

Year 11 Earth and Environmental Science
Human Impacts @ Penrith Lakes
(Water Management)

Key inquiry question : How can water be managed for use by humans and ecosystems?

Students:

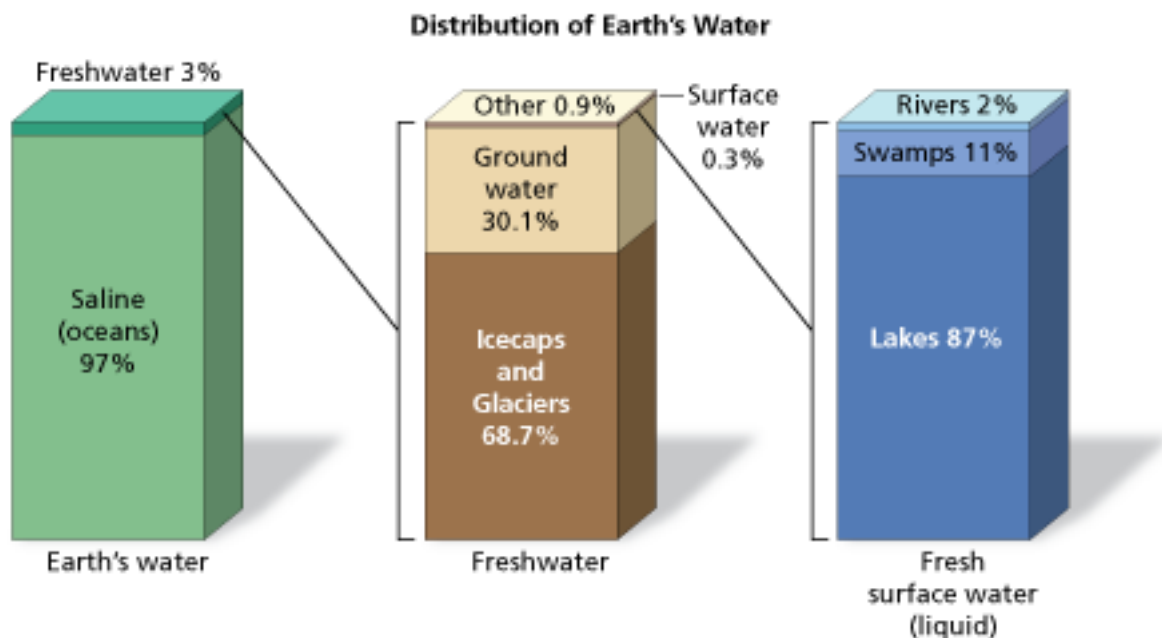
- represent the distribution of the Earth's water, including the amount available to plants and animals
- investigate the treatment and potential reuse of **stormwater**
- Describe ways in which human activity can influence the availability and quality of water indirectly eg algal blooms

Student Name: _____

Case Study: Water Management at Penrith Lakes

Preamble:

