Georges Riverkeeper

Water... WOW!

STAGE 3 EDUCATION

Module 5: Water for Living Cities

People interfere with the natural water cycle in various ways. In urban areas, the water cycle is altered by: the capture and distribution of fresh water through pipes for people to use; the piping of household wastewater to sewage treatment plants; and, directing stormwater from hard urban surfaces into drainage systems.

In this module, students will:

- consider how humans alter the water cycle
- determine where water flows when it rains in their schoolyard
- create a drainage map of their school

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Module 5: Water for Living Cities

Stage 3 Geography | Stage 3 Science | inside | outside | linkage concept: branching

Teacher Background

The Urban Water Cycle (GE3-2: Explains interactions and connections between people, places and environments, GE3-3: Compares and contrasts influences on the management of places and environments, ST3-1WS-S: Plans and conducts scientific investigations to answer testable questions, and collects and summarises data to communicate conclusions)

In *Module 4: Catching Water*, students learned about how water moves through the natural water cycle, including being filtered as it passes through soils. The urban water cycle is very different from the natural water cycle. In urban landscapes, water is redirected for human uses and receives less natural filtration, but this is countered by passing water through treatment plants in the supply and wastewater chain.

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Water Distribution Networks

Branching is used as a linkage concept that will reappear throughout *Georges Riverkeeper Stage 3 Education Modules*, here in the context of urban water distribution networks. Each time that branching is mentioned through the modules, ask students to reflect on how branching networks through which water-based substances flow contribute to carrying materials from one place to another. Repetition of this concept should reinforce the importance of the ability of water to carry substances through branched networks, which is one of the main reasons that water is so important for people.

Recall the natural branched networks of blood vessels within our body and streams across catchments through which water flows through, which were mentioned in previous modules. Water also flows through human-made branched networks for distribution across urban areas.

Household Water Supply

Large dams are built to halt the flow of rivers and catch the water that supplies our cities. In the Georges River catchment, there are dams on the Woronora River and at Prospect Reservoir. The water supply network functions quite differently than the natural watercycle, with water travelling large distances through pipes than have no capacity for filtration. Because of the lack of filtration whilst traveling from place to place, water is purified before redistribution through pipes and to people's taps.

Sydney Water supplies over 1.5 billion litres of drinking water to homes and businesses each day. About 80% of it comes from Warragamba Dam, located on the Nepean River near the Blue Mountains. Water is treated at one of nine water filtration plants, or the Kurnell desalination plant, and supplied through a network of 22,822 kilometres of pipes, 247 reservoirs and 151 pumping stations.

Wastewater Network

The wastewater network also involves lots of pipes. These pipes take dirty water from the sinks, drains and toilets in our homes to wastewater treatment plants. At those plants, the water is cleansed using processes of filtration and biological uptake that mimic those occurring in the natural water cycle, before being released to the environment. Sydney Water's wastewater network consists of 16 wastewater treatment plants, 14 water recycling plants, 686 wastewater pumping stations and 45,863 kilometres of pipes. Most of the wastewater in the network flows downslope, powered by gravity, to wastewater treatment plants.

Stormwater Network

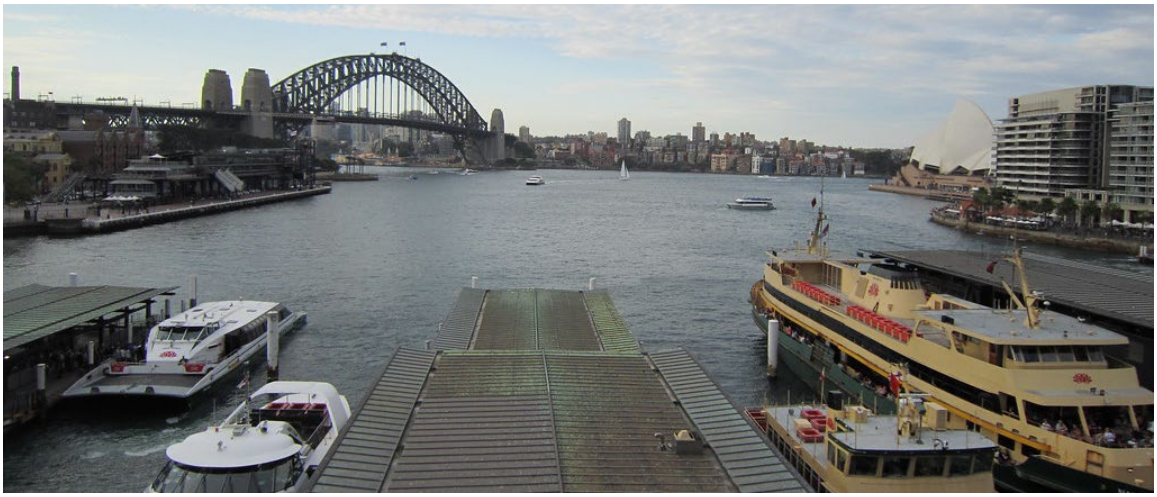
Urban areas have many hard surfaces such as roofs, roads and footpaths, which prevent rain from soaking into the ground. Stormwater is the water that flows across such hard surfaces after rain. Additionally, there are many more potential pollutants in urban areas than in forests. For example, stormwater pollution can include oils, detergents and tyre residue that runs off roads; fertilisers, pesticides and lawn clippings that run off lawns and gardens; sediment that runs of poorly maintained construction sites; and, any other pollutants that are thoughtlessly disposed of down outdoor drains. Stormwater flowing down drains does not travel to wastewater treatment plants, it flows to natural waterways untreated.

