Water is the driving force in nature

- Leonardo da Vinci

Central Coast Council

Central Coast Council - High Schools Water Education Program

Geography Stage 4 - Water in the World


Do the earth a
favour,
be a water saver
love water
use it wisely

CONTENTS

Mardi Dam

INTRODUCTION

Central Coast Council is proud to present the 'Love Water, Use it Wisely' School Water Audit Program designed to support the Stage 4 Geography unit 'Water in the World'. This program has a strong focus on water conservation and water use within the school and in the context of the Central Coast catchment. Throughout this program students will learn about the water cycle, water management, catchments, conservation and what Central Coast Council implements to ensure a safe and reliable water supply for the community.

IMPLEMENTATION

Activities are designed to be taught in sequence and as part of the Stage 4 Geography unit 'Water in the World', however, each activity is self-contained and may be utilised as a stand-alone activity to compliment any water conservation education program.

This program is designed to be taught as a collaboration between the school's geography teachers and Central Coast Council's Environmental Education Officers, with Council offering a FREE incursion program, as well as the optional installation of a Smart Water Data Logger for FREE to schools for two months during this program. However, this program can be taught independently.

- **Incursion One (1hr)**
  A Central Coast Council Environmental Education Officer will come to your school to introduce the program and provide guidance on the Central Coast water supply system and challenges facing the Central Coast's water supply. This workshop will also introduce you to the web portal for your school's Smart Water Data Loggers (optional).

- **Stream Order Activity (1hr)**
  Why are streams in the Mangrove Dam catchment important? In this teacher-led activity, students will develop a practical understanding of the stream network in our local catchment.

- **Platypus Creek Activity (1.5hrs)**
  In this teacher-led activity, students become local hobby farmers trying to manage their water resources in the context of this drought.

- **Water Audit Activity (2hrs)**
  How does your school use water? Students are challenged to independently investigate how and where your school uses the most water.

- **Incursion Two (upon request 1hr)**
  A Central Coast Council Environmental Education Officer can re-visit your school to help investigate the findings of their water audit and the data obtained by the Smart Water Data Logger to create a water management plan designed by the students.

- **Water Cycle Explored Activity (1.5hrs)**
  Using an interactive weather website, students will unpack the water cycle by exploring various components of weather to better understand the water cycle during this teacher-led activity.

- **Water Around Australia Activity (1hr)**
  In this teacher-led activity, students will 'travel' around Australia solving clues about water resources. Bon voyage!

BONUS!

- **Smart Water Data Loggers**

Water audits are a tool for homes, business and schools to look at their own water consumption to see where they can make effective changes to lessen their water usage. New technology exists in the form of Smart Water Data Loggers that provides instantaneous data to the consumer. Central Coast Council is providing this technology for **FREE** to schools for two months during this program. All activities can be facilitated without this component but utilising this free technology will provide students with added information and learning potential.

Smart Water Data Logger Installation Process	Benefits of a Smart Water Data Logger at your school
• Contact the Environmental Education Team at Central Coast Council to express your school's interest in participating in the program • An installation date will be organised prior to the program commencing • A personalised web portal will be set up to provide you with a secure site to view your school's water usage data • De-installation will be organised to remove the data logger once the program has been completed (approximately eight weeks)	• Students and teachers will have access to data that can aid them in the development of a water management plan for the school • Ability to identify leaks that could be causing damage, wasting water and costing money • Ability to determine the school's baseline water usage and identify patterns of peak usage • Potential to save money at the same time as saving our precious water resources

BONUS!

- **Water Treatment Plant Excursion (Optional) (1.5hrs)**

Schools that participate in the Love Water, Use it Wisely program receive an exclusive invitation to a **FREE** excursion to a Water Treatment Plant and Dam. Students will learn about the processes involved in producing clean drinking water for the Central Coast and the strategies involved in the development of a reliable supply for provision to the community.

Mardi Treatment Plant

STAGE 4 GEOGRAPHY

Water in the World Program

FOCUS AREA - Water in the World

Outcomes explored

A student:

- Locates and describes the diverse features and characteristics of a range of places and environments GE4-1
- Describes processes and influences that form and transform places and environments GE4-2
- Explains how interactions and connections between people, places and environments result in change GE4-3
- Discusses management of places and environments for their sustainability GE4-5
- Acquires and processes geographical information by selecting and using geographical tools for inquiry GE4-7
- Communicates geographical information using a variety of strategies GE4-8

Key inquiry question

- Why does the spatial distribution of water resources vary globally and within the countries?
- How do natural and human processes influence the distribution and availability of water as a resource?
- What effect does the uneven distribution of water resources have on people, places and environments?
- What approaches can be used to sustainably manage water resources and reduce water scarcity?

Content:

- Water Resources
- The Water Cycle
- Australia's water resources
- Water scarcity and water management

Australian Syllabus Links:

- ACHGK037
- ACHGK038
- ACHGK039
- ACHGK040

Content focus

Students:

- Examine water as a resource and the factors influencing water flows and availability of water resources in different places
- Investigate the nature of water scarcity and assess ways of overcoming it
- Discuss variations in people's perceptions about the value of water and the need for sustainable water management
- Discuss variations in people's perceptions about the value of water and the need for sustainable water management
- Investigate processes that continue to shape the environment including an atmospheric or hydrological hazard.

Cross-Curriculum Priorities - Sustainability

- Recognise sustainability as focusing on protecting environments and creating a more ecologically and socially just world through informed action.
- Acknowledge that developing more sustainable ways of living requires consideration of environmental, social, cultural and economic systems and their interdependence.
- Examine the effects of human activities on environments and how challenges to sustainability, and strategies to address these, vary from place to place.
- Evaluate these strategies to determine their effects on environments, economies and societies and how they contribute to actions that support more sustainable ways of living.

Central Coast Water Supply System

STAGE 4 GEOGRAPHY

School Water Audit Activity

FOCUS AREA - Water in the World

Outcomes explored

A student:

- Locates and describes the diverse features and characteristics of a range of places and environments GE4-1
- Describes processes and influences that form and transform places and environments GE4-2
- Explains how interactions and connections between people, places and environments result in change GE4-3
- Discusses management of places and environments for their sustainability GE4-5

Key inquiry question

- How do natural and human processes influence the distribution and availability of water as a resource?
- What effect does the uneven distribution of water resources have on people, places and environments?
- What approaches can be used to sustainably manage water resources and reduce water scarcity?

Content:

- Water scarcity and water management

Content focus

Students:

- Investigate the nature of water scarcity and assess ways of overcoming it
- Discuss variations in people's perceptions about the value of water and the need for sustainable water management
- Discuss variations in people's perceptions about the value of water and the need for sustainable water management

Australian Syllabus Links:

- ACHGK040

STAGE 4 MATHS

School Water Audit Program

FOCUS AREA - Computation with Integers, Data Collection and Representation

Outcomes explored

A student:

- Applies appropriate mathematical techniques to solve problems MA4-2WM
- Collects, represents and interprets single sets of data, using appropriate statistical displays MA4-19SP

Content focus

Students:

- Investigate techniques for collecting data, including census, sampling and observation

Australian Syllabus Links:

- ACMNA280
- ACMSP284

STAGE 4 SCIENCE

FOCUS AREA - Processing and analysing data and information, Problem solving, Communicating

Outcomes explored

A student:

- collaboratively and individually produces a plan to investigate questions and problems SC4-5WS
- follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually SC4-6WS
- processes and analyses data from a first-hand investigation and secondary sources to identify trends, patterns and relationships, and draw conclusions SC4-7WS
- elects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems SC4-8WS
- presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations SC4-9WS

Content focus

Students:

- WS5.1 Students identify data to be collected in an investigation
- WS5.2 Students plan first-hand investigations
- WS6 Students conduct investigations
- WS7.1 Students process data and information
- WS7.2 Students analyse data and information
- WS8 Students solve problems
- WS9 Students communicate ACHGK040

Australian Syllabus Links:

- ACSIS012,14, 25, 29, 38-42
- ACSIS125-26, 29, 30, 140-41, 44- 46, 48
- ACSIS213

SCHOOL WATER AUDIT PROGRAM

What is a Water Audit?

Water audits are an important tool in monitoring water usage and finding better ways to lower water consumption so that everyone has water for the future. Looking at various objects in and around our school that use water will provide a good indicator of where water is being used on a daily basis.

Why is an Audit important?

Water is a resource that is vital to all living things. Having a reliable source of water is an ongoing challenge around the world to meet the needs of the environment and the people. The Central Coast is an ever-growing community of businesses, schools, hospitals, homes and farms that use water daily. A water audit is an important tool that allows us to better manage our water usage to ensure we have water for the future.

Let's Do a Water Audit!

What do we need to start?

- School's Water Bill
- School's water meter
- Interview sheets
- Audit recording sheet

Water Meter

How to read the water bill

Water meters are being read every quarter (three monthly) by meter readers to record how much water you have used over that period. This process is no different for schools. The water bill is generated to show you how much water in Kilolitres (1000 litres) the school has used and the cost per kilolitre based on that meter reading.

Using your school's water bill calculate the total cost of water used.

Central Coast Council

love water use it wisely — Can you Live to 150L per person per day? centralcoast.nsw.gov.au/lovewater

Central Coast Council
Address line 1
Address line 2

Property Location:
Street SUBURB NSW 22**
LOT 1 DP 123456

Water Account

ABN 73 149 644 003

Account details

Assessment Number	**02034019**
Issue date	**27 Jul 2018**
Due date	**27 Aug 2018**

Summary

Balance brought forward	**$0.00**
Current Charges	**$271.90**
Pension rebate	**CR $43.75**

Total amount payable

$228.15

Due date 27 Aug 2018

Deduct payments since 20 July 2018

DIRECT DEBIT IN PLACE

Your Account Itemised

Service Charges For the period

	No. of Services	Charge	Amount
Water Service - Residential	1	41.15	41.15
Sewer Service - Residential	1	120.82	120.82
Drainage Service Charge - Residential	1	32.08	32.08

Total Service Charges **$194.05**

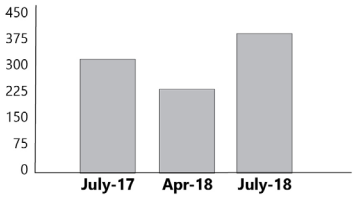
Usage Charges Water meter reading details over the page

	Usage (kL)	Tariff Tariff	Amount
Water Usage	34	2.29	77.85

Total Usage Charges **$77.85**

Your average daily water usage (litres)

1kL = 1000 litres



Biller Code: 7583
Biller Ref: 02034019

BPAY® this payment via internet or phone banking
BPAY View® View and pay this bill using internet banking
BPAY View® Registration No. 02034019

Online Services ID 123987

Central Coast Council
ABN 73 149 644 003

POST billpay
21234566

Send payments to: Central Coast Council
GPO Box 2518
Sydney NSW 2001

This address is for payments only, not for general correspondence.

Cheque Details
Please do not attach cheque or money order with staples or pins

Drawer	
Bank	
Branch	

Payment Slip

Assessment No.	02034019
Date Due	27 Aug 2018
Amount Due	$228.15
Date Paid	
Amount Paid	

000000039234556 000773 0000000000 0000025076

Time to do some simple math!

Example

Usage (kL)		Tariff ($)		Amount
34	X	2.29	=	$77.86

School

Usage (kL)		Tariff ($)		Amount
	X		=	

WHAT IS OUR AVERAGE DAILY WATER USAGE AT SCHOOL?

How to work out your water usage?

When determining your school's average water use per person, we need two important items:

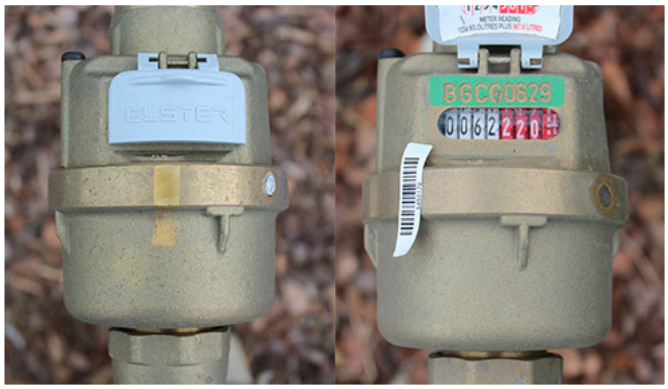
1. Total water used (kL) **Hint: water bill**

2. Total student/teacher number at school

The website link below allows you to access your school's enrolment and teaching staff for this calculation

www.myschool.edu.au

Once we have both total water used and total student/ teacher numbers we can do the calculation.



