities-2021.pdf); Carol L Martin, 'The social dimension to the New South Wales Shark Management Strategy, 2015-2020 Australia: Lessons learned' (July 2022) *Marine Policy*, available at [https://www.researchgate.net/publication/360449460\\_The\\_social\\_dimension\\_to\\_the\\_New\\_South\\_Wales\\_Shark\\_Management\\_Strategy\\_2015-2020\\_Australia\\_Lessons\\_learned](https://www.researchgate.net/publication/360449460_The_social_dimension_to_the_New_South_Wales_Shark_Management_Strategy_2015-2020_Australia_Lessons_learned).

<sup>15</sup> Department of Primary Industries, SharkSmart, Current Program, <https://www.sharksmart.nsw.gov.au/current-program>; Information provided by the Department of Primary Industries on 25 November 2022 in an informal response to a GIPA application.



# Shark management alert in real time (SMART) drumlines

Other Name: “catch-alert” drumlines

## What are SMART drumlines?

A SMART drumline is a singular baited hook suspended from a buoy which is anchored to the seabed. An alert is sent out when an animal has been caught on that hook. Once an alert is triggered, a contractor responds within 30 minutes. If a target shark is on the drumline, the shark is tagged before being released 1km offshore. Drumlines are set every morning approximately 500m offshore and are collected at the end of the day (weather dependent).<sup>16</sup>

## Do SMART drumlines effectively minimise the risk of a shark bite?

There is no evidence indicating the presence of a SMART drumline impacts the rate of shark bites in a location. These devices are relatively expensive to operate and should be operated as a scientific device, not relied upon as a form of shark bite mitigation.

When SMART drumlines are stringently monitored, they are a transitory step towards establishing an effective shark tagging program in NSW.

## How much do SMART drumlines cost to run?

~\$12.1m per year for 305 SMART drumlines (and associated shark tagging) by 20 contractors.<sup>17</sup>

## What else is important to know about SMART drumlines?

These drumlines have a substantially lower mortality than other fishing devices (such as shark nets),<sup>18</sup> provided that rapid response to alerts is maintained. However, these drumlines can pose an entanglement risk to migrating whales. Furthermore, other non-target marine life still become caught on these drumlines.



A baited SMART drumline

<sup>16</sup> Department of Primary Industries, SharkSmart, SMART Drumlines, <https://www.sharksmart.nsw.gov.au/technology-trials-and-research/smart-drumlines>.

<sup>17</sup> Information provided by the Department of Primary Industries on 25 November 2022 in an informal response to a GIPA application.

<sup>18</sup> Rick Tate et al, 'The Effectiveness of Shark-Management-Alert-in-Real-Time (SMART) drumlines as a tool for catching white sharks, *Carcharodon carcharias*, off coastal New South Wales, Australia' (May 2021) *Fisheries Management and Ecology* p.496, available at

[https://www.researchgate.net/publication/351439093\\_The\\_effectiveness\\_of\\_Shark-Management-Alert-in-Real-Time\\_SMART\\_drumlines\\_as\\_a\\_tool\\_for\\_catching\\_white\\_sharks\\_Carcharodon\\_carcharias\\_off\\_coastal\\_New\\_South\\_Wales\\_Australia](https://www.researchgate.net/publication/351439093_The_effectiveness_of_Shark-Management-Alert-in-Real-Time_SMART_drumlines_as_a_tool_for_catching_white_sharks_Carcharodon_carcharias_off_coastal_New_South_Wales_Australia).



## Personal deterrent devices

### What are personal deterrent devices?

Personal deterrent devices are used by individuals to reduce the chance of a shark bite occurring. There is an emerging market for such devices. However not every device is to the same standard, and only independently-tested and verified devices should be encouraged.

### Do personal deterrent devices effectively minimise the risk of a shark bite?

Yes, but only scientifically supported devices that have been independently verified.

The Western Australian Government offers a rebate scheme for devices which meet a scientific threshold of their effectiveness. Currently, only devices from two brands meet this criteria: Ocean Guardian and Rpela. In extreme conditions (chummed and baited waters), the use of Ocean Guardian's FREEDOM+ devices have been independently verified to reduce the chance of a shark bite from 96% to 40%.<sup>19</sup> Rpela devices have a tested 66% reduction of the probability of a shark bite occurring.<sup>20</sup> Most shark bites do not occur in 'extreme' conditions (designed to



**Credit:** Caleb Smith on Unsplash

<sup>19</sup> Charlie Huveneers et al, 'Effectiveness of five personal shark-bite deterrents for surfers' (2018), *Peer J*, available at <https://pubmed.ncbi.nlm.nih.gov/30186701/>.

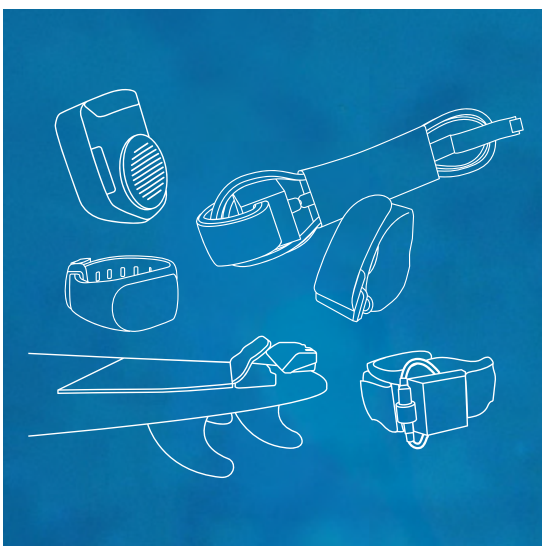
<sup>20</sup> Craig Blount et al, 'Effectiveness Against White Sharks of the Rpela Personal Shark Deterrent Device Designed for Surfers' (September 2021) *Journal of Marine Science and Technology*, available at <https://jmst.ntou.edu.tw/journal/vol29/iss4/13/>; see also <https://www.rpela.com/research-2>



provoke a bite), but rather are mistaken identity,<sup>21</sup> or are 'investigative' bites.<sup>22</sup> These devices are tailored for swimmers, divers, surfers, boats and even larger barriers.

### How much do personal deterrent devices cost to run?

The NSW Government does not currently provide a rebate for personal deterrent devices. As such, these devices are purchased at the expense of each individual. These devices can range in price from several hundreds to thousands of dollars, depending on the device and retailer.



A variety of personal deterrent devices have been developed claiming to protect individuals. However not every device is to the same standard.

### What else is important to know about personal deterrent devices?

The market for personal shark deterrent devices is unregulated. There are various types of devices ranging from stickers to smelling wax and even electrical deterrents that have no independent scientific verification that they work as claimed. As such, there is a strong need for government regulation and guidance on which forms of personal deterrent devices are backed by independent scientific review to ensure people are not using an ineffective product.

