Teacher Support Package

Secondary – Stage 4

This package is designed to support teachers by providing links to relevant, quality and engaging educational resources related to the work that WaterNSW does managing the drinking water catchments and dams for Greater Sydney. The selected content, activities and on-line learning tools are aligned with NSW syllabus outcomes as outlined below.

This package may be used as a standalone resource or to enhance an excursion to Warragamba Dam.

Pre-visit Prior to visiting Warragamba Dam on a school excursion, teachers may choose to introduce new ideas and concepts. This will enable students to connect place-based learning to existing understandings.

Post-visit Following an excursion to Warragamba Dam, teachers may choose to validate, consolidate or further extend student understanding.

Resource topics include:

- The water cycle GE4-2
- What is a catchment and how are they managed? GE4-1, GE4-5
- What is storm water? GE4-2, GE4-3 GE4-5
- Warragamba Dam GE4-1
- Water as a resource GE4-5
- Our water supply system GE4-5
- Water quality monitoring GE4-8
- Healthy water is home to many creatures GE4-5
- Geographical field sketch GE4-7

The following icons have been used to categorise the links:

Websites Videos Books Movement and Singing Puzzles, Games and Creativity

Visit **waternsw.com.au/education** for more information or to book an excursion.

The Water Cycle

The earth only has a limited amount of water. This water keeps going around and around – from the land to the sky and back again. This journey is called the 'water cycle'.

We all need clean freshwater to survive. Although about three-quarters of the Earth's surface is covered with water, less than one percent of this is available for us to use. When we interrupt the natural water cycle by building dams so that we have clean safe water, this is called the 'managed water cycle'.

Resources	
	WaterNSW – Water Cycle Information WaterNSW – Water Cycle Factsheet Sydney Water – Outline of the Natural Water Cycle NASA – Water Cycle Board Game University of Waikato – Global Water Cycle Interactive TES – The Water Cycle: Presentation for IWB • Free PowerPoint presentation of the water cycle
	WaterNSW – How does the water cycle move water around earth? (2:18mins) British MET Office – How does rain form and what is the water cycle? (2:47mins) BBC Planet Earth – Fresh water (2:46mins) National Science Foundation (USA) – How the hydrologic cycle works (6:46mins) Niagara Falls Webcam – Live Yorta Yorta Man and Aboriginal artist Mr Francis Firebrace – "How the Great Fish Goodoo Created the Murray River" (4:30mins)

	Australian Association for Environmental Education NSW (Sustainable Schools NSW) • A range of reaching resources including: - information on sustainable practices to reduce water consumption, - units of work - lesson plans - support materials - catchment investigations - curriculum connections Victorian Department of Education – Rainfall and water supply in Australia - various resources Wilson Education UK – Water World: Unit of Work • 36-page workbook including: - how we and others use water (individual and group activities) - rain types and flooding - rights to clean water - water aid - water shortages
	Blazer Fresh – Water cycle rap (3:16mins)
	WaterNSW – Water Discovery: Water Cycle Puzzles • Students explore aspects of the water cycle by completing fun puzzles Cool Australia – Water cycle and catchment connection • Great information and worksheets on the connection between the water cycle and understanding catchments Scripps institute California – The Water Cycle Quiz • Multiple choice quiz to learn the parts of the water cycle University of Wisconsin (Madison) - Field Day Learning: Water Cycle Game • Students use action cards in this online game to convert water from one form to another (single player or multiplayer options) Science World – Water cycle game • Use an interactive, full-body, moving, sound effect version of Rock, Paper and Scissors to incorporate the four stages of the water cycle with your students

What is a catchment and how are they managed?

A catchment is an area where water is collected by the natural landscape.

Imagine cupping your hands in a downpour of rain and collecting water in them. Your hands have become a catchment.

The outside edge of a catchment is always the highest point. Gravity causes all rain and run-off in the catchment to run downhill where it naturally collects in creeks, rivers, lakes, or oceans.

Rain falling outside the edge of one catchment is falling on a different catchment, and will flow into other creeks and rivers.