Water Meter

Converting kL to Litres

Schools' (kL)				Total Litres
kL	X		=	L

Average Water Use

Total Litres		Total Students teachers		Average water use per person
L	+		=	L

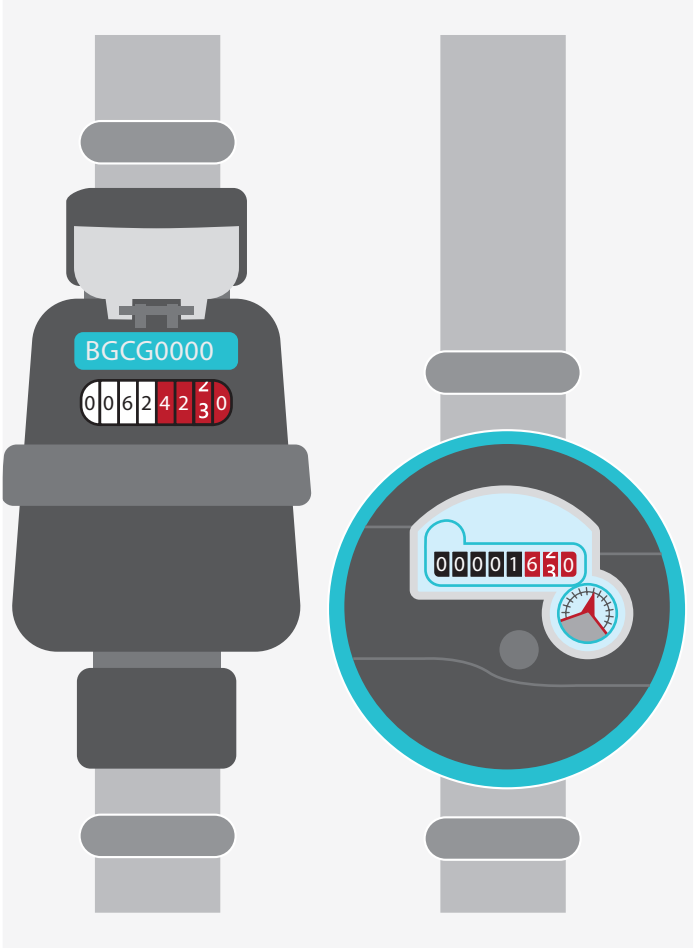
Daily Average Water Use

Average water use per person		Days at school		Average water use per person per day
L/person	+		=	L

Use the colours to help guide you to calculate the average water use per person per day

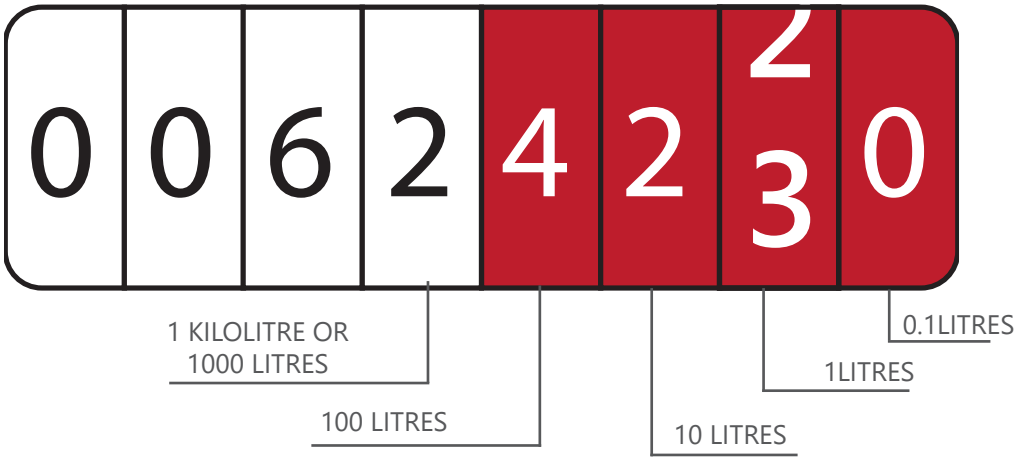
WHAT IS A WATER METER?

Water meters are devices that allow the measurement of water as it passes through to homes, schools and businesses. When you want to see how much water that has been used at any given time you can read the meter to get an accurate number. Water meter are often found near the perimeter of the schools or close to streets. Typically, schools have one water meter monitoring their usage, but it's not uncommon for larger schools to have more than one.



HOW TO READ THE WATER METER

Reading a water meter for the first time may seem confusing but once you know what you are looking at it is a very simple thing to do. Water meters vary – some have numbers and clocks, others only have numbers. The meters generally reads from left to right – black digits show the kilolitres (1,000 litres) and red digits show the single litres used. Your meter may have two, three or four red numbers



TIME TO INVESTIGATE

Start monitoring?

As a class you need to locate your school's water meter(s) and record the number. This number is the starting point for monitoring your water usage from this point onwards.

Example Meter Reading

1000 Kilolitres	100 Kilolitres	10 Kilolitres	1 Kilolitres or 1000L	100 Litres	10 Litres	1 Litre	0.1 Litres
	8	6	7	5	3	0	9

Schools Meter Reading

1000 Kilolitres	100 Kilolitres	10 Kilolitres	1 Kilolitres or 1000L	100 Litres	10 Litres	1 Litre	0.1 Litres

When the water meter is first installed it starts to collect data based on the water passing through it. The water meter is not reset, which means you are reading the total amount of water that has passed through since its installation.

INTERVIEWING SCHOOL STAFF

Let's Talk?

It's important to meet with decision makers at your school to see if any procedures or programs have been put in place to help manage your school's water usage. Principal, teachers, cleaners, kitchen staff and the facilities team are all good people to ask about how the school is using water. The information gathered by interviewing different people at school will help to provide a story or context to your school's water usage.

Who are you interviewing?

- **Principal**
- **Kitchen/Canteen**
- **Facilities/Maintenance**
- **Cleaners**
- **Teachers**

In small groups you will be designated one person/group to interview. Once you have collected information from the interview you will be able to share your findings with the class.

As a group, the class will now be armed with the information needed to identify areas of water loss and conservation within the school.

This will be key in developing a school water management plan.

INTERVIEW QUESTIONS

School Principal Interview Questions	Response
1. How do we report a leaky tap and bubblers if we find them?	
2. Does our school have a water managment plan?	
3. What areas of the school do you think use the most water?	
4. What is something teachers could do to conserve water?	
5. What do you think would be the best thing for the school to do in conserving water?	
6. How often does our school lease out space for community and business functions that use water?	
7. Are there functions on the weekends at school that require water?	

Kitchen /Canteen Staff Interview Questions	Response
1. What tasks use the most water in the kitchen?	
2. Do we have any known water saving devices in use?	
3. What would be something that could lower our water consumption in the kitchen?	
4. What time of the day does the kitchen use the most water?	
5. How do we wash dirty plates, cups etc at school?	

Facilities/Maintenance Interview Questions	Response
1. What locations do we water or hose down at school?	
2. What time of the day do we water plants and/or grass?	
3. What is our method in watering ovals?	
4. Do we use timers when watering?	
5. Is there any water saving devices on fixtures? E.g. aerators, dual flush, etc.	
6. Does the school have water tanks? If so, are they pumped into the school or unplumbed for use outside only?	
7. Do we have drought-tolerants plants at school?	
8. Do we use mulch in garden beds?	




Cleaners Interview Questions	Response
1. Which areas of the school require the most amount of water when cleaning?	
2. When using the hose, does it have a trigger nozzle on it?	
3. Do we use a washing machine at school?	
4. Is the water that is used to clean outside areas potable (drinkable)?	
5. Are there methods in place to help you use less water during cleaning?	

Teacher Interview Questions	Response
1. Have teachers been shown ways to conserve water at school?	
2. What areas of the school do you think use the most water?	
3. Are there any wet spaces for art and industrial subjects at school?	
4. Does our school have commercial kitchens for teaching students?	
5. Are there any projects students could do to help conserve water at school?	
6. Do we have any agriculture plots that require water?	

Students' Choice: Students can create five of their own questions to ask a staff member at school about water usage.

Students' Choice Interview Questions	Response

Mardi Dam

SCHOOL FACILITIES AUDIT

Location: _____

Water Device	Number of devices	Number broken /not working	Number dripping or leaking	Number of Water efficient devices
Toilets single flush				
Toilets dual flush				
Urinals				
Taps				
Bubblers				
Zips/hot water heaters				
Hoses				
Sprinklers				
Other				
Total				

Class Results Combined

Water Device	Number of devices	Number broken /not working	Number dripping or leaking	Number of Water efficient devices
Toilets single flush				
Toilets dual flush				
Urinals				
Taps				
Bubblers				
Zips/hot water heaters				
Hoses				
Sprinklers				
Other				
Total				

What does a drip cost? more than just a drop in a bucket

WHAT DOES A DRIP COST?

A dripping tap may seem like a drop in a bucket when it comes to water loss at school. In fact, if your school has five dripping taps that drip five times a minute, over a year the total water lost is 3,285 litres! That is equivalent to filling up 23 red rubbish bins every year.

So, let's look at how to calculate how much water a dripping tap can lose over a year.

What you need

1) 10mL graduated cylinder

2) Stop watch

3) Calculator

Locate a tap that is dripping or has slow leak. Place the graduated cylinder under the drip/leak and start the stop watch. After 1-minute record how many millilitres of water you collected. Write down this number in section "A" in the table below. If you have no leaky taps at school that is great. If you want to try this experiment to see how much water is potentially lost from dripping/leaky taps, allow a tap to drip slowly and record your data.

Dripping Tap Example

Drip Rate	A ml in 1 minute	B ml in 1hr (A x 60)	C ml in 1 day (B x 24)	D Litres in 1 day (C ÷ 1000)	E Litres in 1 year (D x 365)	F Number of dripping taps	Litres lost in 1 year (ExF)
Slow	2ml/min	120mls/hr	2,880mls/ day	2.88litres/ day	1051.2litres/ yr	1	1051.2litres/ yr
Fast							

Dripping Tap Activity

Drip Rate	A ml in 1 minute	B ml in 1hr (A x 60)	C ml in 1 day (B x 24)	D Litres in 1 day (C ÷ 1000)	E Litres in 1 year (D x 365)	F Number of dripping taps	Litres lost in 1 year (ExF)
Slow							
Fast							

SCHOOL WATER USE ACTION PLAN

An Action Plan is designed based on your findings to make effective changes at your school which will help to conserve water. The table below allows you to put in your findings with suggestions on where, what, how and who can help fix these issues. Take some time as a class to go over your School Water Audit Totals and Interviews to help guide you in this process.

Location	Water Fixture	Water issue (ie. Dripping tap)	What can be done?	Who can fix the problem?
e.g. Boys toilet	*Both sinks*	*Cannot turn off the water completely in both.*	*A plumber can fix the taps so they turn off completely*	*Facilities/maintenance*

WATER ACTION PLAN REPORT

Date:

Name of School:

Number of Students/teachers:

Total water usage (water bill):

Avg Daily Water Use:

Number of broken/dripping/fixtures:

Findings from your Water Action Plan

1. What areas of the school do students and teachers use the most water?

2. What are some things that can be done immediately to improve the school's' water usuage?

3. What are some things that can be done to use less water at school?

4. What are long term improvements that could be done to use less water at school?

5. One suggestion that you think would best help the school in its water usage?

Implementation of your Water Action Plan:

Now is a perfect time to utilise the results from the water audit to design a plan for your school. As a class you will create short- and long-term plans that address your findings from your water audit. This will provide your Principal with viable options in making your school more water efficient.

Monitoring the success of your Water Action Plan:

Once your Water Action Plan is in place and your school has implemented some immediate changes to help save water, you can monitor your school's usage over the next month to see how it compares to the previous month by re-examining the water meter and bill.

WATER ACTION PLAN PROPOSAL

Date:

Class:

Teacher:

Reasoning for a Water Action Plan:

Water Audit findings:

Implementing immediate changes:

Items	Locations

Potential Water Savings

Items Fixed/Changed	Amount of Water Saved

Water Action Plan Short Term Goals:

Water Action Plan Long Term Goals:

Student Signatures:

Teacher Signature:

Principal Signature:

Wyong Weir

STAGE 4 GEOGRAPHY

Stream Order

FOCUS AREA- Water in the World

Outcomes explored

A student:

- Locates and describes the diverse features and characteristics of a range of places and environments GE4-1
- Acquires and processes geographical information by selecting and using geographical tools for inquiry GE4-7
- Communicates geographical information using a variety of strategies GE4-8

Key inquiry question

- How do natural and human processes influence the distribution and availability of water as a resource?
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Content:

- Water Resources
- Australia's water resources
- Water scarcity and water management

Content focus

Students:

- Examine water as a resource and the factors influencing water flows and availability of water resources in different places
- Investigate the nature of water scarcity and assess ways of overcoming it.

Australian Syllabus Links:

- ACHGK037
- ACHGK039
- ACHGK040

STREAM ORDER

Mangrove Creek Dam is a large dam on the Central Coast that can hold approximately 190,000 million litres of water or 76,000 Olympic size pools in volume or 93,137 rugby fields that have 30cm of standing water on them. This dam is primarily a storage dam for collecting water. This location is a great spot to build a dam based on the geology of the area, undeveloped land in the catchment and the narrow valley allowing for a high dam wall. This is a key part of water security for the Central Coast acting as a safety net to provide fresh water in times of need.

Mangrove Dam

Mangrove Dam location

When water demand on the Central Coast increases, water can be released from Mangrove Dam into Mangrove Creek and taken out at Mangrove Creek Weir. The water is then piped to Somersby Treatment Plant for treatment before entering the supply system for household consumption. Water can be released from Mangrove Dam and sent into Wyong River via the Mangrove to Mardi pipeline. This uses gravity to move the water towards Mardi Dam for treatment. Water can also be pumped the other way from Mardi Dam back to Mangrove Dam when Mardi Dam reaches maximum capacity. This can occur during heavy rains. For the water to be moved up the pipeline, high lift pumps are utilised.

Water fills Mangrove Dam naturally in three ways:

1. Rainfall - direct water falling into the dam
2. Creeks - water being transported into the dam via a network of creeks or rivers
3. Runoff - water that rolls off the land directly into the dam.

Creeks or rivers in the catchment area are a vital source of water for the Mangrove Creek Dam. The Strahler System is a classification method that determines the hierarchy or significance of streams (including creeks and rivers) as they make their way to the ocean. It is important to understand how streams can merge to create larger and larger systems thus bringing more water with them. Using the catchment map and implementing Strahler System you will be able to see how streams merge and increase their water volume in the Mangrove Creek Catchment. The smallest creeks start at a value of one and progressively become larger and larger. Globally, the Amazon River tops the chart at a stream order of 12 before it enters the Pacific Ocean. What is the stream order of Mangrove Creek as it enters Mangrove Creek Dam?

The Mangrove Creek Dam catchment area is 101 square kilometres with many streams providing water to the dam. Notice in the example on the Stream Order map below (Figure 8) that order one streams are starting points and haven't merged with any others thus far making them an order one.

How do stream orders increase?