Personal deterrent devices are a layer of protection but should not be considered a substitute for personal risk management.

**Ultimately, no form of shark mitigation (be it personal or systemic) provides a 100% guarantee that an individual will never interact with a shark.**

<sup>21</sup> Laura Ryan et al, 'A shark's eye view: testing the 'mistaken identity theory' behind shark bites on humans' (2021) *J. R. Soc. Interface*, available at <https://royalsocietypublishing.org/doi/10.1098/rsif.2021.0533#:~:text=In%20conclusion%2C%20our%20results%20indicate,identity%20or%20ambiguous%20visual%20cues>.

<sup>22</sup> Eric E.G Clua and Carl G. Meyer, 'The 'Mistaken Identity Hypothesis' for shark bites on humans is an anthropomorphic fallacy' (2023) *Behaviour*, available at <https://brill.com/view/journals/beh/aop/article-10.1163-1568539X-bja10196/article-10.1163-1568539X-bja10196.xml?language=en>.

# INEFFECTIVE MANAGEMENT MEASURES



## Shark nets

### What are shark nets?

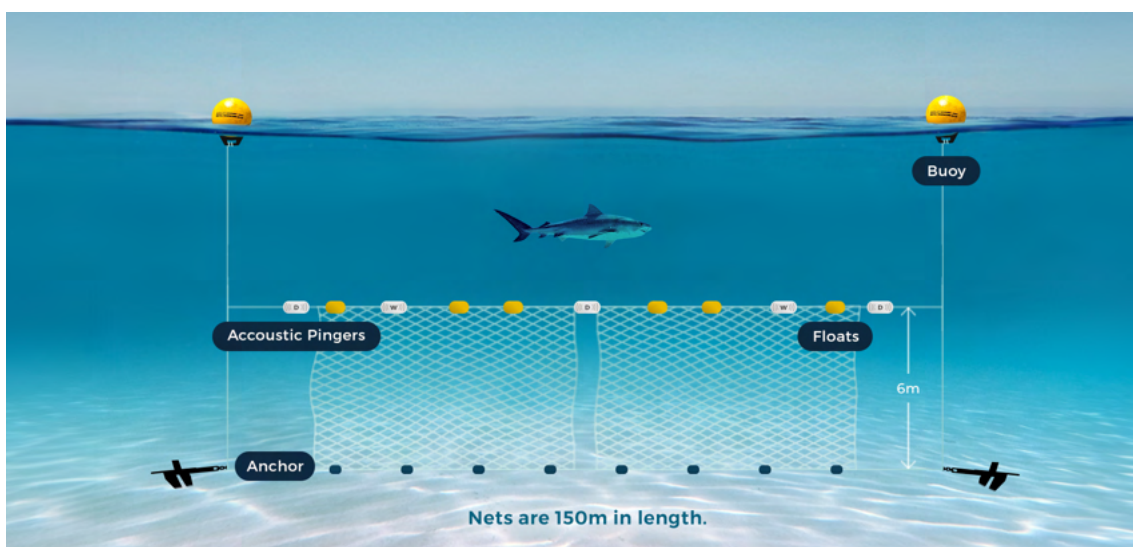
A shark net is a 150m x 6m fishing net set 500m out in the ocean in 10-12m deep water. It is deployed 24 hours a day from September - April. Shark nets were designed in the 1930s to entangle and drown marine animals that swim into the nets. A single net is used at 51 different locations between Newcastle and Wollongong. Each net is only checked roughly every 72 hours.<sup>23</sup>

### Do shark nets effectively minimise the risk of a shark bite?

There is no scientific evidence that the use of shark nets cause a reduction in shark bites.

Scientist Dr Gibbs has studied shark management technologies in NSW and says “shark netting is outdated technology. It is time to move on.”<sup>24</sup>

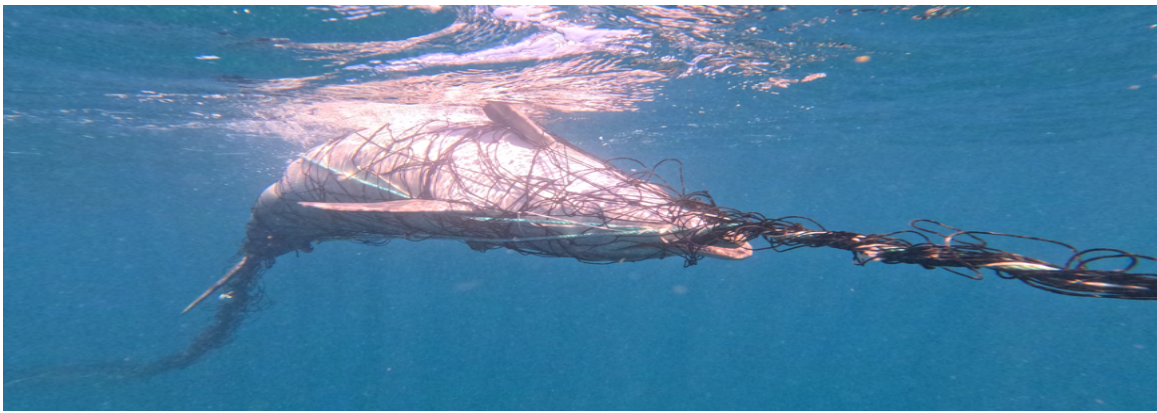
There are 230+ coastal beaches between Newcastle and Wollongong. Shark nets are deployed at 51 of these beaches. Despite this, 85% of shark interactions



Open water between shark nets and the water surface allows sharks to pass to the beach side.  
Diagram not to scale.

<sup>23</sup> Management Plan for the NSW Shark Meshing (Bather Protection) Program, July 2017, s23.3.

<sup>24</sup> Gibbs et al, 'Effects and effectiveness of lethal shark hazard management: The Shark Meshing (Bather Protection) Program, NSW, Australia' *People and Nature Journal*, p 196, available at <https://besjournals.onlinelibrary.wiley.com/doi/full/10.1002/pan3.10063>.