Resources	
	WaterNSW – Catchment information WaterNSW - Special Areas • Special Areas are zones that protect Greater Sydney's drinking water catchment WaterNSW – Sydney's drinking water catchments • This catchment fact sheet has a scale, legend and shows the locations of Sydney's water supply dams and their catchments ABC News – Farmers fence out livestock to clean up rivers, using New Zealand as cautionary tale • Written by Margot Kelly, this story explores how Tasmanian farms are being proactive about reducing pollution and protecting rivers
	WaterNSW – "Protecting the Heart of the Catchment" (4:17mins) ABC Education – Where does water go after it rains? (1:55mins) • What happens to rainfall in Australia? Water usually flows downhill, and because we know where the hills are, scientists have been able to divide the country into drainage divisions, or catchments. Find out which drainage division you're in and learn what happens to rainwater that doesn't make it to the sea Buladerang – A Wiradjuri Creation Story of where two catchments meet (4:53mins) Sharon Riley, a Wiradjuri woman, tells the story of Gaygar and Biladurang on the River Lett (near Lithgow).

	Teach Engineering - Can you Catch the Water • Students build a model of a catchment and investigate how landforms impact the way that water flows WaterNSW – Our Changing Catchment (Video & Activity Sheet) • Students build a model of a catchment and investigate weather, erosion and turbidity WaterNSW – Roots are Underground Superheroes (Video & Activity Sheet) • In this hands-on activity, students investigate the role that plants play in reducing weathering and erosion to ensure that the water in our catchments has low turbidity WaterNSW – Water Discovery: Sydney's Drinking Water Catchments • Students use a factsheet, watch a video, and explore real-time data to better understand Sydney's drinking water catchments

What is storm water?

Storm water is rainwater plus anything the rain carries along with it. As rainwater runs across different surfaces, it can pick up various types of pollutants.

WaterNSW works with councils to reduce pollution in storm water. This means there is less impact on water supply.

After studying the concept of storm water, students can look at the school and playground and discuss where the water goes when it rains. Are there any problems? Is the school doing a good job of managing storm water to keep the environment and waterways clean? How many drains are there? Can you see rubbish in the drain when you look through the grate?

Resources	
	Washington Department of Ecology – Stormwater Information (simple) Australian Government – Stormwater Information (complex) Seqwater – What is a flood? • Although this has a South Eastern Queensland context, the fact sheet provides information and graphics ABC News – Plugging stormwater drains during floods • Lessons from a flood in 1956, help the Renmark Paringa Council manage flooding in 2022 by plugging their aging stormwater systems
	ACT Healthy Waterways - Where does stormwater go? (simple) (2:14mins) Practical Engineering – Where does stormwater go? (complex) (11:47mins) Orange City Council – Stormwater harvesting (5:34mins) • The water which runs through Orange's stormwater channels, to be harvested in different ways, has become an integral part of the city's water supply ABC Australia - Storm water drain sock (1:49mins) NSW SES - Why Hawkesbury-Nepean floods are so dangerous (2:30mins) • Learn how the unique 'bathtub effect' in the Hawkesbury-Nepean Valley causes floodwaters to back-up and cause deep and dangerous flooding.

	Australian Water Association – Water Educator's Toolkit • A 36-page booklet with activities for Stage 1 through Stage 5 students Department Energy and Water Supply – Explaining our catchment • A 28-page booklet with many conceptual diagrams Salisbury Council –Stormwater treatment • Salisbury Council, Adelaide, constructed wetlands to clean storm water Teach Engineering – Natural and Urban Stormwater • Presentation, handout and answer keys to help students understand how human development impacts the flow of stormwater runoff Murray Darling Basin Authority – Wetlands and Food webs • Lessons that explain the role of wetlands in biofiltration
	Sydney Water – Stormwater audit • Students investigate their school's stormwater drains, assess their pollution levels and create a management plan to reduce pollution ABC Science – Catchment Detox • A game to see if you successfully manage a river catchment and create a sustainable and thriving economy

Warragamba Dam

Located about 65 kilometres west of Sydney in a narrow gorge on the Warragamba River, Warragamba Dam is one of the largest domestic water supply dams in the world.

Created by damming Warragamba River and flooding the Burragorang Valley, the storage lake is four times the size of Sydney Harbour and stores up to 80 percent of Sydney's water. Warragamba Dam supplies water to more than 5 million people living in Sydney and the lower Blue Mountains.