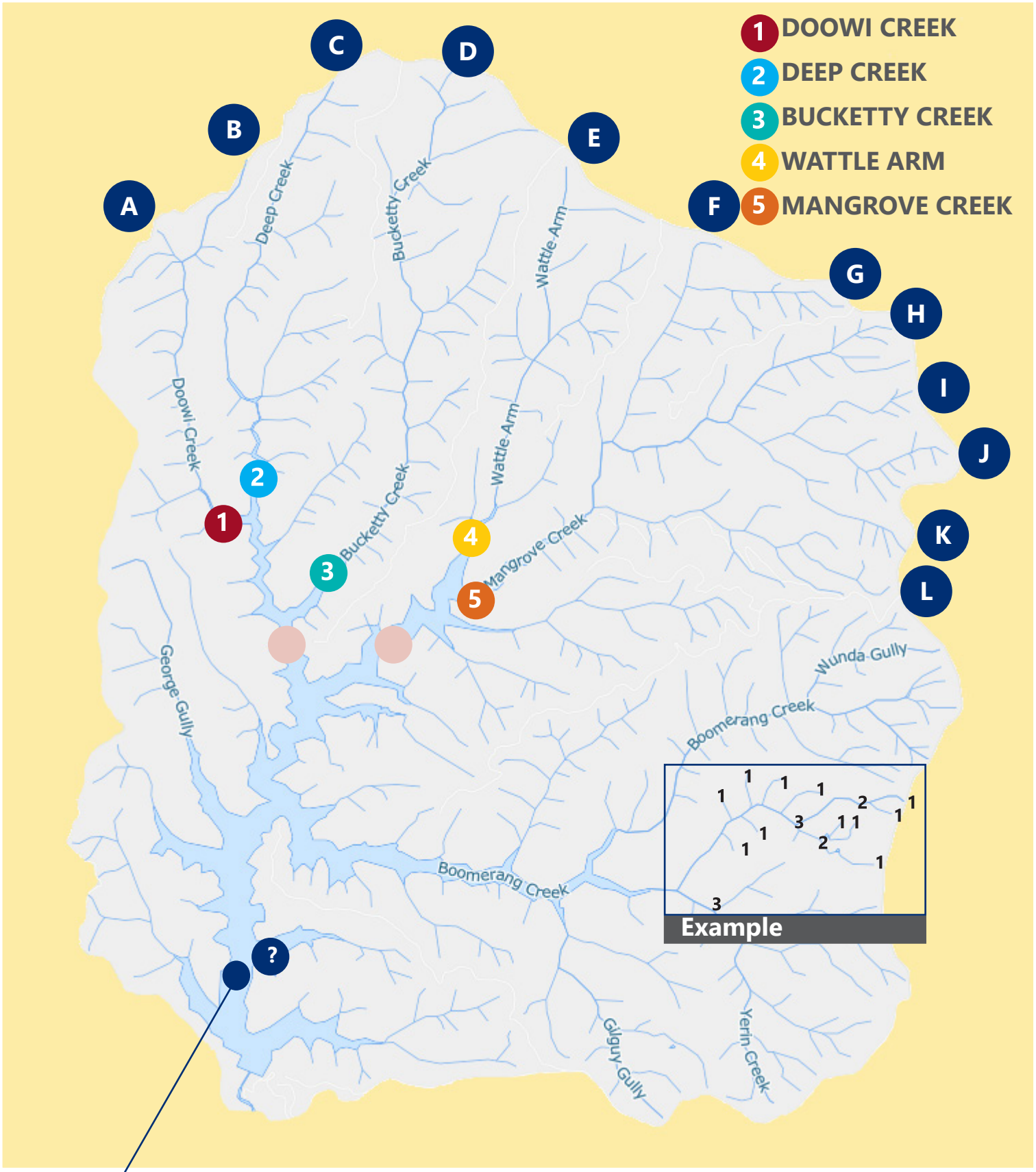
- When **two** order one streams merge, they turn into an order two stream.
- When **two** order two streams combine, they turn into an order three stream.
- When an order one stream merge with an order two it stays an order two.
- Stream orders **only** increase when they meet an equivalent stream order. Otherwise the stream stays at the highest stream order after the merging point.

Stream Order Map Instructions

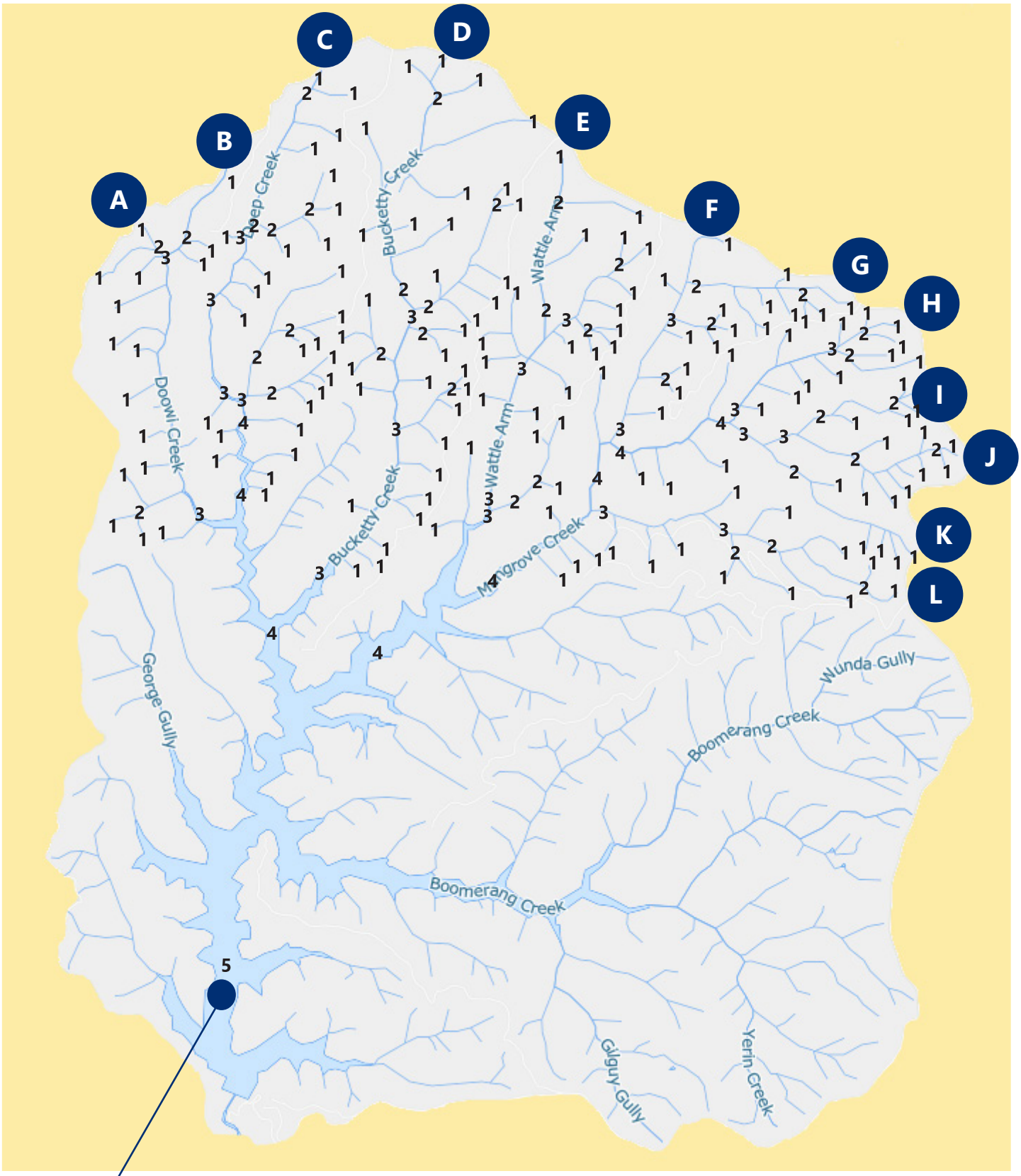
Using the catchment map, use the Strahler System to fill in the missing number with the correct stream orders as shown in the example.

1. Choose a starting point from A-L where you will enter your first stream order on your way to the blue dots.
2. Streams will always begin as an order one Label all the initial streams with a 1 and then progress down towards the blue dot.
3. As streams converge, add new numbers below the intersection point so you know the new stream order as shown in the example.
4. Using the Strahler System, determine the five creeks orders as they enter into Mangrove Dam.

Determine Stream Order in the Mangrove Creek Catchment



Teacher Key - Determine Stream Order in the Mangrove Creek Catchment



STREAM ORDER IN THE MANGROVE CREEK CATCHMENT

Teacher Debrief Q&A Ideas

1. **The catchment at Mangrove Dam has lots of creeks spread throughout. Why is this advantageous when the collecting water for the dam?**

   Creeks in the catchment act like a big net to receive water that hasn't been absorbed into the ground. When it rains, runoff from the land flows downhill with gravity into the creeks. As the creeks merge, they become bigger, bringing water into the dam.

2. **What do you think the topography of the catchment looks like? How does that aid in collection of water?**

   Typically when you see lots of creeks in an area this indicates a very steep, hilly or mountainous terrain. Waterways in the Mangrove Creek Catchment exist because of the steep land formations which divert water to the bottom of the valley. Extreme topography does not allow much time for water to be absorbed into the ground. This same principle happens in the Mangrove Creek Catchment area where water quickly moves down in elevation into the creeks which feed the dam.

3. **Mangrove Dam can not only hold water for future use, but can prevent what type of natural hydrological disaster downstream?**

   Heavy rains can create flooding in towns or cities near creeks and rivers. A large storm may deliver lots of rain far away from a town, yet the town still floods. It may take some time before a river brings the rain water downstream and floods low-lying areas. Mangrove Dam can help mitigate flooding downstream by collecting water in the catchment and filling up the dam. The amount of water that is released downstream can be carefully controlled by the dam controllers.

4. **What are some of the factors that were considered when choosing this location for the dam?**

   The main factors in choosing to put the dam in this location are:
   - the rocky foundation of the site is suitable for dam construction,
   - the narrow valley allowed an 80m dam wall to be built thus creating a deep dam,
   - natural, undeveloped areas in the catchment provide clean, fresh water to the dam
   - location is relatively close to the community, minimising the costs of transferring the water using pipelines and pumping stations.

5. **Why would Central Coast Council want to limit access, development and human activity in the catchment area?**

   To limit the potential for pollutants to enter dam and contaminate the drinking water supply. E.g. example, fertilizers can encourage blue green algae growth which can make the water unsafe to drink.

6. **Why is it important to have a pipeline that allows water be transported between Mardi Dam and Mangrove Dam?**

   The pipeline allows Mardi Dam to transfer excess water to Mangrove Dam to make room for water being extracted from the Wyong River or Ourimbah Creek during heavy flows. The inverse is that Mangrove Dam can send water to Mardi Dam when water levels are low and the demand for potable water increases.

STAGE 4 GEOGRAPHY

Platypus Creek

FOCUS AREA - Water in the World

Outcomes explored

A student:

- Explains how interactions and connections between people, places and environments result in change GE4-3
- discusses management of places and environments for their sustainability GE4-5
- acquires and processes geographical information by selecting and using geographical tools for inquiry GE4-7

Key inquiry question

- Why does the spatial distribution of water resources vary globally and within the countries?
- How do natural and human processes influence the distribution and availability of water as a resource?
- What effect does the uneven distribution of water resources have on people, places and environments?
- What approaches can be used to sustainably manage water resources and reduce water scarcity?

Content focus

Students:

- Examine water as a resource and the factors influencing water flows and availability of water resources in different places
- Investigate the nature of water scarcity and assess ways of overcoming it.
- Discuss variations in people's perceptions about the value of water and the need for sustainable water management

Content:

- Water Resources
- Australia's water resources
- Water scarcity and water management

Australian Syllabus Links:

- ACHGK037
- ACHGK039
- ACHGK040

Platypus

PLATYPUS CREEK ESTATE ACTIVITY

Congratulations, you have inherited a local hobby farm on the Central Coast with a 15-acre vegetable plot from a long lost relative along with $150,000! The property has a small creek called Platypus Creek running on its boundary that provides habitat to some local species of fish, amphibians and birds.

Some important facts about the property and the region:

- The property is relatively flat with some trees along the creek bank and a few small shrubs and grass over-growing on the farm.
- The average rainfall in the area is 700mm a year with temperatures that can range from 10 °C in the winter to 40°C in the summer.
- Platypus Creek is a slow running creek that is one meter wide and one meter deep when full. Over the past five months the water level has dropped by 20% due to lack of rain.
- Currently the region is entering drought with only 60mm of rain falling over the last five months and summer is fast approaching.
- The property has no running water since it has been abandoned for over 50 years. Town water has never been connected to this property.
- This region in NSW is known for a loamy soil - great for growing vegetables!

Your goal is to turn this property back into a functioning hobby farm growing your choice of vegetables. A map of your property has been supplied to you along with a hydrological map to show you any aquifers that reside within your 15 acres. The property has obtained a water access license from NSW State Government that allows extraction of water from streams, creeks and underground aquifers. The money you inherited will allow you to invest in a water supply system and irrigation. The aim is to make this farm water secure for the future.

The Central Coast faces similar situations with water being sourced from:

- Woy Woy Borefield (during drought conditions)
- Wyong River
- Mooney Mooney Creek
- Ourimbah Creek

This activity will provide some insight on the complexity of water accessibility and the effect it can have on the community if not properly managed.

Step 1 Choose which vegetable type you plan on growing. The profits are based on the total cost of planting, maintenance, harvesting and yield per acre.

Step 2 Choose which water supply system you want to purchase.

Step 3 Choose which irrigation method you think is best.

Step 4 Purchase a water storage unit if you think it will be advantageous to your farm.

It is up to you if you want to have a mixture of different systems. You must stay within your $150,000 budget and need to hit your water requirements for your vegetable.

1. Choose Your Vegetable

Vegetable	Water requirements for five months grow time	Profit after harvest
Onion	10 megalitres (ML)	$4,200
Capsicum	6 ML	$3,500
Zucchini	8 ML	$7,000
Sweet Corn	12 ML	$8,500

2. Choose Your Water Supply

Water Supply Options	Supplier of Water	Cost Installation	Water Available/ storage	Cost of Water Per Mega litre
Bore	NSW Gov	$6,000	1.2 ML/day	$9
Rain tanks (storage)	Free	$22,000	0.35 ML holding tank	$ 0
Turbine pump (stream)	NSW Gov	$6,000	0.5 ML/day	$9
Town water (Treated)	Central Coast Council	$10,000	0.1 ML/day	$2,290

3. Choose Your Irrigation

Irrigation type	Cost/ Installation	Water total output
Pivot sprinklers (70% efficient)	$8,000	1 ML/day
Surface irrigation (80% efficient)	$22,000	16 ML/day
Drip (90% efficient)	$25,000	1 ML/day

4. Choose Your Water Storage

Storage Size In ML	Cost/ Installation
16 ML	$10,000
25 ML	$16,000
35 ML	$22,000

Purchase Log

Irrigation Type & ML	x	5 months (~150 days)	=	Total ML	Irrigation Cost
	x	150	=		
				+	+
	x	150	=		
				+	+
	x	150	=		
				Total	Total

Water Supply	x	5 months (~150 days)	=	Total ML	Water Supply Cost
	x	150	=		
				+	+
	x	150	=		
				+	+
	x	150	=		
				Total	Total

Water Storage	x	Number of Tanks purchased	=	Total ML	Water Storage Cost
	x	150	=		
				+	+
	x	150	=		
				+	+
	x	150	=		
				Total	Total

Terms	Description
Bore	To access underground water in an aquifer a bore is drilled. The water is then pumped to the surface for use.
Rain Tanks	Large tanks that collect the rain water from roofs of buildings.
Turbine pump (stream)	This is a pump that is commonly used in rivers and streams to pump water out to homes or businesses.
Town Water (Treated)	Water that has been through the full treatment process and is considered "potable" or drinkable once it arrives at your home.
Pivot sprinklers	Sprinklers attached to a pivot point where they go around in a circle using sprinklers to spray out water.
Surface irrigation	Water is pumped into channels between the crops allowing water flow through the field.
Drip irrigation	Is a process where pipes with small holes have been laid throughout the field so that water can slowly drip out and be absorbed into the ground.
Megalitre (ML)	A Megalitre is equivalent to one million litres. It is expressed as (ML)

PLATYPUS CREEK ESTATE ACTIVITY

Teacher Debrief Q&A Ideas

1. Each group should explain to the class which crop they chose, which type of water sources they used and why, along with the irrigation type selected.
2. Collect all the individual maps from the students (after the presentation about their property). On the whiteboard place the properties in the correct order to make one long map showing the stream and aquifer that is passing through all the properties.
3. The connection to other properties should be used to drive conversation about how resources will be affected when everyone shares and utilises the same water supplies. The below questions can be used to structure this class discussion.