A dolphin caught and killed in a shark net at Bronte Beach

**Credit:** Mother Ocean Freediving

since 2000 have occurred at a beach with a shark net.<sup>25</sup> The NSW Threatened Species Scientific Committee said removing shark nets and expanding modern measures would better reduce the risk of a shark bite occurring and ensure the shark management program does not jeopardise the survival or conservation status of threatened species.<sup>26</sup>

#### How much do shark nets cost to run?

~\$2.4 million per year for 51 nets by 7 contractors.<sup>27</sup>

#### What else is important to know about shark nets?

Removing shark nets is supported by local councils and the sentiment is shared by NSW residents. In 2022, NSW Local Governments passed a motion calling on the NSW Government to replace shark nets with modern alternatives.<sup>28</sup>

This is also supported by the scientific community. The Threatened Species Scientific Committee and the Fisheries Scientific Committee, two independent scientific advisory bodies which oversee the NSW shark net program, have called for the permanent removal of shark nets in favour of alternatives that are already being used in NSW.<sup>29</sup>

Shark nets disproportionately harm other marine life. Between September 2012 - April 2022, NSW's shark nets caught *11.5 times* more non-target marine life than the sharks that are targeted by the shark management program – including dolphins, turtles, rays and sharks. Sadly, 55% of these animals were threatened or protected species.<sup>30</sup>

<sup>25</sup> Cardno, *NSW Shark Management Strategy and Shark Program Review*, 2022, pg iv, available at [https://www.sharksmart.nsw.gov.au/\\_data/assets/pdf\\_file/0009/1398267/Cardno-Report.PDF](https://www.sharksmart.nsw.gov.au/_data/assets/pdf_file/0009/1398267/Cardno-Report.PDF).

<sup>26</sup> NSW Threatened Species Scientific Committee (29 September 2022), *Response to the Shark Meshing (Bather Protection) Program 2021/2022 Annual Performance Report*, available at [https://www.sharksmart.nsw.gov.au/\\_data/assets/pdf\\_file/0003/1433469/9caae8f8c5bb0187413ec01b54fc9c09c882ddb.pdf](https://www.sharksmart.nsw.gov.au/_data/assets/pdf_file/0003/1433469/9caae8f8c5bb0187413ec01b54fc9c09c882ddb.pdf).

<sup>27</sup> Information provided by the Department of Primary Industries on 25 November 2022 in an informal response to a GIPA application

<sup>28</sup> LGNSW Special Conference 2022 (2022), *Record of Decisions, Request to phase out shark nets*, available at

[https://lgnsf.org.au/common/Uploaded%20files/Annual%20Conference%20documents/Special\\_Conference/LGNSW\\_2022\\_Special\\_Conference-Records\\_of\\_Decisions.pdf](https://lgnsf.org.au/common/Uploaded%20files/Annual%20Conference%20documents/Special_Conference/LGNSW_2022_Special_Conference-Records_of_Decisions.pdf).

<sup>29</sup> NSW Threatened Species Scientific Committee (29 September 2022), *Response to the Shark Meshing (Bather Protection) Program 2021/2022 Annual Performance Report*, available as above; NSW Fisheries Scientific Committee (28 November 2022), *2021-2022 Annual Performance Report for the Shark Meshing (Bather Protection) Program*, available at

[https://www.sharksmart.nsw.gov.au/\\_data/assets/pdf\\_file/0003/1458804/FCS-Comments-on-the-2021\\_22-SMP-Performance-Report.pdf](https://www.sharksmart.nsw.gov.au/_data/assets/pdf_file/0003/1458804/FCS-Comments-on-the-2021_22-SMP-Performance-Report.pdf).

<sup>30</sup> Calculated from DPI Annual Performance Reports for the NSW Shark Meshing Program from 2012-2022, reports available at <https://www.sharksmart.nsw.gov.au/shark-nets>.

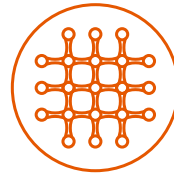


## OTHER MEASURES THAT HAVE BEEN TRIALLED BUT NOT DEPLOYED



### Clever buoys

The Clever Buoy was a sonar buoy that was tested for 13 days in November 2016 in Port Stephens. It could only identify sharks within 46m of the sensor 45% of the time. It has not been tested further and is not considered viable shark mitigation technology.<sup>31</sup>



### Shark barriers

Only two shark barriers were to be trialled in 2016 - one at Lighthouse Beach in Ballina, and the other at Seven Mile Beach at Lennox Head. Neither trial was completed due to poor site selectivity rendering installation of the barriers impossible.<sup>32</sup>

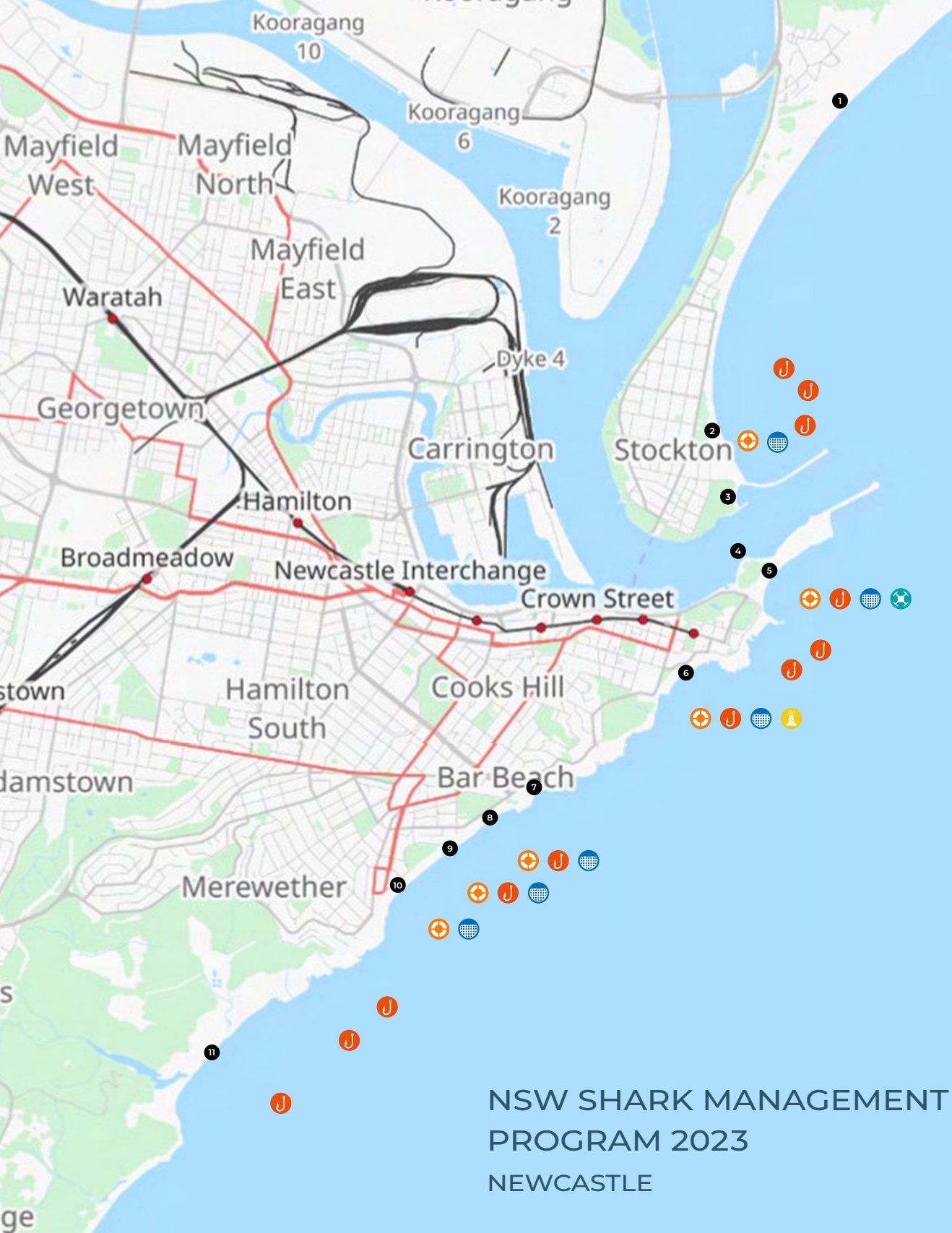
Since 2016, rigid shark barriers such as Eco Shark Barrier have seen improvements in design that allow them to be used at higher energy beaches and deployed in harsher conditions.