The best quality water is selected and drawn through screens on three outlets in the upstream face of the dam. Water flows by gravity through a valve house into two pipelines that feed the raw water to Prospect water filtration plant and via off-takes to smaller filtration plants at Orchard Hills and Warragamba.

Resources	
	WaterNSW – Visiting Warragamba Dam and related information WaterNSW – Greater Sydney Dam Levels • Discover how much water is in Sydney Dams by using this interactive map WaterNSW – Water Insights • Explore how much water is available in each water supply across the state via an interactive state map
	WaterNSW – Warragamba – A story of our making (21:31mins) • Generations of Sydneysiders owe thanks to the 2000 workers who worked round-the-clock shifts to build Warragamba Dam between 1948 and 1960. This is their story told by the men and women who lived and worked at Warragamba. The original footage of the construction reveals how complicated and large the project was. WaterNSW – 2012 Warragamba Dam spilling video footage (2:27mins) & 2021 Warragamba Dam spilling video footage (1:36mins) WaterNSW – How the gates on Warragamba Dam work (2:10mins) WaterNSW – Caring for the Quiet Beast (4:54mins) WaterNSW – How floods impact our storages in Greater Sydney (1:54mins)

	WaterNSW – How drought impacts water storages in Greater Sydney (4:01mins) ABC News – The lost valley (3:53mins) • Warragamba dam flooded the Burragorang valley to supply Sydney with water. ABC interviews people with memories of living in the valley.

Water as a resource

Water is a precious, natural resource that supports all human, plant, and animal life. We use it to grow food and make goods. Water supports life.

Australia is the driest, permanently inhabited continent, and our frequent droughts and long periods of hot, dry weather make water an even more valuable resource. We store more water per person than any other country, to make sure we have enough during times of drought.

When our dams are full, WaterNSW stores over 500,000 litres (half a megalitre) of fresh water for every person in the Greater Sydney area. However, our growing population and variable climate mean that saving water makes good sense.

Resources	
	WaterNSW - A Precious Resource The water we eat • A graphical representation of how we much water we eat in food or to grow the food. How much water is in a grain fed steak? Click here to see the whole graphic
	WaterNSW – How WaterNSW supplies water to Greater Sydney (3:12mins) Through our eyes – Finding water in an arid environment (5:00mins) • Badger Bates is Baarkindji man from Western NSW. He explains how traditional Aboriginal people find water in an arid environment, such as following animals to water or identifying signs left by other people. He also demonstrates a traditional technique for reducing water wastage CSIRO - Aboriginal water values and management in northern Australia (14:16mins) ABC Education - Show me the water! (2:05mins) • Where does the water in your tap come from? Fresh water accounts for only 3% of the earth's water supply and only 1% of that is available to us in lakes and rivers or in the atmosphere BBC News – Cloud catcher of Peru (4:54mins) • The BBC meets Abel Cruz, the man behind a huge fog net project which is providing water to a community in the slums of Lima Real stories – Living without Water (49:18mins) • A full documentary about the slums of Peru National Geographic – What happens with Cape Town runs out of water? (4:08mins) • In 2018 Cape Town, Africa nearly ran out of water

	Water Corporation – How does desalination work? (8:51mins) ABC Education – Engineering clean rivers (3:06mins) • Figuring out how to clean up contaminated rivers is a big challenge. ABC Education – River Kids (8 chapters digibook) • Join Tyrone, a young Ngarrindjeri boy, as he introduces us to people who depend on the Murray River. Discover how Australians are working together to look after the river, and how the river supports people, wildlife, and the economy. ABC Education – Lake Condah (4:46mins) • By creating a paradise for eels using artificial channels and ponds, the Gunditjmara people of western Victoria enjoyed a reliable source of food and a valuable item to trade.
	WaterNSW – Water Discovery: Explore Water Uses • Students investigate how they use water and can reduce their water use WaterNSW - Water Challenge Diary • Students can fill out the water challenge diary to see how much water they use in one day at home The Conversation – Undrinkable Water in Indigenous Communities • Cara Beal (author) discusses a water industry report from 2022 that states that more than 500 remote Indigenous communities regularly have unsafe drinking water. EarthEcho Water Challenge • An international program that runs annually from 22 March (the United Nations World Water Day) until December and equips anyone to protect the water resources we depend on every day. South Australia Water - Captain Plop • A downloadable PDF in the series Captain Plops Tour De recycle for a parent or teacher to read aloud
	Halls Creek Community in the Kimberly - Don't waste the water rap (4:02mins)
	Cool Australia – Water poster campaign WaterAid – WaterQuest game • Explore the village and surrounding area, talk to three key villagers, and help WaterAid decide what solutions to implement

Water Supply System

We use the water collected by the natural landscape (catchments) to help supply water for our needs, by building dams and weirs, or tapping into groundwater.

