Talking to the River

by Clare Knighton

Kaua e kōrero mō te awa, kōrero ki te awa.

Don't talk about the river, talk to the river.

The story

The Pahaoa River curves around three sides of Grant Muir's farm at Hinakura, a rural community in southwest Wairarapa. When Grant arrived in the district in 2002, the river was teeming with life. Ten years later, it was almost dead. The fish had gone, and the water was brown with **algae** and foamed when it rained. Something was killing the river, and Grant thought he knew what.

Cows from nearby farms often grazed on the unfenced riverbanks. This was destroying the vegetation and eroding the banks. The animals' manure in the water added to the problem. Grant tried talking to his neighbours but got nowhere, so he went to the local regional council for help. He was determined to save the river for future generations.

The problem

Before it could help, the council needed to know how much pollution was in the river and where it was coming from. Grant could see for himself that the Pahaoa was dying, but he needed to prove it. Getting that proof wouldn't be easy. Nobody was monitoring the river, and the equipment that could do this job was expensive. Most people would have given up, but not Grant.

COWS AND RIVERS

Cows and rivers are a bad mix. Cows produce a lot of manure, and this contains phosphorus and nitrogen, the same **nutrients** that are found in fertiliser. In fresh water, high levels of nutrients cause problems. Algae can start to grow very fast (called an algal bloom) and use up too much oxygen. This can harm fish and river insects. Cow manure also contains bacteria that sometimes cause serious illness in people. High levels of harmful bacteria is the main reason many of our rivers are now unswimmable. Finally, as Grant saw, wandering cows damage riverbanks. This usually means that more **sediment** is washed into the water, reducing the amount of light that can reach the riverbed (see page 22).

Designing the prototype

Grant needed something that could monitor river water cheaply and effectively. Engineering and computer science students at Victoria University in Wellington needed a real-life project. They offered to design, develop, and test a **prototype** that could gather data from the Pahaoa – and any other river in New Zealand.

When it came to designing the prototype, the students had to find solutions to four main challenges.

1. River water changes by the minute. This meant the monitor had to stay in the water. How could the device be protected from damage from flooding and debris? The answer was to design a strong outer shell with small holes so the water could still flow through.

2. Many things affect the health of a river. If there's too little dissolved oxygen in the water, for example, fish can't survive. Fish also die if the temperature of the water changes too much. So how do you gather different kinds of information? By having different sensors. The students decided their monitor needed five. These would measure temperature, turbidity, dissolved oxygen, pH, and conductivity (more about these things later).

3. Pulling the monitor out of the river to access the data would be a hassle. There had to be an easier way, and there was – using Wi-Fi. This meant the monitor could send the data directly to a phone or computer. Users could stay dry on the riverbank and still know what was happening in the water.

4. Grant wanted as many people as possible to keep an eye on our rivers. How could the students encourage this? The solution was to develop an app. People could take and upload photos of river pollution along with the river's name and its location. This information would be shared on a website. Eventually, the website would become a national **database**, where people could go to see exactly what was happening in our rivers.

An algal bloom

THE DATA: WHAT AND WHY?

The prototype monitor was named RiverWatch. It was designed to measure five different aspects of water quality.

TEMPERATURE: The temperature of a river affects every living thing in that river. A significant change in temperature causes stress; extreme changes can cause death. Most native fish prefer water to be between 18 and 22 degrees Celsius.