Biomimicry barriers combine artificial kelp forests with magnetic repulsion. Biomimicry barriers such as the Shark Safe Barrier have been successful in completely excluding target sharks.<sup>33</sup> They can now be deployed in sandy bottomed coastlines. This type of barrier combines artificial kelp forests with magnetic repulsion and is yet to be trialled in NSW.

<sup>31</sup> Department of Environment, Shark Smart, Summary Report on the Evaluation of the Clever Buoy Shark Detection System (July 2017), available at [https://www.sharksmart.nsw.gov.au/\\_data/assets/pdf\\_file/0007/815866/evaluation-of-clever-buoy-shark-detection-system-summary.pdf](https://www.sharksmart.nsw.gov.au/_data/assets/pdf_file/0007/815866/evaluation-of-clever-buoy-shark-detection-system-summary.pdf).

<sup>32</sup> Department of Primary Industries, Barriers Fact Sheet, available at [https://www.sharksmart.nsw.gov.au/\\_data/assets/pdf\\_file/0004/1237009/sms-factsheet-barriers.pdf](https://www.sharksmart.nsw.gov.au/_data/assets/pdf_file/0004/1237009/sms-factsheet-barriers.pdf)

<sup>33</sup> Craig O'Connell, 'Testing the exclusion capabilities and durability of the Sharksafe Barrier to determine its viability as an eco-friendly alternative to current shark culling methodologies' (July 2017) *Aquatic Conservation*, available at <https://onlinelibrary.wiley.com/doi/abs/10.1002/aqc.2803>.



## NSW SHARK MANAGEMENT PROGRAM 2023

### NEWCASTLE

- |                   |                       |
|-------------------|-----------------------|
| 1 Camping Area    | 7 Susan Gilmore Beach |
| 2 Stockton Beach  | 8 Bar Beach           |
| 3 Little Beach    | 9 Dixon Park Beach    |
| 4 Horseshoe Beach | 10 Merewether Beach   |
| 5 Nobbys Beach    | 11 Glenrock Beach     |
| 6 Newcastle Beach |                       |

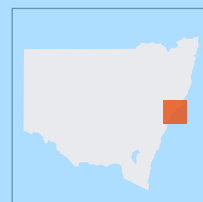
- |  |   |
|--|---|
|  Surveillance Drone |  Surf Life Saving Patrol |
|  SMARTDrumline      |  Shark Listening Station |
|  Shark Net          |   |