Rainfall in Greater Sydney's five drinking water catchments - Warragamba, Shoalhaven, Upper Nepean, Woronora and Blue Mountains - flows into creeks and rivers that flow into 11 major dams managed by WaterNSW.

The dams are connected to each other by a complex system of rivers, weirs, canals and pipelines. This is called the water supply system.

WaterNSW manages the dams and raw (untreated) water supply for Greater Sydney, and also helps protect the health of the water catchments.

Resources	
	WaterNSW – Our water supply system WaterNSW – Factsheets: What is a dam? & What is a weir? WaterNSW – Heritage and History Sydney Water – Education • A range of information regarding drinking water, wastewater and recycling and water management Sydney Water – Water Network Sydney Desalination Plant – Virtual Tour Department of Energy and Water Supply – Year 7 Science • This 34-page document contains lesson suggestions ABC News – Remote community trials technology that makes water 'out of thin air' • A trial to shore up the supply of drinking water in a remote Central Australian community will soon get underway, involving hydropanels that make water "out of thin air".
	WaterNSW – WaterNSW Water Operations (2:34mins) WaterNSW – How WaterNSW supplies water to Greater Sydney (3:12mins)
	WaterNSW – Water Discovery: Exploring Rivers of New South Wales • Use real-time data to learn more about some important rivers in Western New South Wales

	WaterNSW – Water Discovery: Greater Sydney Dams • Use real-time data to learn more about Greater Sydney's Dams and Water Supply WaterNSW – Water Discovery: Our Dams • Explore dams in New South Wales by completing these fun puzzles WaterNSW – Using syphons (Video, Instructions & Factsheet) • In this hands-on activity, students investigate how syphons help us to move water over hills. South East Water – Water Sources game

Water Quality Monitoring

WaterNSW operates an extensive water quality and quantity monitoring program to track how we are meeting quality standards for our customers along with public health requirements.

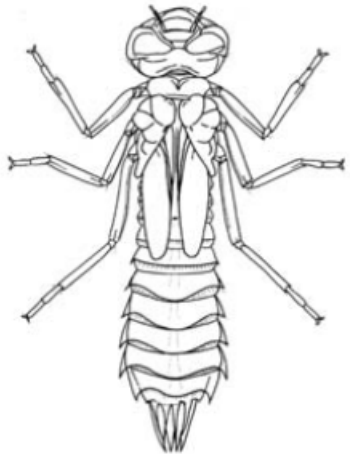
WaterNSW monitors water quality in rivers, water bodies, groundwater, water storages and the delivery network. Monitoring is a critical tool for managing the water supply - as it provides early warning of changes to water quality - so that the configuration of the water supply system can be adapted to ensure only the best quality water is supplied to our customers. It also helps verify the effectiveness of our actions.

Resources	
	Water NSW – Water Quality Monitoring WaterNSW – WaterLive App • Access real-time information from our automatic digital devices from over 1,200 water monitoring sites throughout the state. Information includes stream, storage or groundwater levels, stream flows, storage volumes, water temperatures, rainfall and various types of water quality data. WaterNSW – How WaterNSW manages algal blooms ABC News – Water catchments are covered in bushfire ash, what will happen when it rains?
	NSW Waterwatch – Various videos on water testing methods WaterNSW – Learn more about water quality in Lake Burragorang • Beneath Lake Burragorang (5:45mins) • Lake turnover in Lake Burragorang (3:48mins) WaterNSW – Bushfires and Water Quality Management (9:41mins) WaterNSW – Various videos about algae and algal blooms • What are algae? (2:10mins) • Research into algal blooms (1:56mins) • How WaterNSW manages algal blooms (3:25mins)
	Water NSW – WaterInsights • Use WaterNSW's comprehensive WaterInsights portal and this worksheet to explore our dams using real-time volume data Streamwatch – Get involved in water quality data collection

Healthy water is home to many creatures

Rivers, streams and dams are a hidden world full of life and diversity. Sheltered bays and shallow inlets, where creeks and rivers flow into the lake, are an ideal habitat for native animals such as turtles, platypus, and water rats.