- **What type of water source was the most used? Why?**

  This question pertains to the entire 8 maps joined together to create a holistic view of which types of water sources were used. Get one answer from each group to compare their reasoning.

- **What were the reasons for choosing the water sources on your property?**

  Student's decision-making process on what water sources they chose is the focal point. Inquire if was money, location of water source, sanitation etc.

- **How can your neighbour's water use affect your farm in the future?**

  After looking at the combined map of all the properties, ask the students their concerns now on water security for their property.

- **How did the prices for irrigation affect your decision?**

  Was money a concern when choosing an irrigation option or did the student look at what you believed was the most efficient delivery method of water to their crops?

- **How do you think your farm will survive over the next 10 years if there is no change in how others use water?**

  This question is to have the students look at the long-term impacts of their water usage and the community around their property.

- **At an instant the stream contains approximately 0.66ML for all eight properties bordering it. What could happen if everyone uses the stream as their primary water source?**

  Lowering the water level in the creek too much can change the ecosystem. Local plants, fish, mammals and insects that also utilise the creek may not have enough water to survive. Further down the creek other people may also rely on this water.

- **Currently on the Central Coast water is a very valuable resource. What water sources are currently being used to meet the needs of the community?**

  Currently Water is being harvested from the Wyong River, Ourimbah Creek, Mooney Mooney Creek and Mangrove Creek. Water is being stored at Mangrove Dam, Mardi Dam and Mooney Mooney Dam before being treated at either Mardi Water Treatment plant or Somersby Treatment Plant. Woy Woy bore fields are the main borefields used to access underground aquifers (during drought only).

- **Why is it important to have rules and regulations on how much water is harvested?**

  A lack of regulations on water harvesting could result in extreme water shortages, especially during drought. Other impacts include ecological damage, economic collapse, increase cost of food and displacement of communities.

Extension Questions

1. **What are some of the factors that determine how long it takes for an aquifer to replenish itself?**

   Aquifers replenish at different rates due to soil types, gradient of the land, rainfall, recharge areas and location. There are lots of variables. One-way scientists determine how water flows underground is by placing sampling bores in the area. This website is a good link to learn more about aquifers: https://www.usgs.gov/special-topic/water-science-school/science/aquifers-and-groundwater?qt-science_center_objects=0#qt-science_center_objects

2. **Pumping water from streams and creeks can change the ecosystem for fish, birds, amphibians, insects and plants. Investigate the concerns for over harvesting water from streams.**
   This topic will require some extension research due to the complexities.

   This is a good link to Water Quality and River Flow Objectives for healthy rivers in NSW: http://www.water.nsw.gov.au/__data/assets/pdf_file/0003/548076/policy_advice_11-waterqualitymanagement.pdf

Teachers Notes:

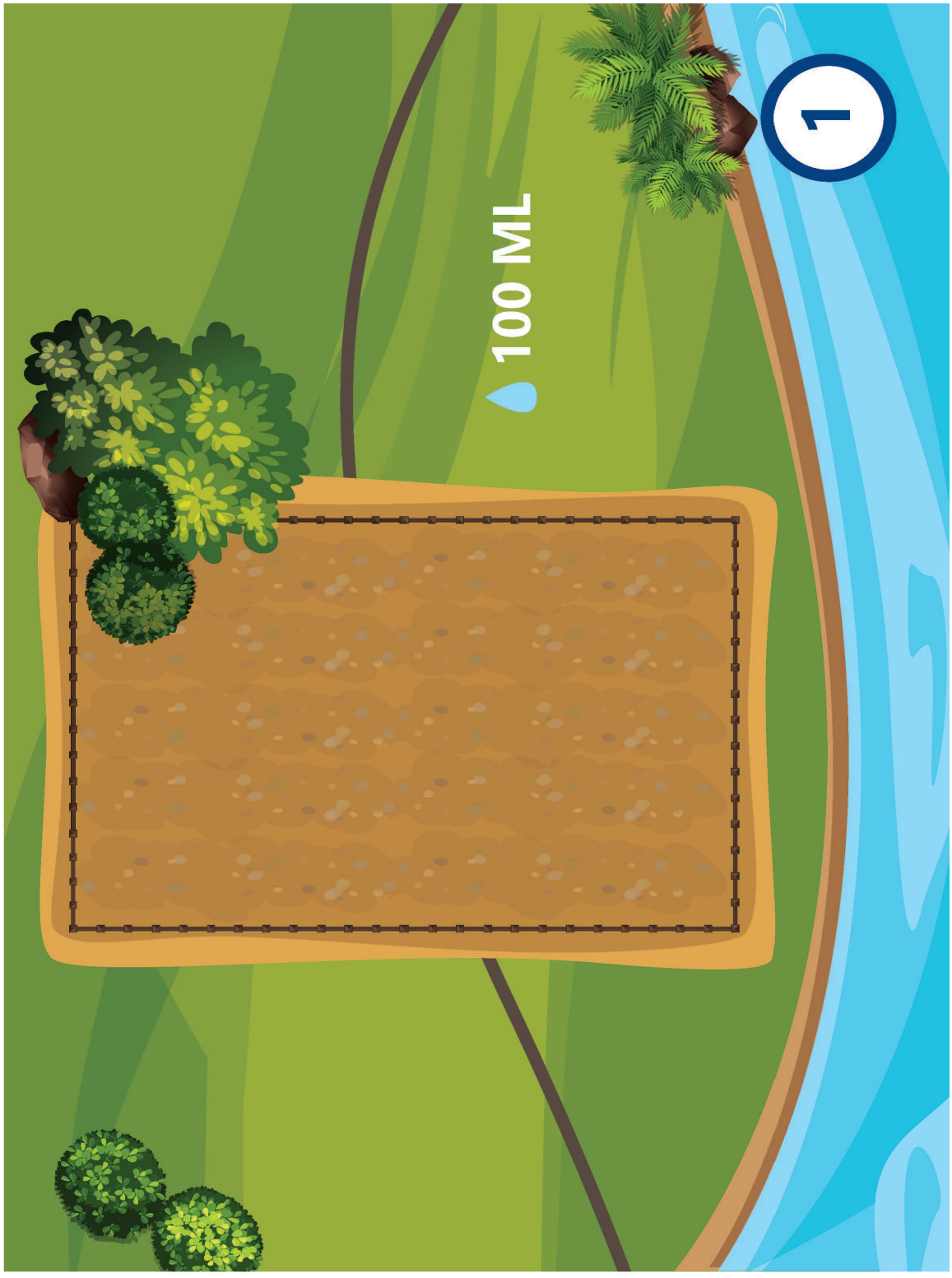
Central Coast Council responsibility: The water supply on the Central Coast is managed in three parts. Long term planning and water strategy for the Central Coast; operation and maintenance of the dams and weirs; and treatment plants. Council also manages the day to day delivery of water and sewerage services in the local government area.

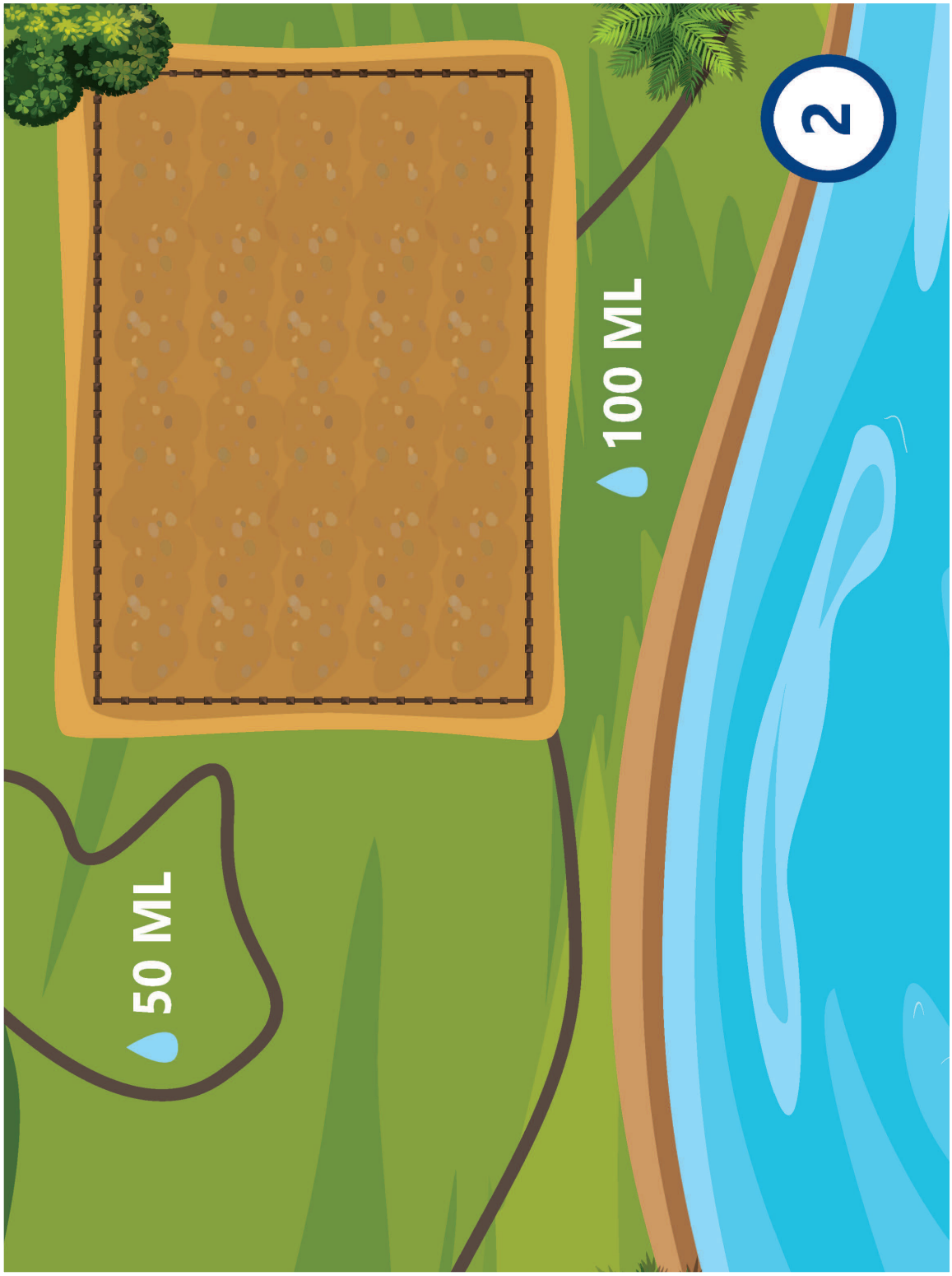
NSW State Government responsibility: Department of Industry is responsible for surface and groundwater management including ensuring water security for NSW. They ensure the equitable sharing of surface and groundwater resources and that water entitlements and allocations are secure and tradeable. They manage NSW water resources through planning, policy and regulation. Department of Industry also leads negotiations with the Commonwealth, including the Murray-Darling Basin Authority and other jurisdictions.