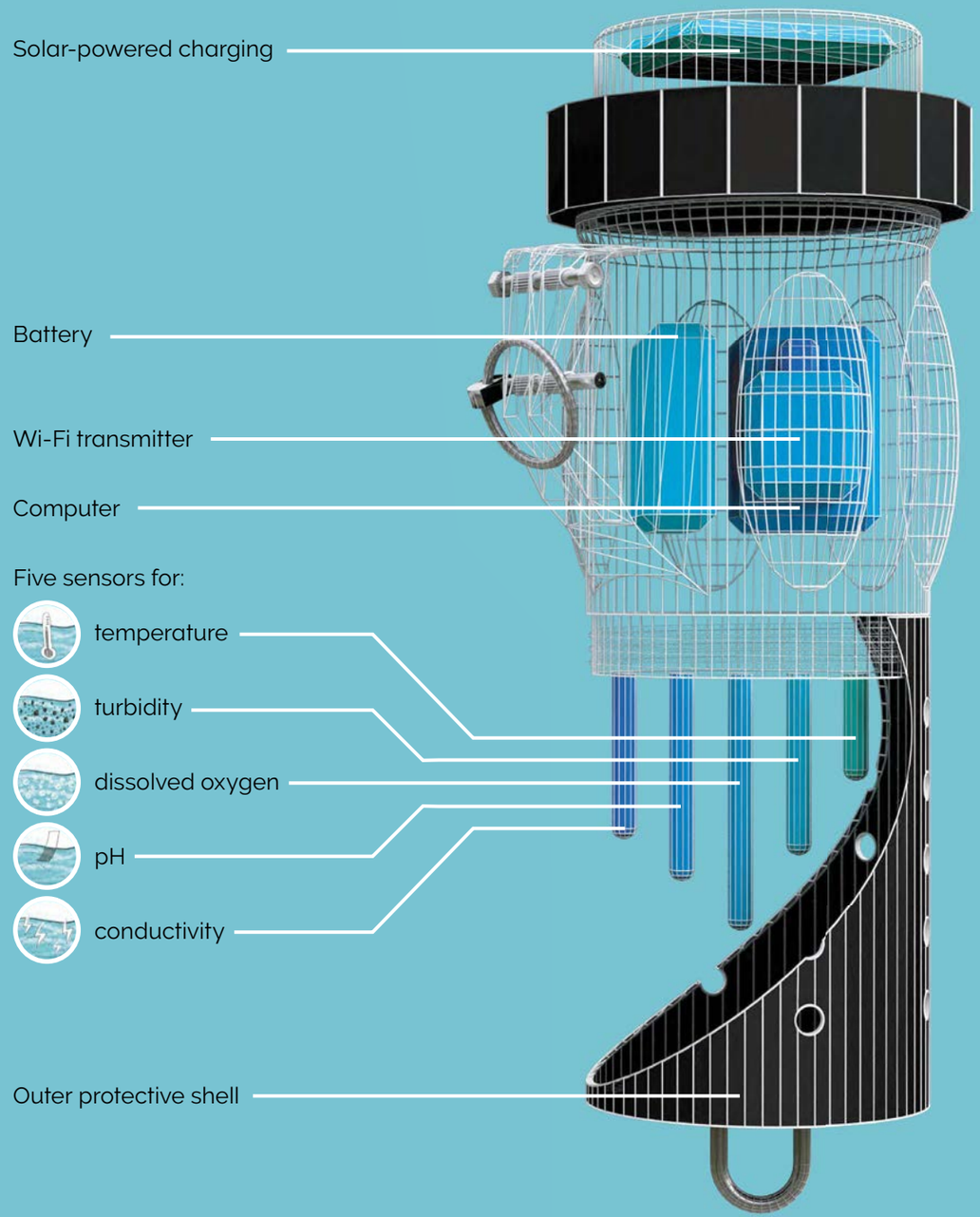
TURBIDITY: The turbidity (cloudiness) of a river is caused by sediment. Too much sediment reduces the amount of light that can reach the riverbed, and plants and algae need light to grow. If they die, so will the creatures that feed on them. Sediment also clogs up the riverbed and the small spaces that many freshwater species call home.

DISSOLVED OXYGEN: This is the amount of oxygen in the water, which aquatic life needs to survive. If the dissolved oxygen level becomes too low, river plants and animals will die.

PH: This is a way to measure acidity or alkalinity, a scale that ranges from 1 to 14 (under 7 is acidic, over 7 is alkaline). River water with a very low or very high pH can become **toxic** for aquatic life. River plants and animals need water that has a pH between 6.5 and 9.