## NSW SHARK MANAGEMENT PROGRAM 2023

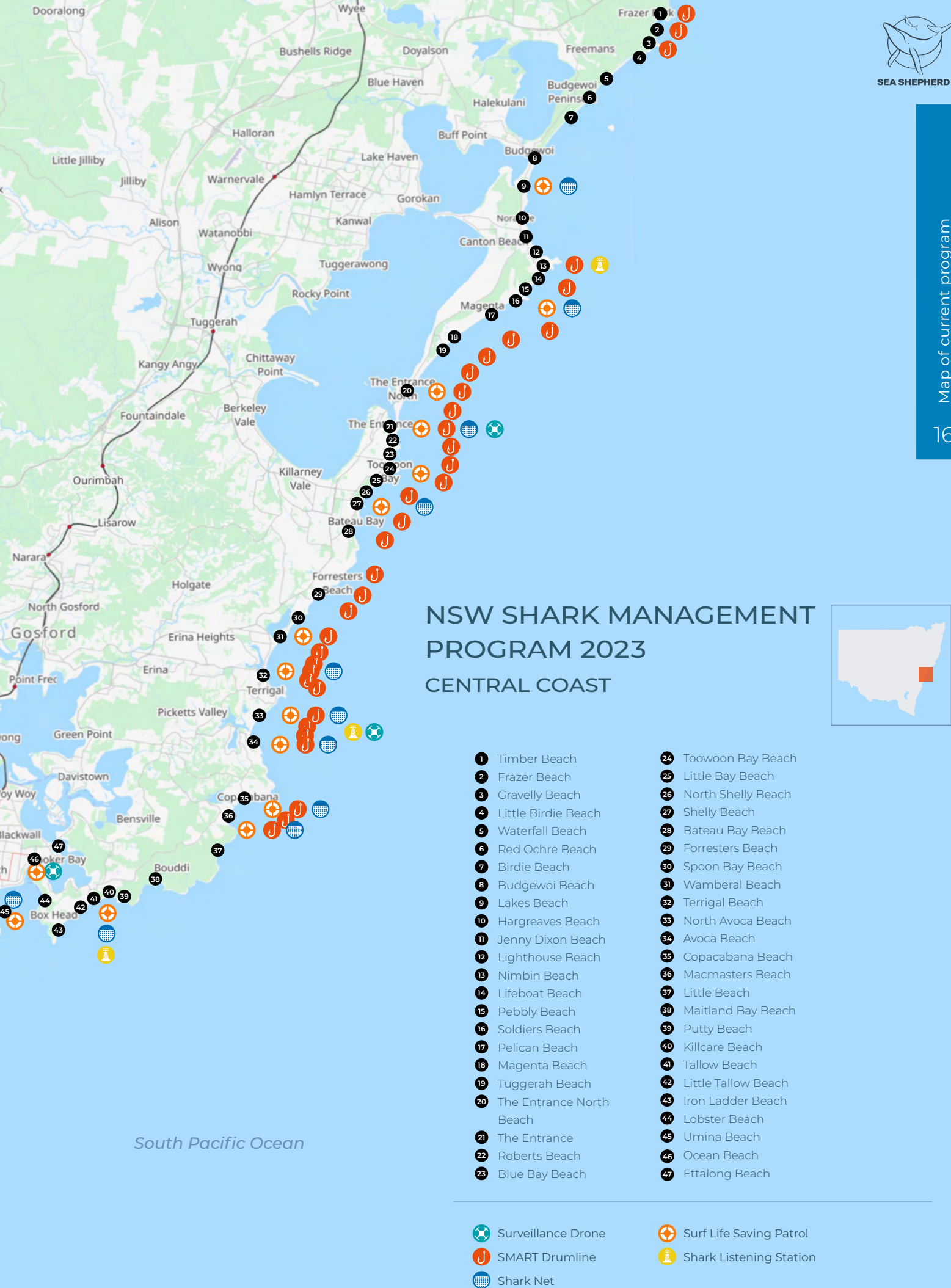
### LAKE MACQUARIE

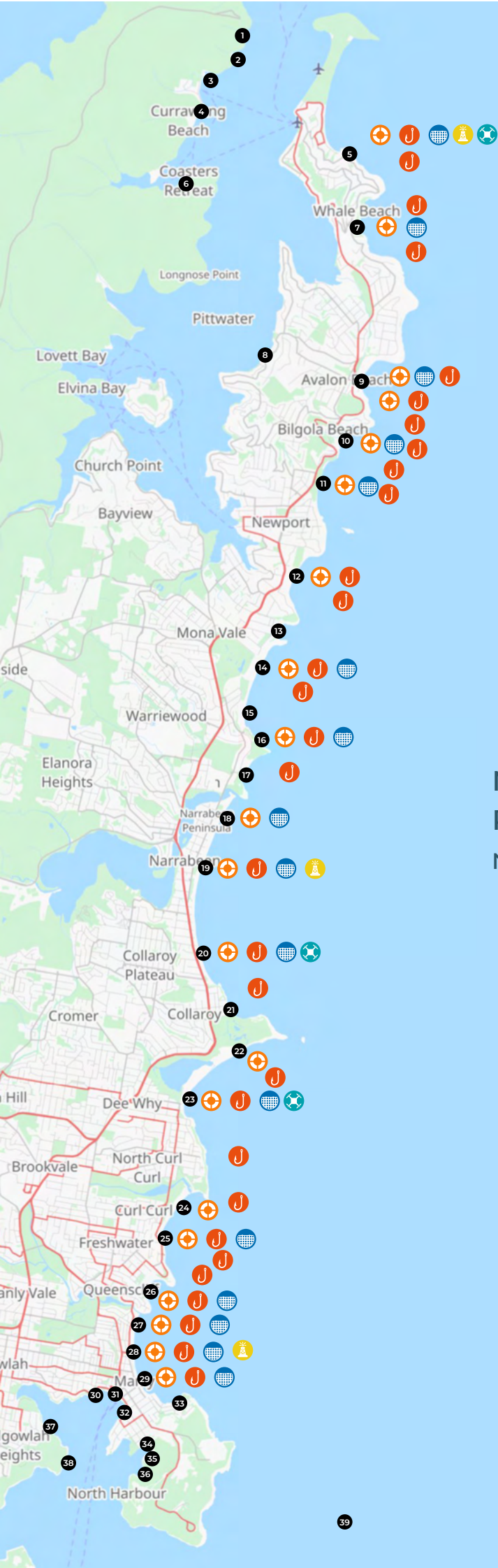


- |                           |                             |
|---------------------------|-----------------------------|
| 1 Dudley Beach            | 10 Caves Beach              |
| 2 Redhead Beach           | 11 Spoon Rock Lookout       |
| 3 Nine Mile Beach         | 12 Quarry Beach             |
| 4 Blacksmiths Beach       | 13 Pinny Beach              |
| 5 Naru Beach              | 14 Middle Camp Beach        |
| 6 Blacksmiths/Heads Beach | 15 Catherine Hill Bay Beach |
| 7 Grannys Pool            | 16 Moonee Beach             |
| 8 Reids Reserve           | 17 Little Beach             |
| 9 Hams Beach              | 18 Ghosties Beach           |

- |  |   |
|--|---|
|  Surveillance Drone |  Surf Life Saving Patrol |
|  SMART Drumline     |  Shark Listening Station |
|  Shark Net          |   |

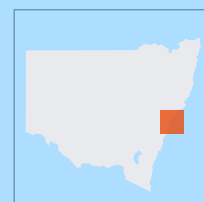






## NSW SHARK MANAGEMENT PROGRAM 2023

### NORTHERN BEACHES



- |                          |                          |
|--------------------------|--------------------------|
| 1 Station Beach          | 21 Fishermans Beach      |
| 2 North Palm Beach       | 22 Long Reed Beach       |
| 3 Barrenjoey Beach       | 23 Dee Why Beach         |
| 4 Great Mackerel Beach   | 24 North Curl Curl Beach |
| 5 Palm Beach             | 25 South Curl Curl Beach |
| 6 Sandy Beach            | 26 Freshwater Beach      |
| 7 Whale Beach            | 27 Queenscliff Beach     |
| 8 Clareville Beach       | 28 North Steyne Beach    |
| 9 Avalon Beach           | 29 Manly Beach           |
| 10 Bilgola Beach         | 30 Delwood Beach         |
| 11 Newport Beach         | 31 Cabbage Tree          |
| 12 Bungan Beach          | 32 East Manly Cove       |
| 13 Basin Beach           | 33 Shelly Beach          |
| 14 Mona Vale Beach       | 34 Little Manly Beach    |
| 15 Bongin Bongin Beach   | 35 Collins Beach         |
| 16 Warriewood Beach      | 36 Store Beach           |
| 17 Turimetta Beach       | 37 Fairlight Beach       |
| 18 North Narrabeen Beach | 38 Forty Baskets         |
| 19 Narrabeen Beach       |                          |
| 20 Collaroy Beach        |                          |