Mangrove Mountain Dam wall

PLATYPUS CREEK ESTATE

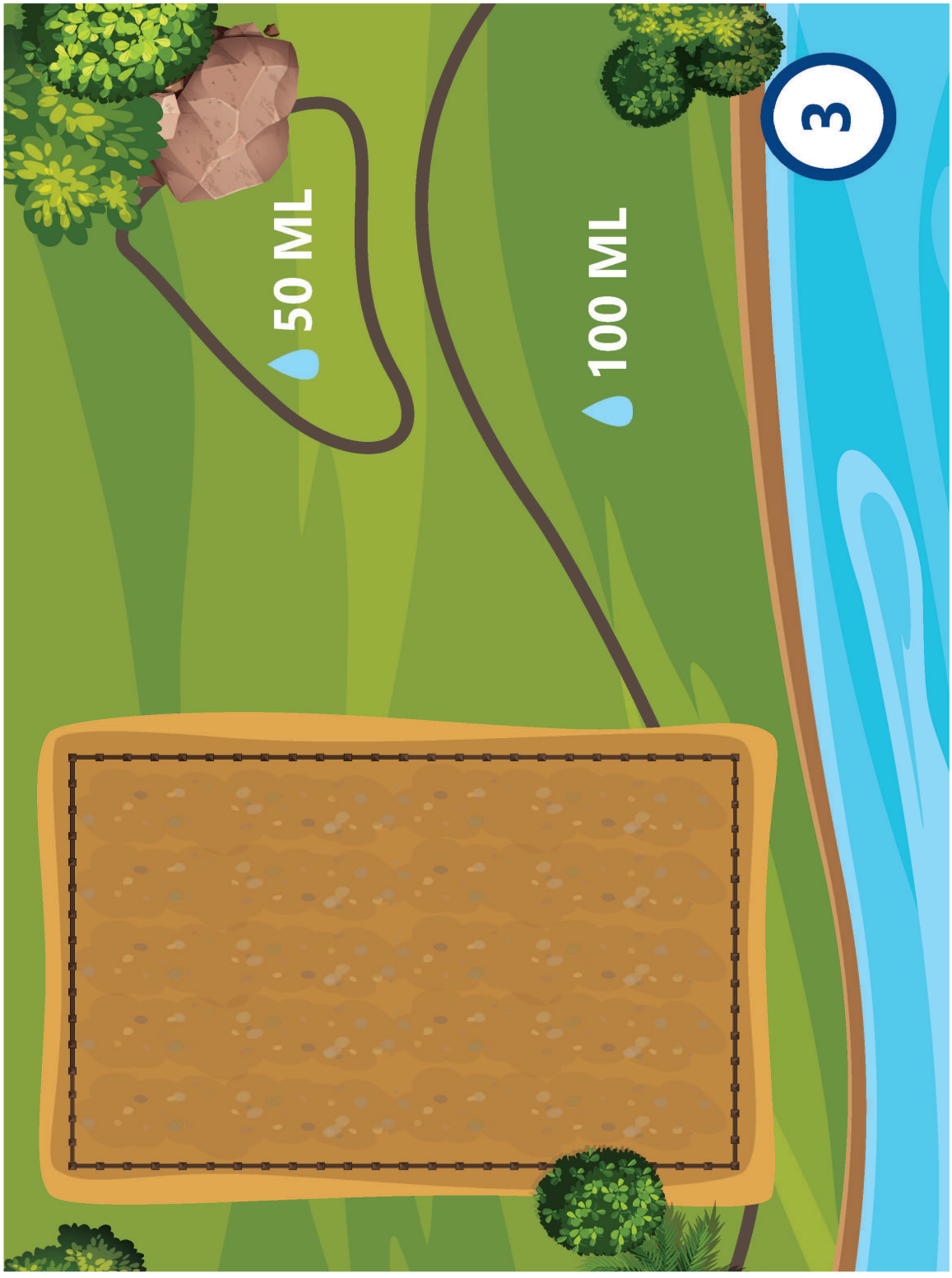
ACTIVITY

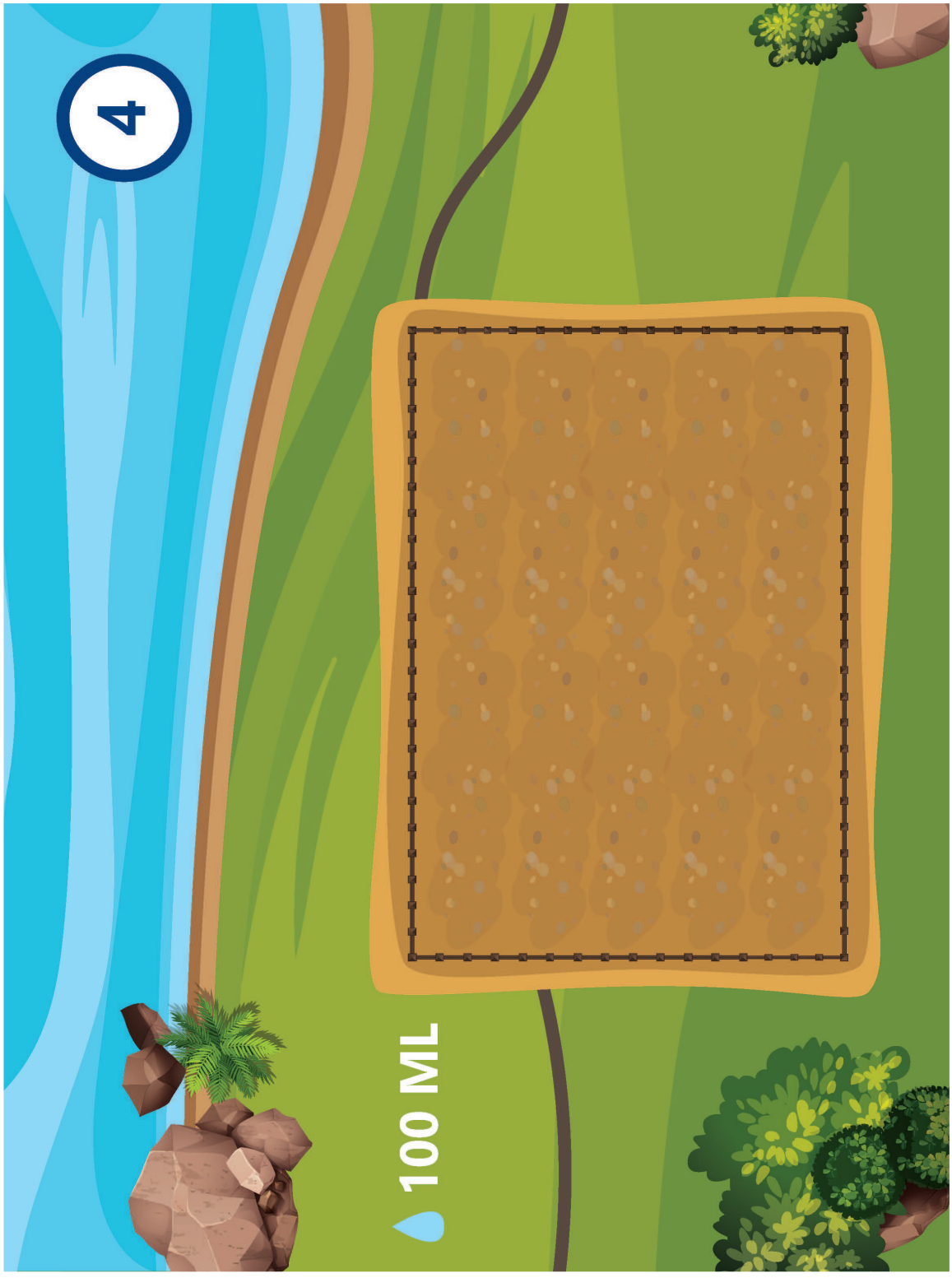



2
100 ML
50 ML

PLATYPUS CREEK ESTATE

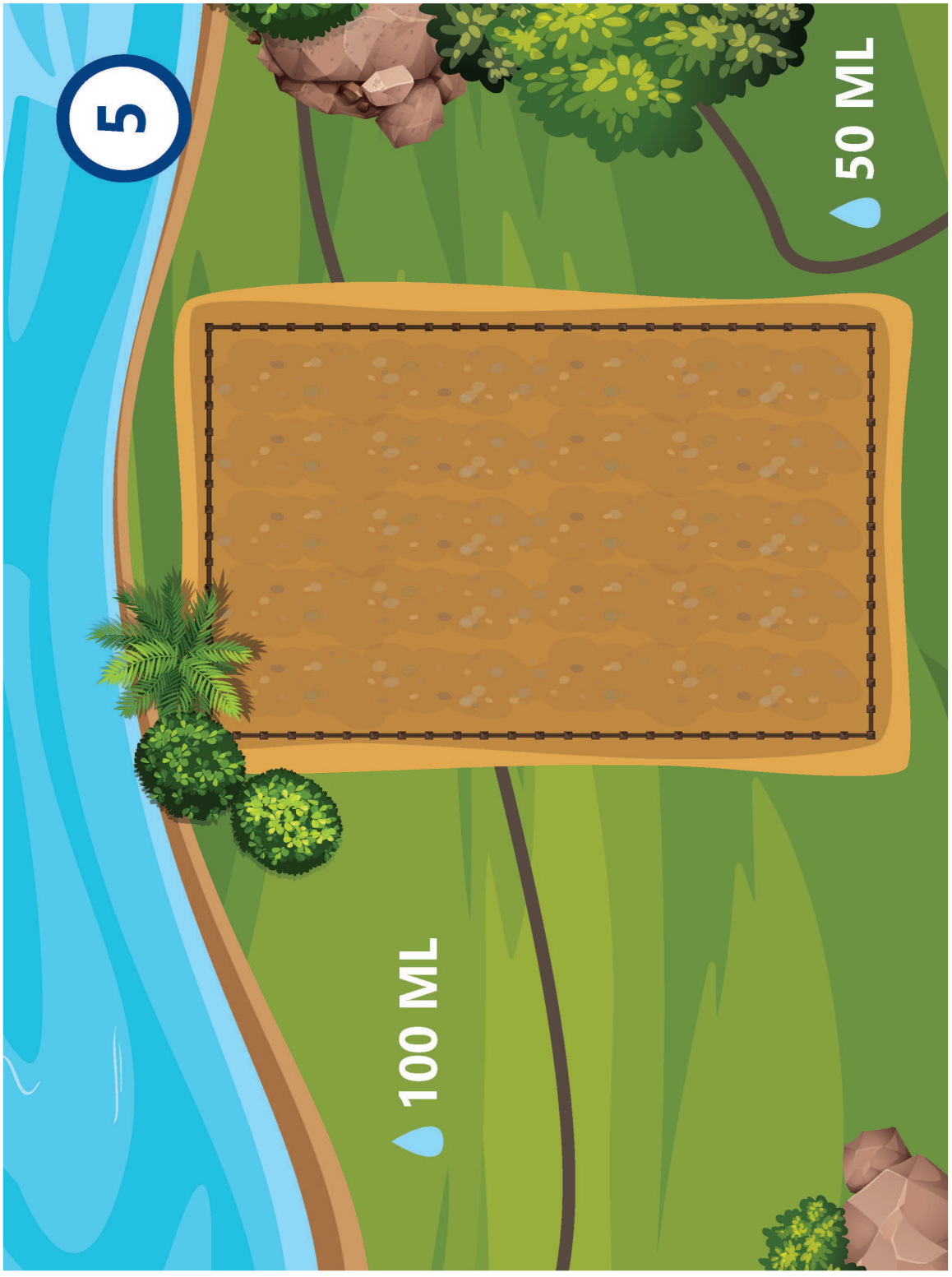
ACTIVITY

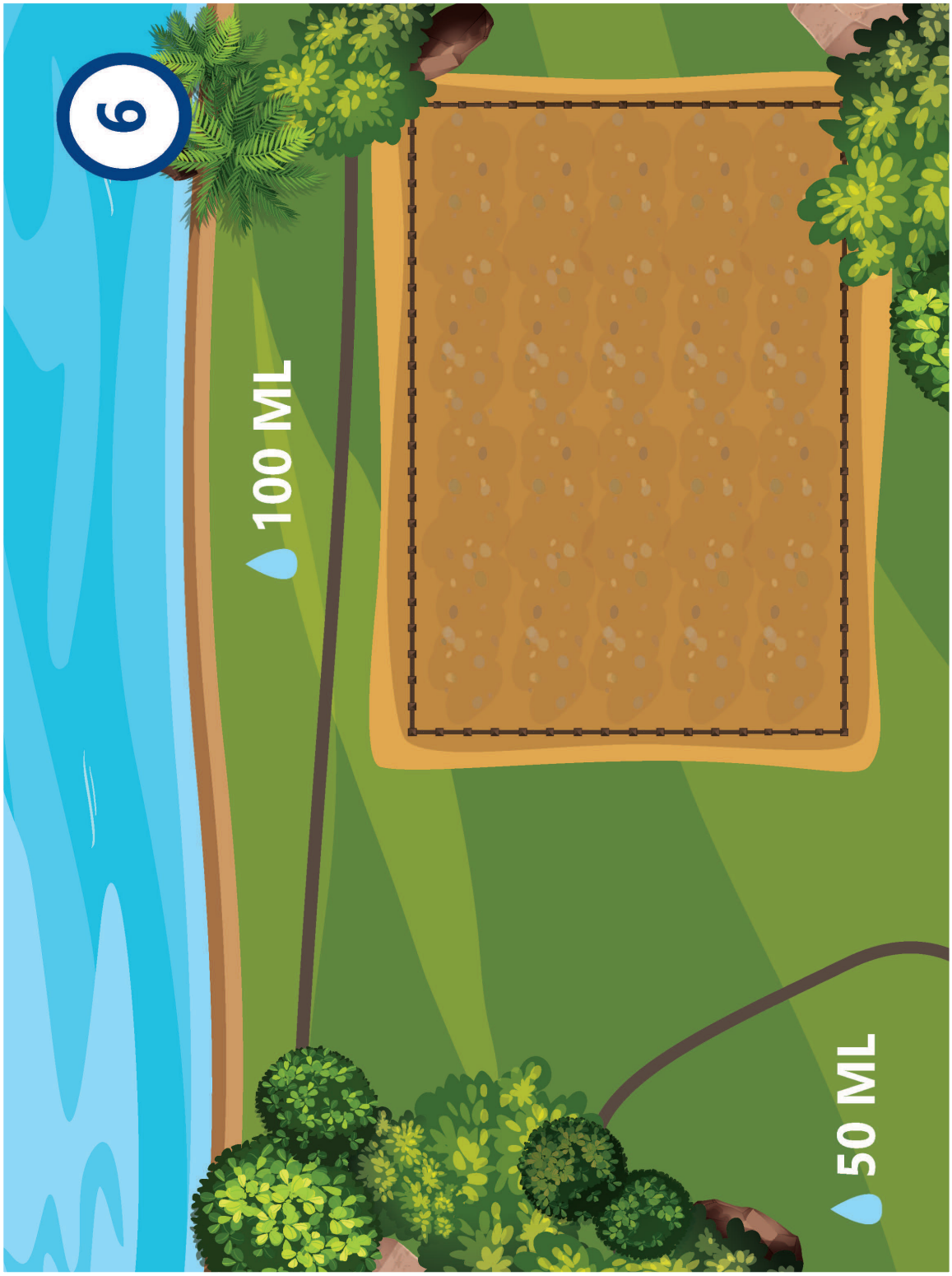


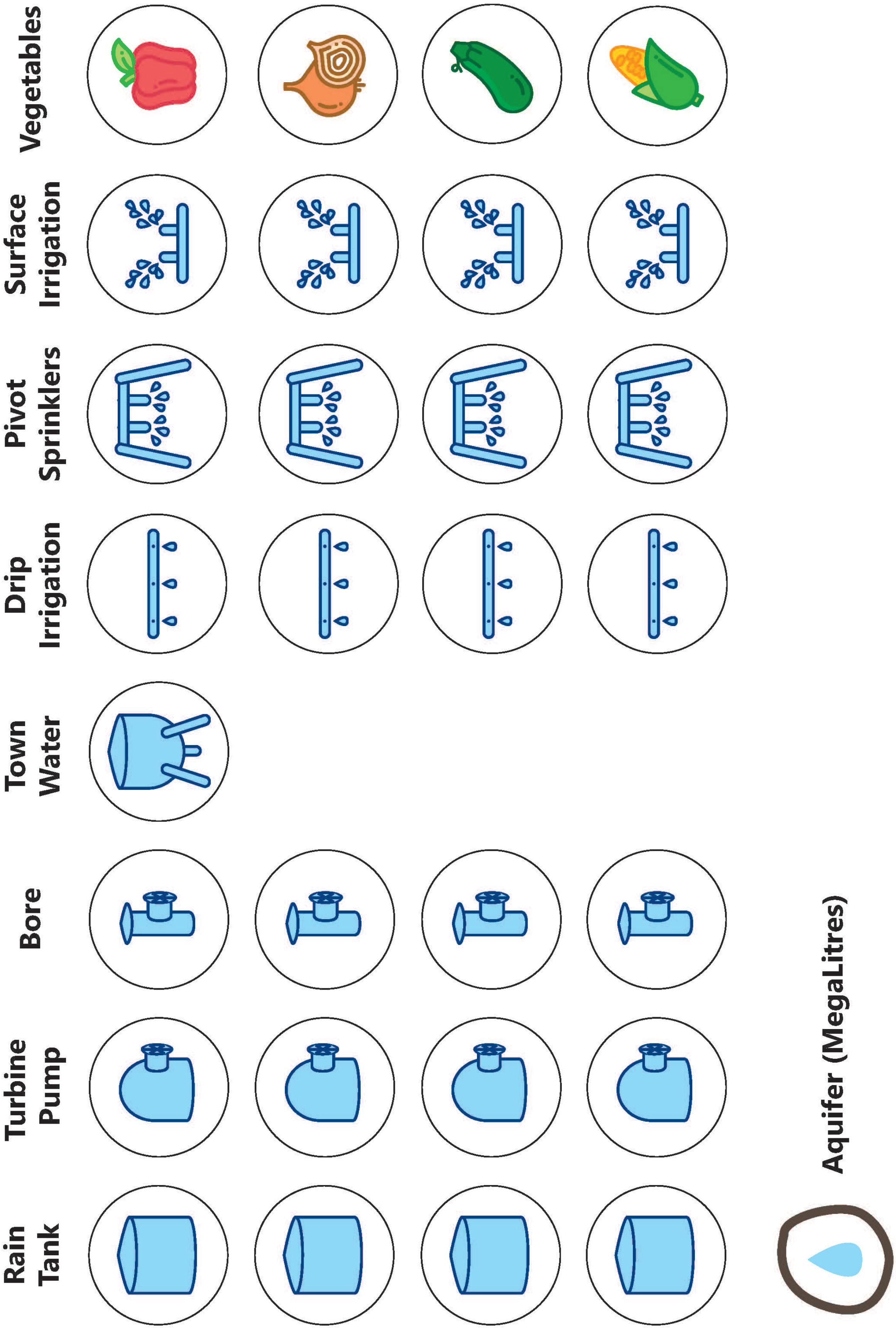

4
100 ML

PLATYPUS CREEK ESTATE

ACTIVITY

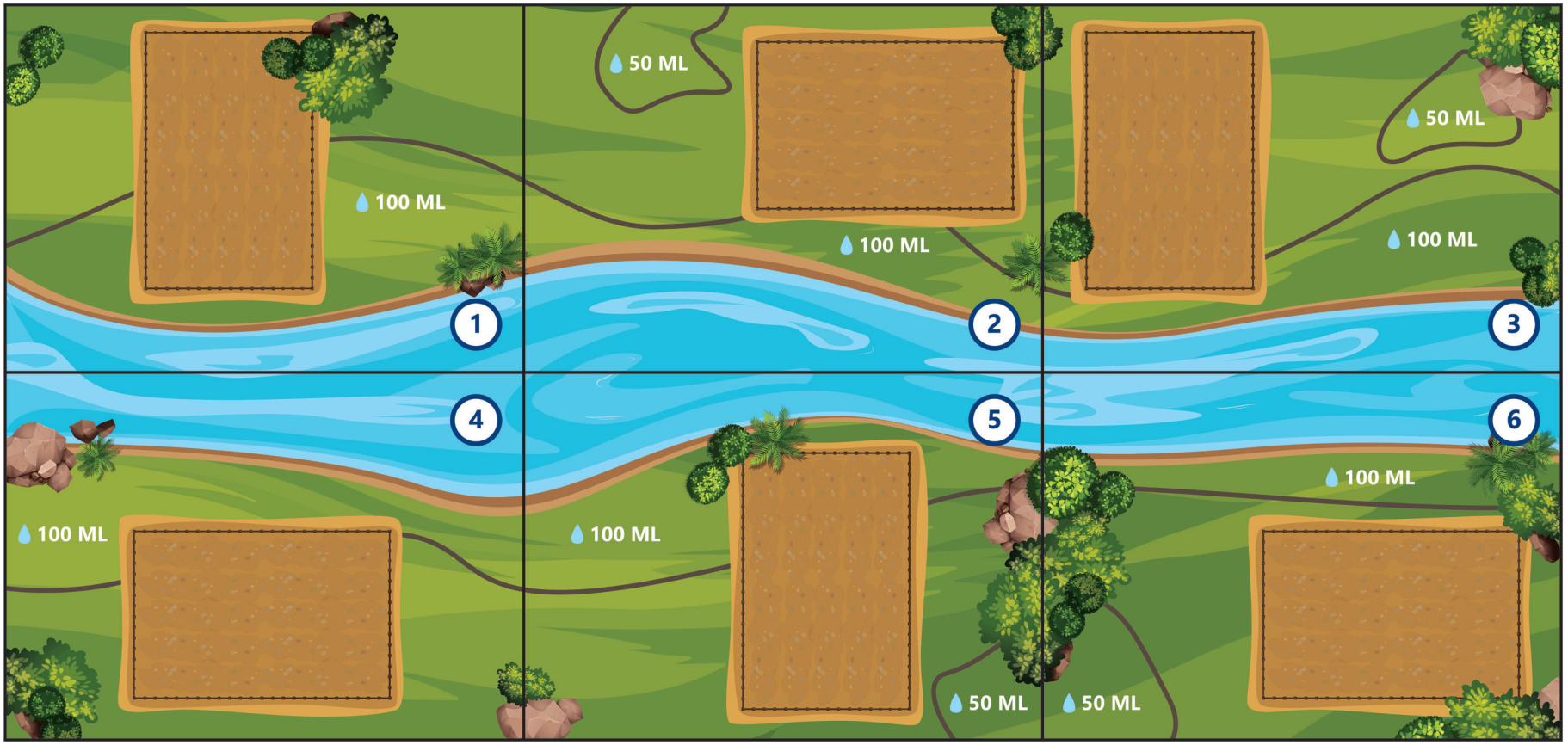



6
100 ML
50 ML


Vegetables
Surface Irrigation
Pivot Sprinklers
Drip Irrigation
Town Water
Bore
Turbine Pump
Rain Tank
Aquifer (MegaLitres)

PLATYPUS CREEK ESTATE MAP

Teacher Key



Rain Tank | Turbine Pump | Bore | Town Water | Drip Irrigation | Pivot Sprinklers | Surface Irrigation | Vegetables | Aquifer (MegaLitres)

STAGE 4 GEOGRAPHY

Water Cycle Explored

FOCUS AREA - Water in the World

Outcomes explored

A student:

- Locates and describes the diverse features and characteristics of a range of places and environments GE4-1
- Describes processes and influences that form and transform places and environments GE4-2
- Acquires and processes geographical information by selecting and using geographical tools for inquiry GE4-7
- Communicates geographical information using a variety of strategies GE4-8

Key inquiry question

- Why does the spatial distribution of water resources vary globally and within the countries?