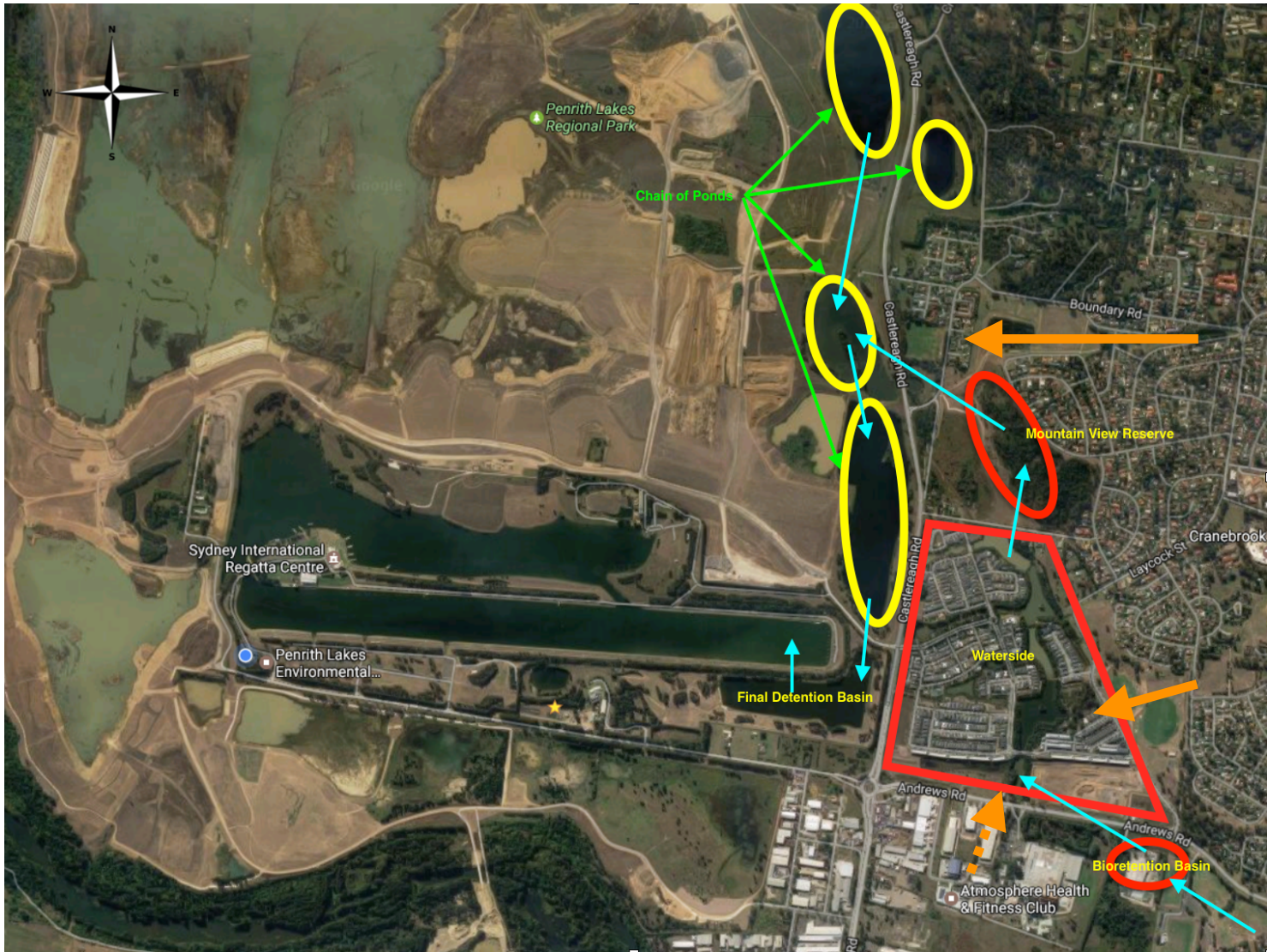
The amount of water available to plants and animals is extremely scarce resource (see diagram below). Humans need to manage, treat and reuse available freshwater for life as we know it today.



Investigation inquiry question:

How is stormwater reused for recreation at Penrith Lakes?

1. Where does the stormwater come from? (Introduction to the Penrith Lakes Scheme)



Introduction to stormwater at Penrith Lakes

- Use the following places/features to complete the flow of Farrell’s Creek stormwater to Penrith Lakes:

Middle detention basins

Regatta Lake,

Waterside,

Final detention basin

Andrews Rd Bioretention Basin

Chain of ponds

Mount View Reserve

FLOW: Northeast Penrith urban area ⇒ _____ ⇒ _____

⇒ _____ ⇒ _____ ⇒ _____

⇒ _____ ⇒ _____

- The ‘chain of ponds’ is made up of Cranebrook Lake, Duralia Lake and the _____.
- Treated stormwater is used at Penrith Lakes for rowing, canoeing, kayaking, whitewater rafting, jet packing, triathlons, long distance swimming, model boat racing, _____ and other approved activities.
- Stormwater also enters from the _____ Creek catchment (large orange arrow), the _____ urban area (small orange arrow) and the Penrith North _____ area (small dotted orange arrow).

Andrews Road Bioretention Basin

Aim: To track the flow of stormwater through Penrith Lakes to its primary contact for recreational use.

The journey for stormwater entering and flowing through Penrith Lakes
(Bus tour of the Penrith Lakes Scheme)



Picture 1: Andrews Road Bioretention Basin Location Map and Conceptual Design

The Andrews Road Bioretention Basin System involves:

- Diverting stormwater from an urban catchment upstream of the site. The catchment area is approximately 70ha.
- Stormwater is pre-treated in a gross pollutant trap, which removes litter, organic debris and some coarse sediment.
- Stormwater flows into a sediment basin for settling of coarse sediment.
- Stormwater is then treated in a bioretention system, which removes suspended solids, nutrients, heavy metals, hydrocarbons, pathogens and other pollutants.
- At the base of the bioretention system, treated stormwater is captured in subsoil drains and directed to the existing drainage channel to **Waterside**

Waterside

Waterside has been planned around a series of lakes that are designed to provide amenity to the estate as well as water quality improvements.