 Surveillance Drone

 SMART Drumline

 Shark Net

 Surf Life Saving Patrol

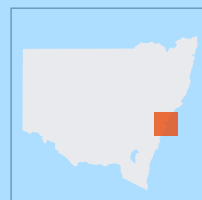
 Shark Listening Station








## NSW SHARK MANAGEMENT PROGRAM 2023

### WAVERLEY

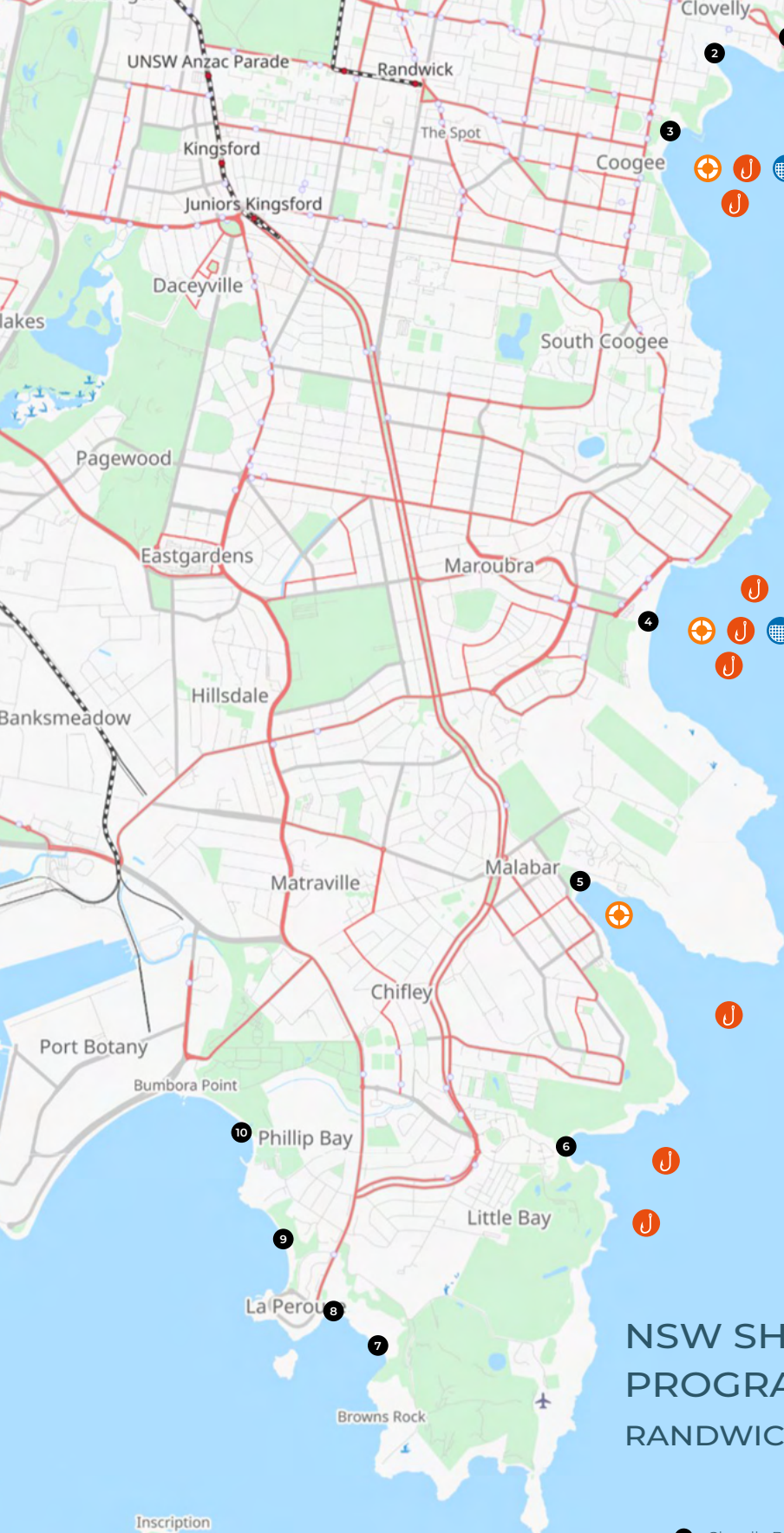


- 1 Bondi Beach
- 2 Tamarama Beach
- 3 Bronte Beach

-  Surveillance Drone
-  SMART Drumline
-  Shark Net

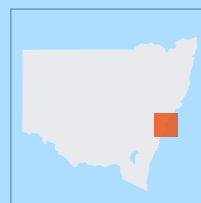
-  Surf Life Saving Patrol
-  Shark Listening Station