- What effect does the uneven distribution of water resources have on people, places and environments?

Content focus

Students:

- Investigate processes that continue to shape the environment including an atmospheric or hydrological hazard
- Discuss variations in people's perceptions about the value of water and the need for sustainable water management

Content:

- The Water Cycle

Australian Syllabus Links:

- ACHGK038

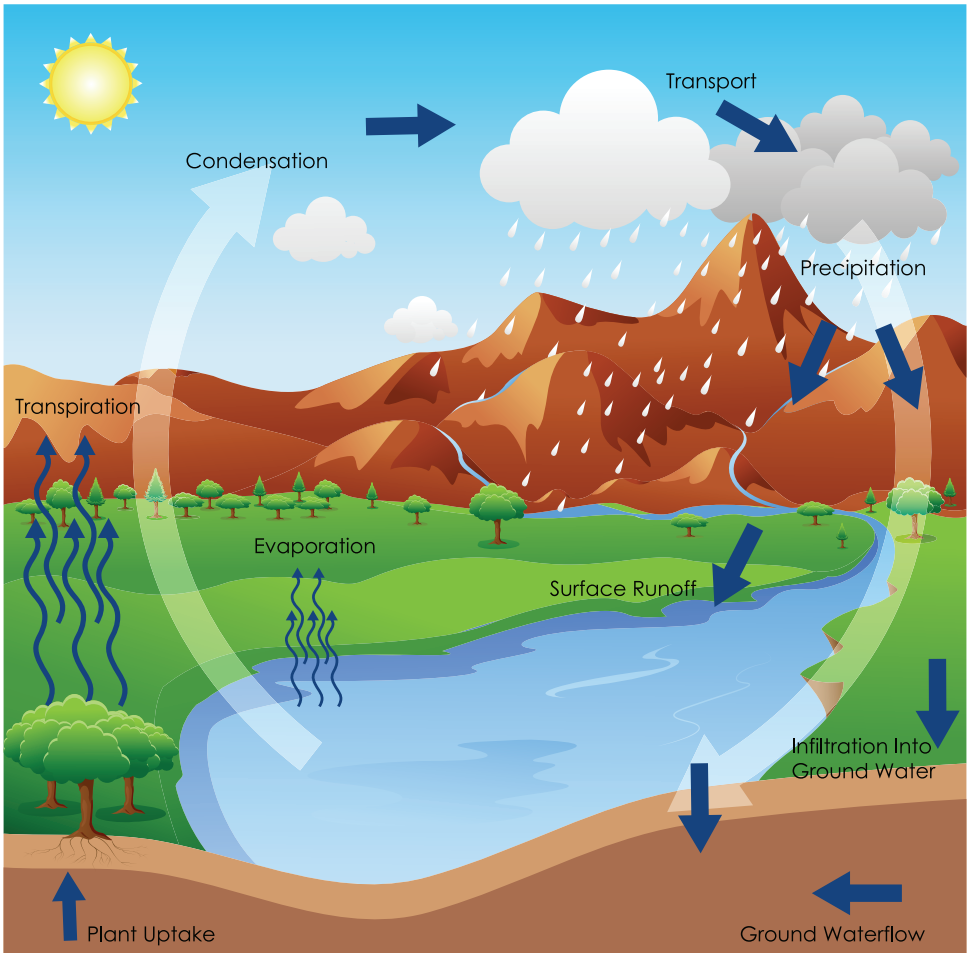
WATER CYCLE EXPLORED

The most important factor in the water cycle is the sun! The sun heats the ocean (just a little bit) and then starts the continuous water cycle.

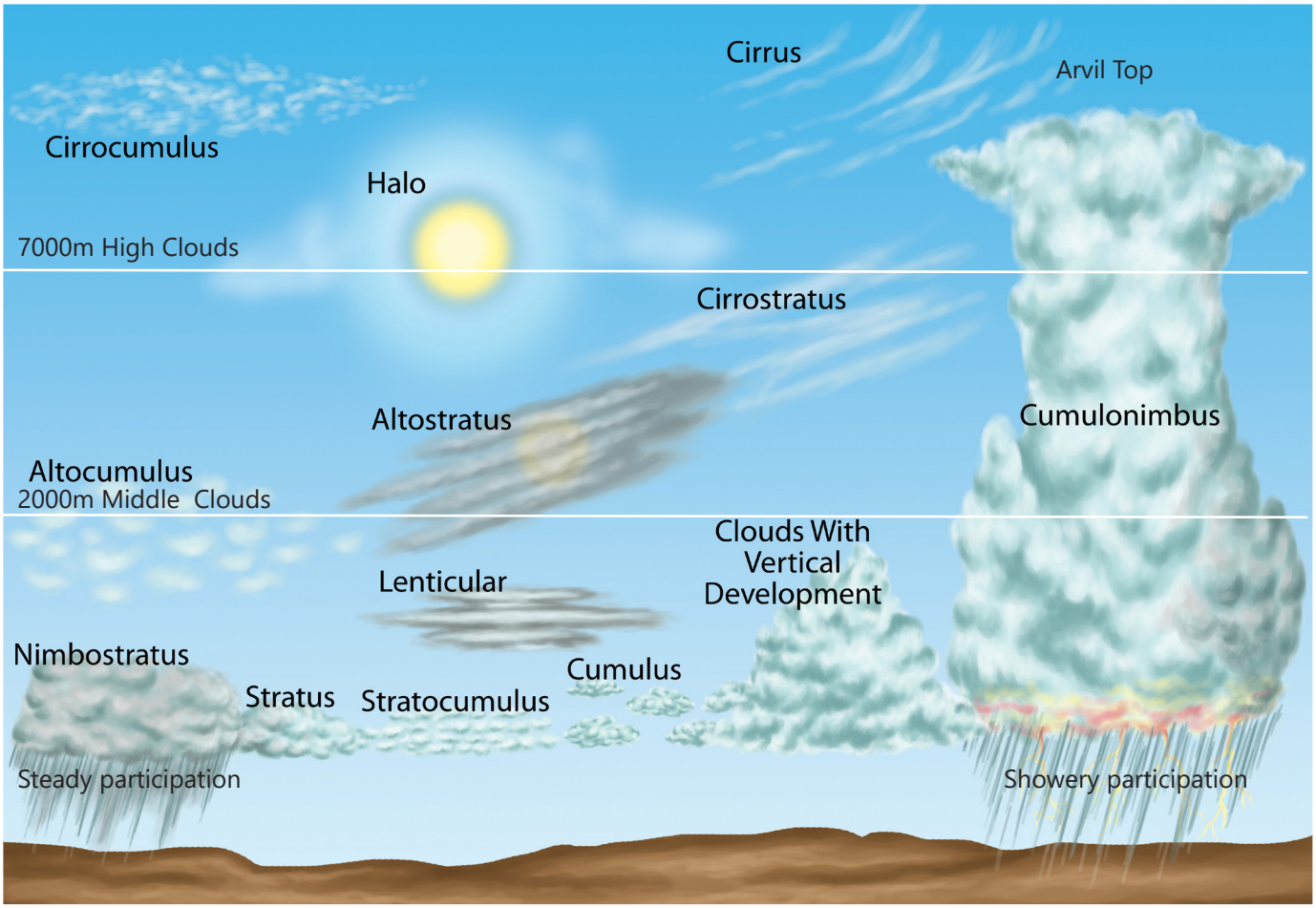
1. Some of the water (a liquid) on the surface of the oceans evaporates. The evaporated water is now a gas and is called water vapour.
2. Wind and air currents help the vapour to rise into the atmosphere. The temperature is cooler high in the atmosphere, so the water vapour condenses and forms clouds.
3. When the weight of the condensed water in the clouds is too heavy the water falls to Earth as rain, snow, sleet or hail. This is called precipitation.
4. The precipitation that falls onto land either soaks into the ground (called groundwater) or it flows downhill into stormwater or surface run off.