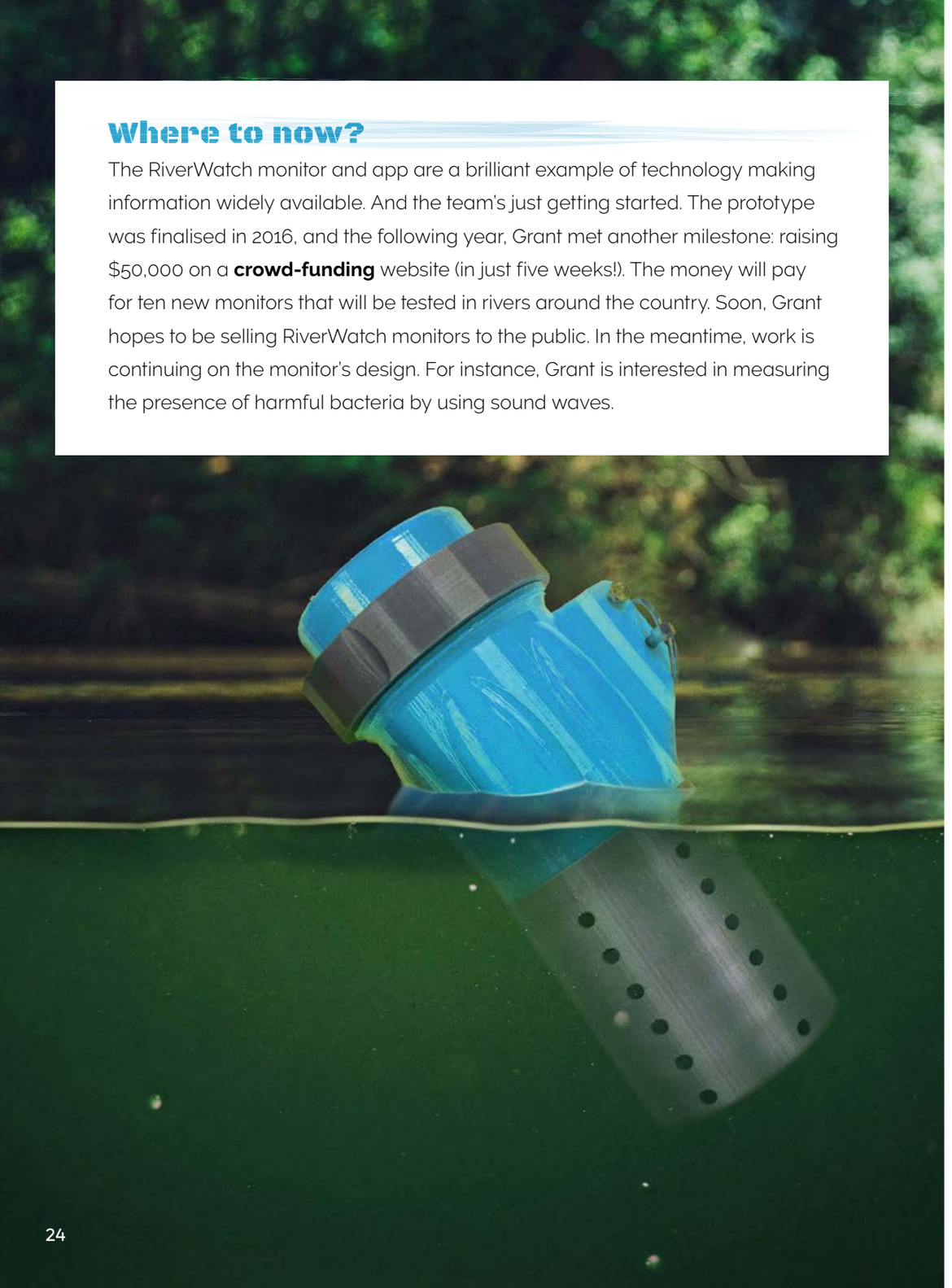
CONDUCTIVITY: Conductivity is a measure of how much electricity can pass through water. This information tells scientists about the nitrogen and phosphorus levels of a river, both of which conduct electricity. A river ecosystem needs a small amount of nitrogen and phosphorus to survive – but too many nutrients cause algal blooms, which can choke the waterway and affect oxygen levels.