The “Waterside” development is being built by Stockland and is made up of two areas – Corporate (Employment) and Residential. Waterside Corporate covers 12.5ha of developable land providing valuable employment. The residential area of Waterside covers 54 ha. There will be 686 lots available. The estimated population is 2,150 persons. The public open space will cover 11 ha and the lakes another 11 ha.

Central to Waterside is the practice of “Water Sensitive Urban Design” (WSUD). This involves the management and protection of stormwater.

Key principles of WSUD (fill in the blank spaces below using the word list):

1. Protect _____ quality
2. Integrate _____ treatment into the landscape
3. Reduce _____ and peak flows (e.g. rain gardens and plant buffer zones)
4. Add value while _____ development costs (e.g. water drains to centre of road)
5. Reduce _____ water demand (e.g. rainwater tanks for gardening)

Word List : **potable** **runoff** **lowering** **water** **stormwater**

From Waterside the water flows to **Mountain View Reserve**.

Mountain View Reserve, Cranebrook



Picture 3: Mountain View Reserve, Cranebrook, Location Map

Key points about Mountain View Reserve:

- Receives water from Waterside and surrounding catchment hills.
- This water is then redirected to the restored wetlands.
- The wetlands naturally filter the water by taking out pollutants and excess nutrients.
- This water then flows in to the chain of ponds and the **Final Detention Basin**.
- So the restoration works will improve water quality entering Penrith Lakes and the Hawkesbury–Nepean River System

Working Scientifically – Is water management working? (Water Testing)

Water Test	Instrument	Units	Directions
Phosphate	Test Tablet Kit	ppm	
pH	Universal Indicator	Number	
Turbidity	Turbidity Tube	ntu	
Temperature	Thermometer	°C	
Conductivity (Salts)	TDS Scan	ppm	

Waterside				Final Detention Basin			
Phosphate (nutrients): _____ ppm				Phosphate (nutrients): _____ ppm			
0 – 1 ppm	>1 – 2 ppm	>2 – 3 ppm	>3 – 4 ppm	0 – 1 ppm	>1 – 2 ppm	>2 – 3 ppm	>3 – 4 ppm
8	6	2	0	8	6	2	0
pH: _____				pH: _____			
6.5 – 8.5	8.6 – 9.0	6.0 – 6.4	<6 or >9.0	6.5 – 8.5	8.6 – 9.0	6.0 – 6.4	<6 or >9.0
8	6	4	0	8	6	4	0
Turbidity (clarity): _____ ntu				Turbidity (clarity): _____ ntu			
<10 ntu	10 – 20 ntu	20 – 50 ntu	>50 ntu	<10 ntu	10 – 20 ntu	20 – 50 ntu	>50 ntu
8	4	2	0	8	4	2	0
Temperature: _____ °C				Temperature: _____ °C			
Summer	20 – 30 °C	Summer	>30 °C	Summer	20 – 30 °C	Summer	>30 °C
Autumn/ Spring	15 – 25 °C	Autumn/ Spring	<15 or >25 °C	Autumn/ Spring	15 – 25 °C	Autumn/ Spring	<15 or >25 °C
Winter	10 – 20 °C	Winter	>20 °C	Winter	10 – 20 °C	Winter	>20 °C
8		4		8		4	
Conductivity (salts): _____ ppm				Conductivity (salts): _____ ppm			
<250 ppm	251–650 ppm	651–1000 ppm	>1000 ppm	<250 ppm	251–650 ppm	651–1000 ppm	>1000 ppm
8	6	4	0	8	6	4	0
Appearance							
Clear	Cloudy/some colour	Muddy/murky	Oily/scummy and/or smelly	Clear	Cloudy/some colour	Muddy/murky	Oily/scummy and/or smelly
8	6	2	0	8	6	2	0
Overall Score Waterside: _____				Overall Score Final Detention Basin: _____			

Overall Rating	Excellent	Very Good	Good	Fair	Poor	Very Poor
Waterside	42+	37 – 41	32 – 36	25 – 31	20 – 24	<20
Final Detention Basin	42+	37 – 41	32 – 36	25 – 31	20 – 24	<20

What water management methods are being used on-site at Penrith Lakes?