On the Central Coast the surface runoff flows into Wyong River or Ourimbah Creek and then into Tuggerah Lake and eventually into the ocean. Groundwater also flows in a downhill direction due to gravity. Water moving through the ground can also enter into creeks and streams and eventually be returned to the ocean where the cycle starts again.

The water cycle is a relatively simple system that provides fresh water for the Earth. We generally see the result of this process as rain falling to the earth, but rarely do we investigate some of the mechanisms at a global scale. At any time on the earth storms rage producing water, but why do some storms produce more rain? What determines where the rain will fall? How does air temperature, humidity, water temperature, windspeed, etc play a role in this process? Living on the Central Coast we regularly see large storms that come off the ocean or long periods of clear skies with no rain. Understanding how the water cycle works and the driving mechanisms can demonstrate why rain maybe more prevalent in certain areas of Australia while lacking in others and how that can affect our water supply on the Central Coast.



Water Cycle



Types of Clouds

Let's Begin!

This program will have you accessing the website https://earth.nullschool.net/ to analyse various mechanisms that drive the water cycle. The weather data is forecast by super-computers every three hours based on data collected from the Global Forecast System. This data will provide knowledge on where, why and how weather systems begin and how this drives the water cycle here in Australia and around the world.

Some new terms to look at before we start: Understanding these terms will help you develop a story about your location.

- **Sea Surface Temp (SST)** - this is the temperature of the water at the ocean's surface. The warmer the water, the easier water evaporates.
- **Total Cloud Water (TCW)** - is the total amount of water in clouds in a column of air from ground to space. Big storm clouds called cumulonimbus look dark from below due to the density of water inside absorbing sun light or reflecting up into the sky. Conversely, cirrus clouds are white in appearance due to very little water vapor which allows more light through.
- **3hr Precipitation Accumulation (3HPA)** - this is the amount of precipitation (rain/snow) over the next three hours in that location.
- **Relative Humidity (RH) -** the amount of water in the air at that location. If the RH is at 80%, the air in that location is at 80% ability to hold water.
- **Air temp**— is the temperature of the air at that specific height. The closer you are to the Earth's surface the hotter it is.
- **Windspeed**— the speed of the air at that specific height. The windspeed at the outer limits of the atmosphere can be over 300km/hr.

Some helpful hints:

- Hot air is less dense than cold air so when hot and cold air collide, the warmer air is forced to rise over the colder air. When the warm air is forced up, it causes surface air pressure to drop, sort of like having a small vacuum develop at the Earth's surface at the boundary between the two air masses. Cold air rushes in to fill the area of lower air pressure, which causes more warm air to be displaced upward. These extreme differences in air pressure result in a storm.
- Warm air with moisture rising into cooler air higher up will condense to make clouds and rain. Change the "height" of your location using the tool bar. Select 1000hPa, 850hPa and so on to 10hPa. You will notice as you lower your pressure number the temperature will start to drop along with it. Remember to reset your height back to "SFC" for surface temperature.
- Where do you notice most of the biggest storms in the world are coming from?
- The warmer the water the more evaporation. Notice the water temp and where storms are brewing.
- Wind will carry water vapor up into the atmosphere. Where you have a warm air mass and a cool air mass you generally will find strong winds.
- In the tool bar you can select a different date by opening the calendar. Choose the date and click "apply". This will show you the weather at the same time for that date. You can compare that date to the current day to see how much the weather has changed. Make sure you change the date back to the current day to progress in this program.

Pressure	Height(metres)
1000hPa	~100m
850hPa	~1,500m
700hPa	~3,500m
500hPa	~5,000m
250hPa	~10,500m
70hPa	~17,500m
10hPa	~26,500m

WATER CYCLE EXPLORED

Step 1) Opening Program

1. Open up https://earth.nullschool.net/
2. Left click on "earth" on the bottom left corner. This will open your tool bar for choosing any filter you need.
3. Under "Projection" select "E". This is your map view, using this map view you can see the entire earth at once.
4. Under the "Mode" option you will be in either "Air" or "Ocean" for the program
5. To minimize the tool bar click on "earth"

Step 2) Choosing location

1. Open the tool bar, in the "Overlay" option select "3HPA"
2. Using the mouse scroll around until you find an area that shows rain fall. This is indicated by the colour scheme on the scale.
3. You can zoom in to an area by using the wheel on the mouse and holding the left click button allows you to drag the map.
4. A single left click on the map will provide you with a location and details on the bottom left corner.
5. Only choose one location until you collect all your data.

Step 3) Sea Surface Temperature (SST)

1. Open the tool bar and in the "Mode" option and choose "Ocean"
2. In the "Overlay" option select "SST" to get your water temp. This will be displayed in the box above the tool bar.

Step 4) Air Temperature (Temp)

1. Open the tool bar and in the "Mode" option and choose "Air"
2. Make sure the "Height" is set to "Sfc" for the entire time.
3. In the "Overlay" option choose "Temp"
4. This will display the air temp at that location you selected in the box above the tool bar.

Step 5) Total Cloud Water (TCW)

1. Open the tool bar and in the "Mode" option and choose "Air"
2. Make sure the "Height" is set to "Sfc" for the entire time.
3. In the "Overlay" option choose "TCW".
4. This will provide you with the total water in the clouds from earth to space in a column one meter by one meter
5. It will be display as kg/m2 above the tool bar.

Step 6) 3hr Precipitation Accumulation (3HPA)

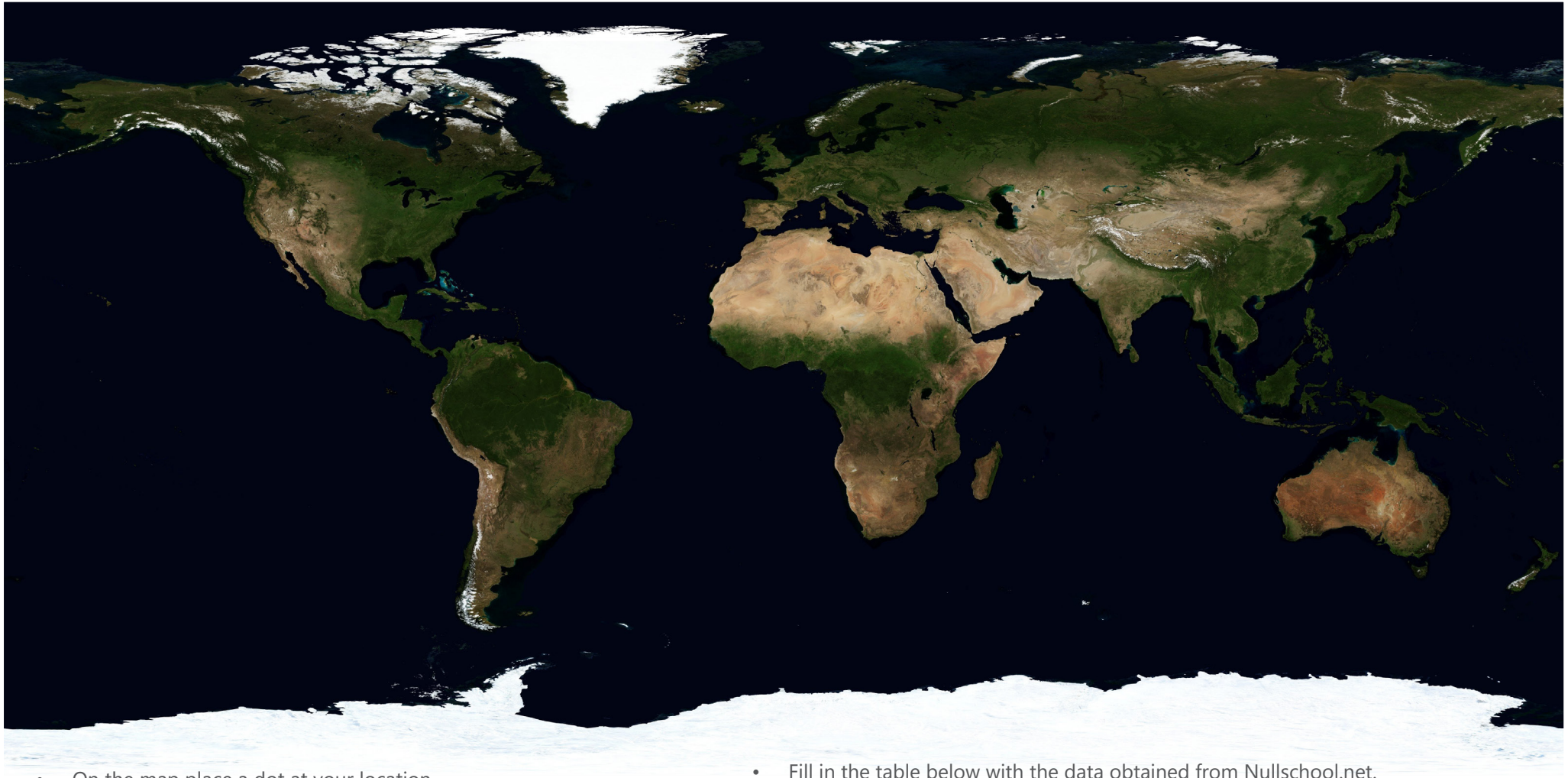
1. Open the tool bar and in the "Mode" option and choose "Air"
2. Make sure the "Height" is set to "Sfc" for the entire time.
3. In the "Overlay" option choose "3HPA".
4. This will provide you with the amount of rain falling every three hours in that location.
5. It will be in the box above the tool bar in mm.

Step 7) Wind Speed (Wind)

1. Open the tool bar and in the "Mode" option and choose "Air"
2. Make sure the "Height" is set to "Sfc" for the entire time.
3. In the "Overlay" option choose "Wind"
4. This will provide you with the wind speed at your location
5. It will be in the box above the tool bar in km/h

Step 8) Relative Humidity (RH)

1. Open the tool bar and in the "Mode" option and choose "Air"
2. Make sure the "Height" is set to "Sfc" for the entire time.
3. In the "Overlay" option choose "RH"
4. This will provide you with how much water is in air as a %
5. It will be in the box above the tool bar in a %



- On the map place a dot at your location
- You can draw on the map to help you remember what have seen
- Fill in the table below with the data obtained from Nullschool.net.
- Think about how the data you're collecting affects each other and the water cycle.

Water body (sea/ocean)	Sea Surface Temp (SST)	Air Temp (Temp)	Total Cloud Water (TCW)	3 hr Precipitation Accumulations (3HPA)	Wind Speed (Wind)	Relative Humidity (RH)	Date

WATER CYCLE EXPLORED

Teacher Debrief Q&A Ideas

1. **When viewing the Nullschool map, where did most of the heavy rain seem to be located? Why do you think those areas had such large storms?**

   A large portion of storms that develop around the world originate near large bodies of water. Oceans provide this needed water in most cases. Large storms do occur inland, but most storms occur around coastal areas where warm and cold air masses meet.

2. **What are some of the reasons why areas inland in Australia are very dry?**

   Having cool air from the ocean mixing with warmer air over the land creates a prime spot for rain to occur. Once the storm system moves inland there is very little water to evaporate compared to the ocean. This lack of water limits evaporation and water vapor to condense to create clouds and rain.

3. **Why is the Central Coast able to experience large storms bringing lots of rain?**

   Coast areas are a prime location for large storms due to warm air temps on the land meeting cooler air from the ocean. Pressure systems spin clockwise for low pressure and anti-clockwise for high pressure systems. This spinning motion can bring the cooler wet air of the ocean towards the coastline where it meets the warmer air on the land. It is this meeting point, between the warm and cold air, that creates the large storms the Central Coast encounters.

4. **When wind speeds increase or becomes gusty what might this be indicating is changing?**

   Wind speeds increasing may indicate a change in pressure systems. These pressure systems often have a change in temperature or bring rain. In general, the weather is going to change with the onset of strong winds.

5. **When looking at warm and cooler surface temps meeting, what seems to occur at those locations?**

   Strong winds, clouds, rain, temperature changes, strong weather systems, pressure changes

6. **Why is it important to have numerous catchments in the Central Coast to collect water?**

   Having numerous catchments is key in water security since storms do not always provide rain to the entire Central Coast. Often it can rain in one area in the Central Coast while other areas see no rain. By having numerous catchments this increases the ability to harvest the water in those areas which provides a more secure water supply to the community.

STAGE 4 GEOGRAPHY

Water Around Australia

FOCUS AREA - Water in the World

Outcomes explored

A student:

- Discusses management of places and environments for their sustainability GE4-5
- Acquires and processes geographical information by selecting and using geographical tools for inquiry GE4-7
- Communicates geographical information using a variety of strategies GE4-8

Key inquiry question

- Why does the spatial distribution of water resources vary globally and within the countries?
- How do natural and human processes influence the distribution and availability of water as a resource?
- What effect does the uneven distribution of water resources have on people, places and environments?
- What approaches can be used to sustainably manage water resources and reduce water scarcity?

Content focus

Students:

- Examine water as a resource and the factors influencing water flows and availability of water resources in different places
- Investigate the nature of water scarcity and assess ways of overcoming it.
- Discuss variations in people's perceptions about the value of water and the need for sustainable water management

Content:

- Water Resources
- Australia's water resources
- Water scarcity and water management

Australian Syllabus Links:

- ACHGK037
- ACHGK039
- ACHGK040

WATER AROUND AUSTRALIA

Australia is a unique country with roughly the same land mass as the United States but with a population 90% smaller. One would assume with a much smaller population and large landmass that resources, like water, would not be a concern. The driest continent on Earth is Antarctica, but after that is Australia with 20% of the continent being classified as a desert. Most of Australia's population inhabits major cities on the coastline while the remaining areas of Australia are scattered with small towns with few people. The Central Coast often experiences heavy rain and occasional flooding while areas inland may not see rain for many months. The current population of the Central Coast is just over 346,000 people and by the year 2036 the population is expected to increase to 414,615 people. With an ever-increasing population in the area, the demand for water also increases. This increase in demand requires more access to fresh drinking water.