WaterNSW scientists use the study of aquatic life as bioindicators of potential issues. A change in the health and numbers of aquatic life could tell us that there is a change in water quality. By studying these changes, we can better understand where we need to put measures in place to stop potential pollutants from traveling into the water supply. Populations of macroinvertebrates or "water bugs" are studied on an ongoing basis.



Macroinvertebrates are creatures without backbones that you don't need a microscope to see. An example is the dragonfly larvae picture to the right.

Macroinvertebrates are usually abundant and diverse when water quality is good, but they are sensitive to deteriorating water quality and habitat condition, and to changes in water flow.

Resources	
	Atlas of Living Australia – Access Australia's biodiversity data Georges Riverkeeper – Meet the water bugs • Excellent images of water bugs organised according to their sensitivity to pollution Native Fish Australia – Full list of common species
	Melbourne Water – Water Bugs (3:13mins) Georges Riverkeeper – Catching water bugs at Maddens Creek (1:25mins) Marion Huxley, an aquatic ecologist, demonstrates how to catch water bugs ABC Science Program Catalyst – Eel Migration (5:13mins) • The eel migration is the epic story of eels travelling thousands of kilometres to breed ABC Education – Lives of Platypuses (4:17mins) The Secrets of Nature – Sky Hunters World of the Dragonfly (49:48mins) • An excellent dragonfly documentary with vivid closeups

	ABC Education – Ingenuity of Aboriginal People in Aquaculture • Bruce Pascoe shows how Aboriginal people caught fish without nets, spears, or fishing line ABC News – Mosquito population boom • The 2022 floods caused plague-like proportions of mosquitos across New South Wales that caused animal welfare concerns and risks to humans.
	NSW Waterwatch – Printable resources including Bug ID Charts and Posters Department of Primary Industries – A Guide to Freshwater Fish in NSW Victoria Government – Aboriginal freshwater middens Book – The Waterbug Book: A Guide to Freshwater Macroinvertebrates of Temperate Australia (2022) by Gooderham, J. & Tsyrlin, E.
	National water bug blitz – Get involved and meet the bugs The Platy-Project – Record a sighting of a platypus

Geographical Field Sketch

A field sketch provides an opportunity for students to contextualise the features of, and activities that are happening in the environment they are studying.

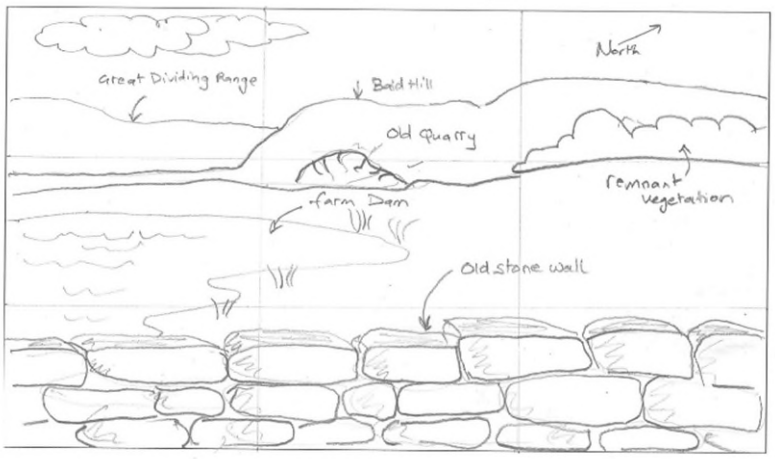
Field sketches are useful to record, highlight and annotate key features of the place being observed.

A field sketch is judged on its ability to convey information, not judged on its artistic merit. This means annotations and labels are an important part.

Steps to draw a field sketch:

- Divide the page into thirds with a light pencil line
- Draw the horizon
- Add important large features
- Draw the foreground & closest things last
- Use shading to give depth
- Which way are you looking?
- Label features e.g. mountain names

Hint: Always draw the background or horizon first. Don't forget the clouds and what is happening in the sky.



Resources	
	Click here for more information on field sketching