## NSW SHARK MANAGEMENT PROGRAM 2023

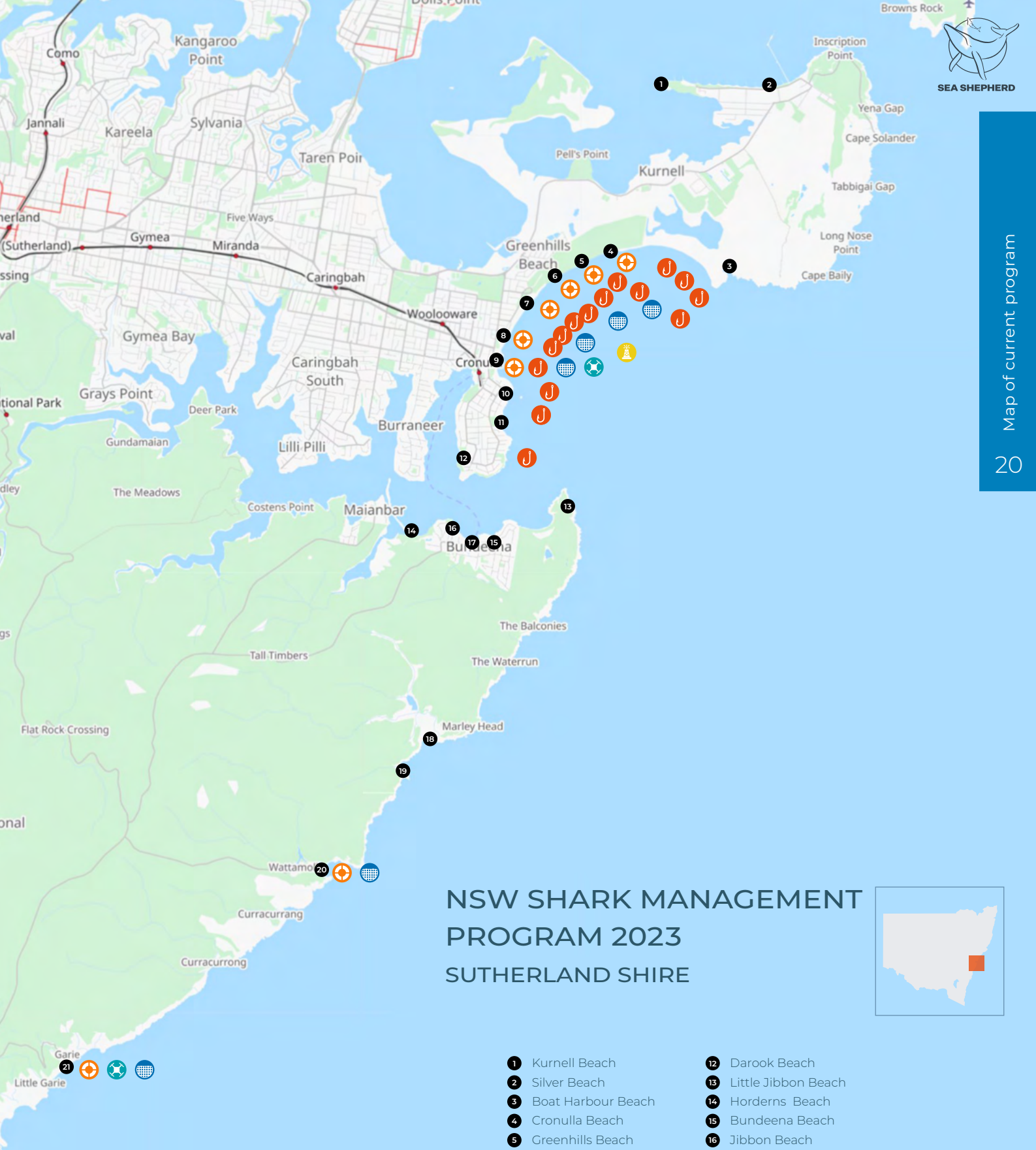
### RANDWICK



- |                    |                         |
|--------------------|-------------------------|
| 1 Clovelly Beach   | 7 Little Congwong Beach |
| 2 Gordans Bay      | 8 Congwong Beach        |
| 3 Coogee Beach     | 9 Frenchmans Bay        |
| 4 Maroubra Beach   | 10 Yarra Bay Beach      |
| 5 Malabar Beach    |                         |
| 6 Little Bay Beach |                         |

-  Surveillance Drone
-  SMART Drumline
-  Shark Net


-  Surf Life Saving Patrol
-  Shark Listening Station



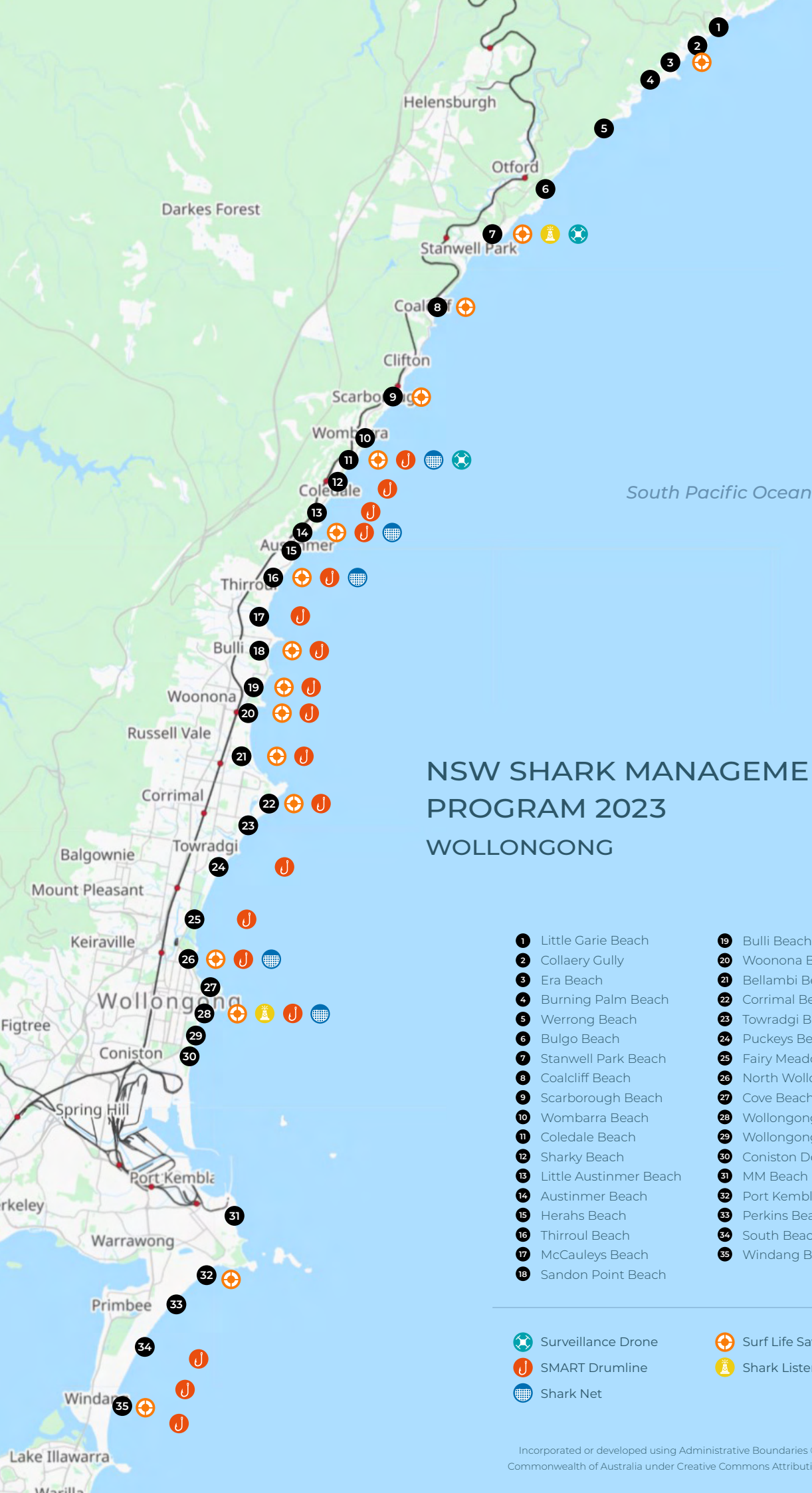
## NSW SHARK MANAGEMENT PROGRAM 2023

### SUTHERLAND SHIRE

- |                      |                        |
|----------------------|------------------------|
| 1 Kurnell Beach      | 12 Darook Beach        |
| 2 Silver Beach       | 13 Little Jibbon Beach |
| 3 Boat Harbour Beach | 14 Horderns Beach      |
| 4 Cronulla Beach     | 15 Bundeena Beach      |
| 5 Greenhills Beach   | 16 Jibbon Beach        |
| 6 Wanda Beach        | 17 Gunyah Beach        |
| 7 Elouera Beach      | 18 Marley Beach        |
| 8 North Cronulla     | 19 Little Marley Beach |
| 9 South Cronulla     | 20 Wattamolla Beach    |
| 10 Blackwoods Beach  | 21 Garie Beach         |
| 11 Shelly Beach      |                        |

- |  |  |
|--|--|
|  Surveillance Drone |  Surf Lifesaving Patrol   |
|  Smart Drumline     |  Shark Listening Stations |
|  Shark Net          |  |