This activity will have you travel around Australia learning about access to water, catchments, rivers, topography and more. The Central Coast has many challenges facing water security due to population growth, drought, infrastructure, flooding and climate change. This activity shows how the Central Coast is not alone in Australia in its quest to have a secure water supply to meet the needs of the community.

Water Clues

Instructions: Put your detective skills to the test! Below are questions that need to be answered in a specific order to get the correct final answer. The first question will have you starting in Perth and from there you will need the correct answer to proceed to your next location. The table below has the remaining questions in no particular order. Once you have the correct answer for Perth the first and last letter of your answer will allow you to find your next location on the map. The first letter is located at the top of the map and the last letter on the side. Where the two cross paths are your next location which is a major city or town in that area. Once you find your last location write your answer in the "Final Answer" box to show you followed the correct path. Bon voyage!

*** You will need the internet to help you search for the answers to your clues**

*** HINT: The questions have specific answers that can be found by searching the city or town with a question.**

First Clue!

- Perth receives water from dams, ground water, desalination and groundwater replenishment. Which one provides the least amount of water to the Perth?

Map Clues		
With its steep topography which creates a multitude of streams and rivers, Tasmania has 48 of these natural landscapes where water is collected.	The Brisbane River is a brownish colour due to sediment being suspended by dredging, run-off and this process when the riverbank falls into the water.	The Amadeus Basin is where Alice Springs water supply comes from. They use this type system to extract water.
The_____ _____ Project was completed in 1981 that included a major pumping station and a water treatment plant that allowed this city to increase their water storage capacity to 95,000million litres.	The Murray Darling Basin holds three of Australia's longest rivers in its catchment. What is the name of the location by Adelaide where the longest river enters the sea?	Water supplied to Cairns is extracted from rainforest areas untouched by humans. The water before it gets to homes and businesses is untreated or unfiltered. The term for water not treated is called "____" water.
The majority of Broome's water is locked in a unconfined aquifer which requires a bore to be drilled to access the water below. What is it called when you have many bores in one area pumping water from underground?	In Darwin 85% of its water needs are meet by this type of structure.	The Warragamba Dam flooded this valley to provide 80% of the available water supply to the Sydney region.

FINAL ANSWER

Draw lines of travel from location to location. also add the names of the locations once you find them.

WATER AROUND AUSTRALIA

Map Clues - Teachers Answer Key

Instructions: Put your detective skills to the test! Below are questions that need to be answered in a specific order to get the correct final answer. The first question will have you starting in Perth and from there you will need the correct answer to proceed to your next location. The table below has the remaining questions in no particular order. Once you have the correct answer for Perth the first and last letter of your answer will allow you to find your next location on the map. The first letter is located at the top of the map (x axis) and the last letter on the side (y axis). Where the two cross paths you will find your next location which is a major city or town in that area. Once you find your last location write your answer in the "Final Answer" box to show that you followed the correct path. Bon voyage!

You will need the internet to complete this activity

1. Perth—Perth receives water from dams, ground water, desalination and ground water replenishment.

Which one provides the least amount of water to the Perth? **(ground water replenishment) (G,T)**

2. Alice Springs — The Amadeus Basin is where Alice Springs' water supply comes from.

They use this type system to extract water? **(Bore) (B,E)**

3. Melbourne— The_____ _____ Project was completed in 1981 that included a major pumping station and water treatment plant that allowed this city to increase their water storage capacity to 95,000million litres. **(Sugarloaf Reservoir) (S, R)**

4. Darwin—In Darwin 85% of its water needs are meet by this type of structure. **(Dam) (D,M)**

5. Brisbane— Brisbane River is a brownish colour due to sediment being suspended by dredging, runoff and this process when the riverbank fall into the water? **(Erosion)**

6. Sydney - The Warragamba Dam flooded this valley to provide 80% of the available water supply to the Sydney region? **(Burragorang Valley) (B, Y)**

7. Tasmania—With steep topography creating a multitude of rivers Tasmania has 48 of these where water is collected? **(Catchments) (C, S)**

8. Broome—The majority of Broome's water is locked in a unconfined aquifer which requires a bore to be drilled to access the water below. What is it called when you have many bores in one area pumping water from underground? **(Borefield) (B, D)**

9. Cairns— Water supplied to Cairns is extracted from rainforest areas untouched by humans. The water before it get to homes and businesses is untreated or unfiltered. The term for water not treated is call "____" water. **(Raw) (R, W)**

10. Adelaide - The Murray Darling Basin holds three of Australia's longest rivers. What is the name of the location by Adelaide where the longest river enters the sea? **(Murray Mouth)**

FINAL ANSWER

Murray Mouth

WATER AROUND AUSTRALIA

Teacher Debrief Q&A Ideas

1. **What are some of the methods used around Australia to acquire fresh water?**

   Pump stations in rivers and creeks, creating borefields to gain access to aquifers, creating dams or weirs to hold more water, desalination plants to treat seawater and collecting rain using rain water tanks.

2. **Do any of the locations in this activity have similarities with the Central Coast and our water resources?**

   The Central Coast built treatment plants and pumping stations like what Melbourne did in 1981. Darwin's main source of water is a dam and the Central Coast's largest fresh water storage is at Mangrove Dam. Sydney needed to flood the Burragorang Valley to create the Warragamba Dam and Mangrove Dam also needed to flood the valley for creating storage for the Central Coast. Woy Woy has borefields to acquire water from the aquifer during drought times and Broome also uses borefields to access their main source of water.

3. **The Murray Darling Basin extends from Southern Queensland just north of Brisbane and extends all the way to Adelaide in South Australia. What is the economic significance of the basin to Australia?**

   The Murray Darling Basin contains over 40% of all the farms in Australia. It is the most important agricultural region in all of Australia as it's known as the "Food basket". Not having water in the Murray Darling Basin can cause high food prices, failing businesses, displacement of families and communities.

4. **Alice Springs only has one main source of water while many other parts of Australia have more than one. Why is that?**

   Alice Springs is in the centre of Australia and is very hot during the summer. The area doesn't receive regular rain, nor does it have creeks or rivers that are consistently flowing. The Amadeus Basin is an aquifer in Alice Springs and holds an estimated 300-400 years' worth of water in the aquifer which is why they use borefields to acquire water. What is unknown is the quality of the water as they dig deeper into the aquifer.

5. **What location's water supply is primarily focused on rain water collection? Would having a single system be advantageous in the Central Coast to meet the needs of the community?**

   Darwin's water supply is primarily focused on rain water collection. This system would not be advantageous for the Central Coast as a single system to provide water due to droughts. Darwin typically gets much more rain compared to the Central Coast which is why having a variety system is key in water security in the Central Coast. Darwin runs the risk of catastrophic water shortage if a drought would happen to occur in that region or if pollution affects the water.

BONUS

Mardi Dam and Water Treatment Plant School Tour

FOCUS AREA - Water in the World

Outcomes explored

A student:

- Explains how interactions and connections between people, places and environments result in change GE4-3
- Discusses management of places and environments for their sustainability GE4-5

Key inquiry question

- How do natural and human processes influence the distribution and availability of water as a resource?
- What effect does the uneven distribution of water resources have on people, places and environments?
- What approaches can be used to sustainably manage water resources and reduce water scarcity?

Content focus

Students:

- Investigate the nature of water scarcity and assess ways of overcoming it.
- Discuss variations in people's perceptions about the value of water and the need for sustainable water management

Content:

- Water Resources
- Australia's water resources
- Water scarcity and water management

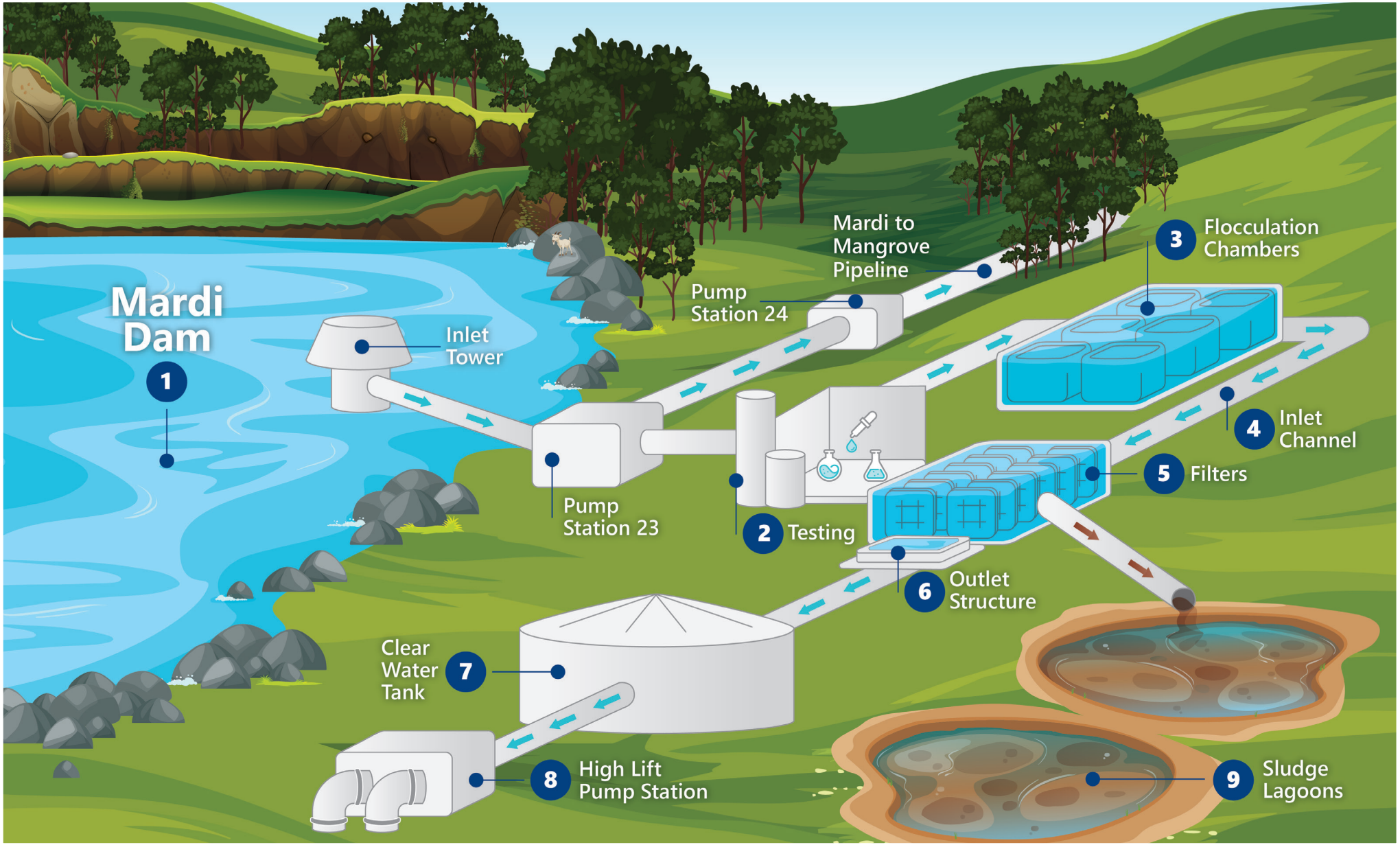
Excursion to Mardi Dam and Water Treatment Plant

Students have an opportunity to tour an important component of the Central Coast's water supply system. An expert from the Mardi facility will provide a behind the scenes look at the processes involved in treating water to make it potable and the significance of the facility for the Central Coast's water security. Students will explore the dam to learn where the water comes from and the dam's structural components. An illustration of the site with questions tied to the tour is available to complement this excursion.

Mardi Treatment Plant - Flocculation Chamber

Mardi Treatment Plant - Sludge Lagoons

MARDI DAM AND WATER TREATMENT PLANT



Excursion to Mardi Dam and Water Treatment Plant

Student Worksheet

Student Questions	Response
1. How deep is the dam at the lowest point?	
2. What is the total water holding capacity of the dam?	
3. How often do staff analyse the water quality?	
4. Flocculation chambers create floc which are small dirt particles attached to each other. What chemical do they add to make this happen?	
5. The inlet channel correts the pH of the water passing through by adding which chemical?	
6. What materials are used to make the filters?	
7. Why is the outlet structure dark on the inside?	
8. The Clear Water Tank holds the treated water before it leaves the treatment facility. How much can the tank hold?	
9. High lift pumps are used to pump water to the Tuggerah Reservoir. How much water can the pumps move every second?	
10. In the sludge lagoons, the dirt eventually settles to the bottom and the clean supernatant (water on top) is removed. Where does it go?	

Excursion to Mardi Dam and Water Treatment Plant

Teacher Answers

Student Questions	Response
1. How deep is the dam at the lowest point?	**17 metres**
2. What is the total water holding capacity of the dam?	**7,400 million litres**
3. How often do staff analyse the water quality?	**Daily**
4. Flocculation chambers create floc which are small dirt particles attached to each other. What chemical do they add to make this happen?	**Liquid aluminium sulphate (Alum)**
5. The inlet channel correts the pH of the water passing through by adding which chemical?	**Lime**
6. What materials are used to make the filters?	**Coal, sand and garnet**
7. Why is the outlet structure dark on the inside?	**Prevent algae growth**
8. The Clear Water Tank holds the treated water before it leaves the treatment facility. How much can the tank hold?	**15 Mega Litres or 15million litres**
9. High lift pumps are used to pump water to the Tugger-ah Reservoir. How much water can the pumps move every second?	**1200L/Sec**
10. In the sludge lagoons, the dirt eventually settles to the bottom and the clean supernatant (water on top) is removed. Where does it go?	**Back to the dam**

Helpful Websites

Love Water Use it Wisely
https://lovewater.centralcoast.nsw.gov.au/

Central Coast Council Water Services
https://www.centralcoast.nsw.gov.au/residents/roads-and-water

Blueplanet
http://www.blueplanet.nsw.edu.au/home/.aspx

Drip Calculator
https://water.usgs.gov/edu/activity-drip.html

Reporting Local Issues
https://www.snapsendsolve.com/

Water Footprint network
https://waterfootprint.org/en/

Topographic maps
https://maps.six.nsw.gov.au/etopo.html

Central Coast Council

Love water, use it wisely
Stage 4 Geography - Water in the World

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