The RiverWatch monitor: what's inside



Where to now?

The RiverWatch monitor and app are a brilliant example of technology making information widely available. And the team's just getting started. The prototype was finalised in 2016, and the following year, Grant met another milestone: raising $50,000 on a **crowd-funding** website (in just five weeks!). The money will pay for ten new monitors that will be tested in rivers around the country. Soon, Grant hopes to be selling RiverWatch monitors to the public. In the meantime, work is continuing on the monitor's design. For instance, Grant is interested in measuring the presence of harmful bacteria by using sound waves.



The river today

The Pahaoa River is still in crisis. RiverWatch testing has shown high levels of sediment, and in the summer, the water temperature has been rising above 27 degrees Celsius. This is much higher than most fish prefer.

Sadly, Grant believes these trends aren't unique. "It's not only the Pahaoa that's changing," he says. "River pollution is a problem all over the country." Recent studies show that almost three-quarters of our native freshwater fish species face an uncertain future. Water pollution and habitat destruction are the main reasons for this. A lot of these species are only found in New Zealand. Once they're gone from our rivers, they'll be wiped off the planet.

"If we want to solve our pollution problem," Grant says, "we need to start gathering data from as many sites as possible. Then we need to do something about what this data is telling us. There's so much at stake."

BUILDING THE RIVERWATCH APP

The RiverWatch app is an essential part of Grant's project. It's the main way the public can become involved. So how was the app developed?

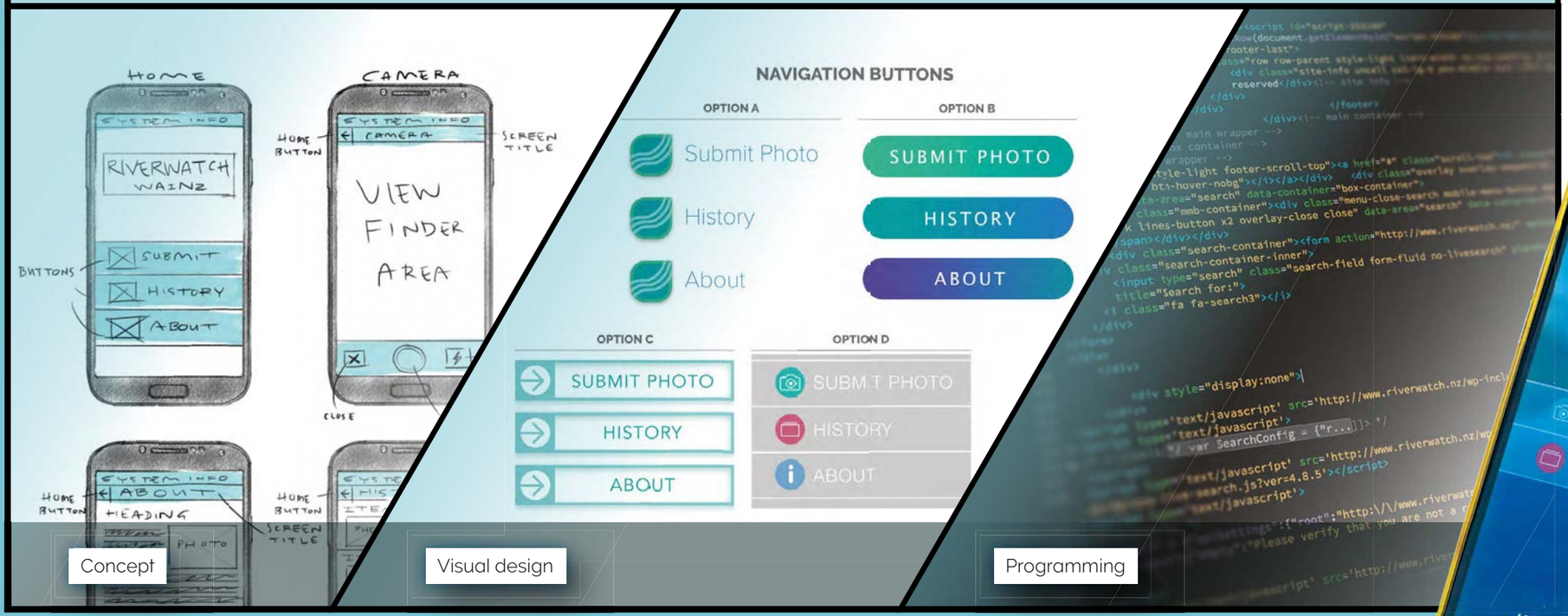
First, the students discussed the app's purpose and the ways people were likely to use it. They wanted the app to be as user-friendly as possible. One important decision was choosing what the user would see when they uploaded a photo. How would they know their photo was uploading? What would they see on the screen once this process was finished?