Final Detention Basin

Before reaching the Final _____ Basin, stormwater has been treated at a number of sites and slowed down by the _____ of ponds. Within the Final Detention Basin there are some further water management practices in place to ensure the stormwater is clean enough for recreational use. For sustainable recreational water a well balanced native _____ needs to be in place.

Word List

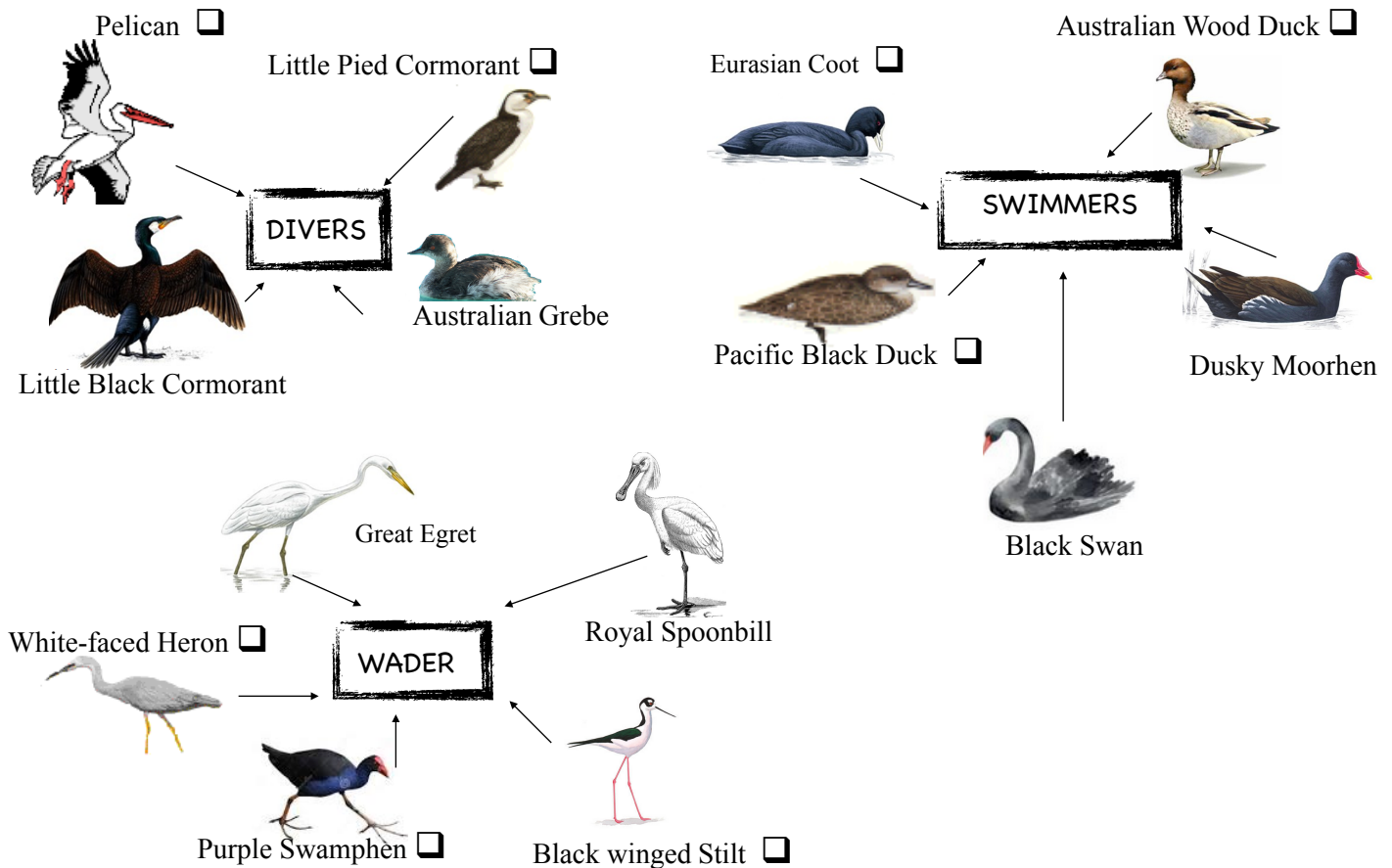
sluice; chain; harvesting; air pump; detention; stratification; nutrients; turbidity; boom; carp; blue-green; perched; bass; wetlands; submerged; screen; ecosystem; spraying