Sequence for Module 5: Water for Living Cities	
Syllabus Outcomes	**GE3-1** Describes the diverse features and characteristics of places and environments. **GE3-2** Explains interactions and connections between people, places and environments. **GE3-3** Compares and contrasts influences on the management of places and environments. **GE3-4** Acquires, processes and communicates geographical information using geographical tools for inquiry. **ST3-1WS-S** Plans and conducts scientific investigations to answer testable questions, and collects and summarises data to communicate conclusions.
Learning Intentions	For students to: ♦ determine where water flows when it rains in their schoolyard ♦ create a drainage map of their school ♦ explore and map where water goes on school premises when it rains
Teaching & Learning Activities	Inquiry Question: *How do we change the natural environment?* ♦ Revisit the imagined stories that students created following the Tiddalik the Frog story about water distribution in Module 3 and the Inquiry Question: Where does water come from and where does it go? Ask students about their ideas about where does water in our home really come from and where does it really go to. Use the 'Playground fact' to remind students that humans have always relied upon a source of fresh water for their survival, although we have become increasingly detached from where our water is sourced over time. ♦ Schoolyard drainage mapping (see page 29 for an example) - Using Google Maps, print a map of your school. Mark NORTH on the map. Take a tour of the school yard and map out all the drains, marking their location with a star on the map. Extension: Can you add a scale bar to your map to show distance? **GE3-1, GE3-4** ♦ Activity: mapping drainage around the school - When it rains at school, where does water go? Which drains collect water? Form a hypotheses stating where water will flow when it rains. Pour water from a watering can at various locations across the school to determine in which direction water will drain away from the schoolyard. Draw arrows on your map showing drainage directions across hard surfaces or crosses for locations where you tested and the water infiltrated into the soil, rather than flowed towards drains. Add a legend to show drains, direction of water flow across hard surfaces and where water infiltrates the ground. **GE3-3, GE3-4** ♦ Discuss how the natural environment within the school yard has been changed over time. Compare how many drains occur around hard surfaces (e.g. asphalted areas), compared to how many occur around open surfaces (e.g. grassed areas). **GE3-2, GE3-3**

	♦ Using your aerial image of the school, estimate the percentage of the school covered by hard surfaces (e.g. roofs, paths, carparks, asphalt, hardened playgrounds). How do hard surfaces affect where rain goes? If there were no hard surfaces at all, where would rainfall go? **GE3-2, GE3-3, GE3-4** ♦ What about rubbish when it rains? Drop some confetti on the ground in various locations and observe and map where it goes when water is poured from a watering can. Map where it will go. (Much will go down the drain). How does rubbish and hard surfaces affect our waterways when it rains? **GE3-3, ST3-1WS-S**
Feedback	Your feedback is important to us. Please complete this quick online survey: http://bit.ly/ModulesFeedback

Playground fact:

Sydney city is located where it is today because the Tank Stream, which flowed into the harbour under what is now Circular Quay, provided fresh water to early British settlers. Unfortunately, it took less than 40 years for those settlers to pollute the stream so badly that it became undrinkable, being used instead as a sewer that was later directed through stone tunnels as the city grew above it. Until the late 1800s, sewage continued to be discharged untreated into Sydney Harbour.
See https://www.sustainabilitymatters.net.au/content/wastewater/article/history-of-wastewater-treatment-in-sydney-311574744 for more history of Sydney's wastewater treatment.




Drains
Direction of water flow indicated by arrows
Water infiltrates ground
N
10 metres
X
X
X
X
Google

Biographies of authors

Dr David Reid

David is a scientist who studies waterways for his work at Georges Riverkeeper in southern Sydney. He grew up near Lake Macquarie and the beaches south of Newcastle, where he spent much time swimming, surfing, exploring the life in water and generally enjoying being close to water. After finishing school, he went to university and his studies eventually led to completion of a PhD on waterbugs and food webs in farmland streams. Gaining those qualifications has allowed him to do research and monitoring work in waterways around the world, including those in New South Wales, Victoria, South Australia, New Zealand and New York City (see https://www.researchgate.net/profile/David_Reid15). He still enjoys having fun in water too!

Antonina Fieni

Antonina loves rivers. She is often seen paddling up rivers and creeks looking for Eastern water dragons or sacred kingfishers. When not paddling, Antonina is teaching environmental science and geography at the Georges River Environmental Education Centre and at the Field Study Centre at Sydney Olympic Park. Her qualifications include a Bachelor of Education and a Graduate Diploma in Environment.

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Georges Riverkeeper is an alliance of Councils with collective responsibility for the Georges River and its catchment.
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