Then came the visual design. What would the buttons look like? What colours would be used for the screens? Would there be any images or animation? How much information would a screen contain?

Next, the app had to be built. This meant writing the computer code that would instruct the phone to produce the screens and functions needed. While apps can be built using basic drag-and-drop software, the students chose to use Java. This programming language was more flexible and allowed them to be more creative.

Finally came user testing, when people trialled the app. User testing was a crucial part of the process. It allowed the students to ask some important questions. Was their product working? Was anything confusing people? What needed to change?

For most app developers, user testing isn't the end of the process. Often, it's just the end of the first development cycle. When it came to the RiverWatch app, each new class of students added their own ideas, slowly improving and refining the design.



Glossary

algae: a very basic form of plant life, usually microscopic

crowd-funding: raising money for a project from a large number of people, usually on the internet

database: a set of information that is accessed using a computer

nutrient: any substance that provides nourishment for a living thing

prototype: a model to test how an invention will work

sediment: particles of soil along with plant and animal matter carried by water

toxic: poisonous

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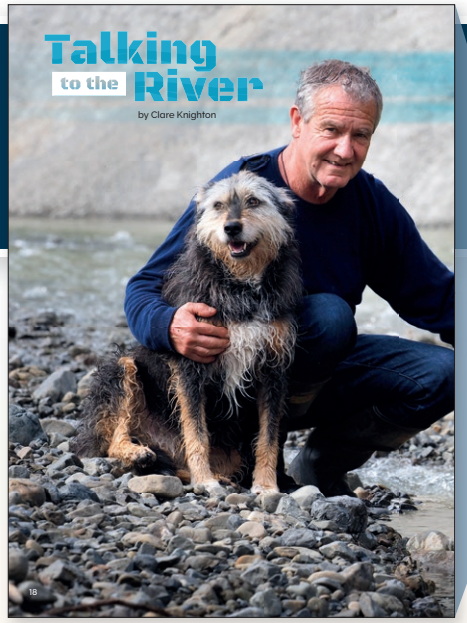

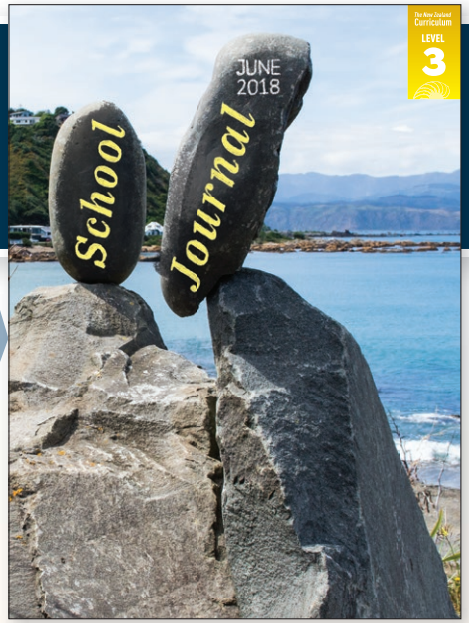

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