	Problem	Effects on water quality	Water Management
A	High nutrient run off	Encourages _____. _____ algal blooms.	(2) _____ wetlands (use up nutrients) (3) Floating Treatment _____ .
B	Excessive sediment from land clearing and non sealed areas	Causes turbid (brown) water which raises water temperature and lower O2 by blocking sunlight.	(4) A silt _____ (filters sediment). (2) _____ wetlands (slows inflow). (1) Detention basin system and sluice gate.
C	_____ (high water surface temperatures and low bottom temperatures)	Stratified water (low O2 at bottom level) releases _____ from "floor" sediment. Warm top layer encourages algal blooms.	(5) An _____ and hoses create currents to mix water. (6) Remote temperature sensor (yellow floating instrument with solar panels) triggers the air pump.
D	Petrochemicals (e.g. oil) and litter	Harmful impacts on ecosystem life. Blocks sunlight (low O2).	(7) A trash _____ holds back oil and litter.
E	Polluted storm water/ storm events	First flush run-off brings pollutants. Large flows can exceed basin capacity.	(8) _____ gate can be closed for pollutants or opened during flooding/storms.
F	European _____ (introduced fauna)	High _____ - stirs up sediments and rips out water plants which leads to lower O2 and higher nutrients.	Electro-fishing (in the past). (9) Stocking the lakes with _____ (biological control)
G	Hydrilla (native flora)	Hydrilla canopies lower O2 by blocking sunlight. Chokes out _____ plants.	(10) Weed _____ . (11) Selective _____ . (12) Covering with mats.



Working Scientifically - Is water management working? (Bird Observation)

1. On your walk - Look at the bird pictures. Once you and the teacher have ID the bird, tick the box.
2. Using column 5, fill in the bird numbers seen today. The teacher will guide you. Use this to work out abundance/distribution and then a habitat/food supply point score.



Waterbirds observed today	Circle points for birds seen today
Bird Species	
1. Australian Grebe	4
2. Australian Wood Duck	2
3. Black Swan	5
4. Blackwinged Stilt	5
5. Dusky Moorhen	3
6. Eurasian Coot	3
7. Great Egret	5
8. Little Black Cormorant	4
9. Little Pied Cormorant	4
10. Pacific Black Duck	3
11. Pelican	5
12. Purple Swamphen	4
13. Royal Spoonbill	5
14. White-faced Heron	5
15. Other: _____	5
Total point score today	

Habitat total bird score?	
0-10	Poor
11-18	Fair
19 - 25	Good
>25	Excellent

Wrap Up

1. Are stormwater management practices working at Penrith Lakes?

- Assessment of abiotic indicators
- Did you notice any biotic indicators during the day?

2. How can human activity influence the availability and quality of recreational water at Penrith Lakes? (Discussion)

- Read the algal alert bulletin below
- What factors cause a blue green algal outbreak?
- What are the effects of such an outbreak?
- How has this outbreak impacted on the availability and quality of recreational water at Penrith Lakes?
- What human activity could have been responsible for this outbreak?

ALGAL ALERT BULLETIN

Metropolitan and South Coast Regional Algal Coordinating Committee

23 March 2016

Blue-green algae red alert for Sydney International Regatta Centre - Penrith

The Metropolitan and South Coast Regional Algal Coordinating Committee today issued a red alert warning for blue-green algae covering the Sydney International Regatta Centre at Penrith.

This red alert level warning indicates that people should not undertake recreational activities where they may come into direct contact with the water such as swimming, as well as domestic uses such as drinking, showering and washing.

Contact with the water may also pose a threat to pets and livestock.

Blue-green algae are potentially toxic and may cause gastroenteritis in humans if consumed and skin and eye irritations after contact. Boiling the water does not inactivate algal toxins.

Blue-green algae usually appear as green paint-like scums on the water, near the edges, or as greenish clumps throughout the water. It makes the water appear dirty, green or discoloured and generally has a strong musty or earthy odour.

People should not eat mussels or crayfish from red alert level warning areas. Any fish caught should be cleaned and washed thoroughly in uncontaminated water and any internal organs disposed of before consumption.

Regular monitoring will continue and the alert will be lifted as soon as the high levels of algae dissipate.

Information on health impacts can be found here:

<http://www.health.nsw.gov.au/environment/water/Pages/water-recreational.aspx>

Information updates about blue-green algae blooms and red level warning areas can be obtained from the Regional Algal Coordinating Committee freecall Algal Information Hotline on **1800 999 457** or visit – **www.water.nsw.gov.au**