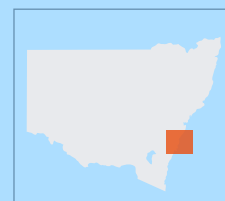




South Pacific Ocean

## NSW SHARK MANAGEMENT PROGRAM 2023

### WOLLONGONG



- |                           |                           |
|---------------------------|---------------------------|
| 1 Little Garie Beach      | 19 Bulli Beach            |
| 2 Collaery Gully          | 20 Woonona Beach          |
| 3 Era Beach               | 21 Bellambi Beach         |
| 4 Burning Palm Beach      | 22 Corimal Beach          |
| 5 Werrong Beach           | 23 Towradgi Beach         |
| 6 Bulgo Beach             | 24 Puckeys Beach          |
| 7 Stanwell Park Beach     | 25 Fairy Meadow           |
| 8 Coalcliff Beach         | 26 North Wollongong Beach |
| 9 Scarborough Beach       | 27 Cove Beach             |
| 10 Womburra Beach         | 28 Wollongong City Beach  |
| 11 Coledale Beach         | 29 Wollongong Beach       |
| 12 Sharky Beach           | 30 Coniston Dog Beach     |
| 13 Little Austinmer Beach | 31 MM Beach               |
| 14 Austinmer Beach        | 32 Port Kembla Beach      |
| 15 Herahs Beach           | 33 Perkins Beach          |
| 16 Thirroul Beach         | 34 South Beach            |
| 17 McCauleys Beach        | 35 Windang Beach          |
| 18 Sandon Point Beach     |                           |

 Surveillance Drone

 SMART Drumline

 Shark Net

 Surf Life Saving Patrol

 Shark Listening Station



## Proposal to modernise the shark management program



### **Remove shark nets at six beaches**

Shark nets are deployed at Stockton Beach, Nobbys Beach, Newcastle Beach, Bar Beach, Dixon Park Beach and Merewether Beach. These should be permanently removed.



### **Expand drone surveillance**

Surf Life Saving operates a drone at Nobbys Beach. Due to current drone restrictions in this region, drone surveillance may be further deployed at Stockton Beach .



### **Expand shark smart education**

Councils can work with the Department of Primary Industries to identify what further education could be rolled out to benefit your community (e.g. signage, outreach, raising awareness about resources already available).



### **Expand shark listening stations**

A shark listening station has been deployed at Newcastle Beach. To expand the network, other listening stations could be deployed at Stockton Beach and Dixon Park Beach.

## Proposal to modernise the shark management program



### **Remove shark nets at four beaches**

Shark nets are deployed at Redhead Beach, Blacksmiths Beach, Caves Beach and Catherine Hill Bay. These should be permanently removed.



### **Expand shark listening stations**

A shark listening station has been deployed at Redhead Beach.

To expand the network, another listening station could be deployed at a location such as Catherine Hill Bay.



### **Expand shark smart education**

Councils can work with the Department of Primary Industries to identify what further education could be rolled out to benefit your community (e.g. signage, outreach, raising awareness about resources already available).

## CENTRAL COAST

### Proposal to modernise the shark management program



#### **Remove shark nets at eleven beaches**

Shark nets are deployed at Lakes Beach, Soldiers Beach, The Entrance, Shelly Beach, Terrigal Beach, North Avoca Beach, Avoca Beach, Copacabana Beach, Macmasters Beach, Killcare Beach and Umina Beach. These should be permanently removed.



#### **Expand shark smart education**

Councils can work with the Department of Primary Industries to identify what further education could be rolled out to benefit your community (e.g. signage, outreach, raising awareness about resources already available).



# NORTHERN BEACHES

## Proposal to modernise the shark management program



### Remove shark nets at fifteen beaches

Shark nets are deployed at Palm Beach, Whale Beach, Avalon Beach, Bilgola Beach, Newport Beach, Mona Vale Beach, Warriewood Beach, North Narrabeen Beach, Narabeen Beach, DeeWhy Beach, Curl Curl Beach, Freshwater Beach, Queenscliff Beach, Manly Beach and North Steyne Beach. These should be permanently removed.



### Expand drone surveillance

Surf Life Saving operates drones at Palm Beach and Dee Why Beach. Drones could be deployed at the other popular beaches where Surf Life Saving is already operational, including any of the other beaches between Whale Beach and Manly Beach.



### Expand shark smart education

Councils can work with the Department of Primary Industries to identify what further education could be rolled out to benefit your community (e.g. signage, outreach, raising awareness about resources already available).



### Expand shark listening stations

Shark listening stations have been deployed at Palm Beach, North Narrabeen Beach and Manly Beach.

To expand the network, other listening stations could be deployed at locations such as Avalon Beach and Dee Why Beach.

## Proposal to modernise the shark management program



### **Remove shark nets at two beaches**

Shark nets are deployed at Bondi Beach and Bronte Beach. These should be permanently removed.



### **Expand drone surveillance**

Surf Life Saving operates a drone at Tamarama Beach. Drones could be deployed at Bondi Beach and Bronte Beach, especially as Surf Life Saving is already operational at these beaches.



### **Expand shark smart education**

Councils can work with the Department of Primary Industries to identify what further education could be rolled out to benefit your community (e.g. signage, outreach, raising awareness about resources already available).



### **Expand shark listening stations**

A shark listening station has been deployed at Bondi Beach.

To expand the network, another listening station could be deployed at Bronte Beach.

## Proposal to modernise the shark management program



### **Remove shark nets at two beaches**

Shark nets are deployed at Coogee Beach and Maroubra Beach. These should be permanently removed.



### **Expand shark listening stations**

A shark listening station is already deployed at Maroubra Beach. To expand the network, other listening stations could be deployed at Coogee Beach, Malabar Beach and Little Bay Beach.



### **Expand shark smart education**

Councils can work with the Department of Primary Industries to identify what further education could be rolled out to benefit your community (e.g. signage, outreach, raising awareness about resources already available).



Proposal to modernise the shark management program



**Remove shark nets at six beaches**

Shark nets are deployed at Wanda Beach, Elouera Beach, North Cronulla Beach, Cronulla Beach, Wattamolla Beach and Garie Beach. These should be permanently removed.



**Expand shark listening stations**

Shark listening stations are already deployed at Cronulla Beach. To expand the network, other listening stations could be deployed at Marley Beach and Garie Beach.



**Expand shark smart education**

Councils can work with the Department of Primary Industries to identify what further education could be rolled out to benefit your community (e.g. signage, outreach, raising awareness about resources already available).

## Proposal to modernise the shark management program



### **Remove shark nets at five beaches**

Shark nets are deployed at Coldeale Beach, Austinmer Beach, Thirroul Beach, North Wollongong Beach, and South Wollongong Beach. These should be permanently removed.



### **Expand drone surveillance**

Surf Life Saving operates drones at Stanwell Park Beach and Coledale Beach. They could be deployed at the other popular beaches where Surf Life Saving is already operational, including Austinmer Beach, Thirroul Beach and Windang Beach.



### **Expand shark smart education**

Councils can work with the Department of Primary Industries to identify what further education could be rolled out to benefit your community (e.g. signage, outreach, raising awareness about resources already available).



### **Expand shark listening stations**

Shark listening stations are already deployed at Stanwell Park Beach and Wollongong Beach.

To expand the network, other listening stations could be deployed at Thirroul Beach and Windang Beach.