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# Citizen Science

# Secondary

## Ms Galouzis's Year 9 Science

## Brighton Secondary School

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Australian Government Department of Defence

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# CITIZEN SCIENCE

## THE IMPORTANCE OF WETLANDS

This citizen science project focuses on the significance of wetlands in maintaining water quality. The aim is to investigate the research question*: "Does water quality correspond with the number and biodiversity of organisms in the water?"*

The class undertook a study of the Urrbrae wetlands, particularly examining four specific areas: the Kitchener Street sediment pond, the Cross Road sediment pond, the main pond in front of the learning center, and the outlet stream. However, the Kitchener Street sediment pond was dry during the study, so it was excluded from the analysis. The project involved collecting water samples and surveying these locations to determine the relationship between water quality and biodiversity.

To answer the research question, "Does water quality correspond with the number and biodiversity of organisms in the water?", the class conducted a series of tests. They measured flow rates, turbidity, salinity (EC), and pH levels to assess water quality. Additionally, they collected samples from various locations in the wetlands to examine the biodiversity of macroinvertebrates.

Citizen science is particularly useful for this project as it allows for extensive data collection across multiple locations and times, providing a broader understanding of the ecosystem. By involving the class, the project not only gathers valuable data but also educates participants about the importance of wetlands and the impact of environmental factors on water quality and biodiversity.

## ABOUT WETLANDS

Wetlands are diverse ecosystems that support a wide range of flora and fauna, including birds, insects, and aquatic plants. They provide critical benefits such as habitat provision and water management. The Urrbrae wetlands, in particular, play a vital role in Adelaide's water management by filtering rainwater from the surrounding area.

The process includes:

1. Trash racks filter out large contaminants.

2. Sediment ponds allow larger particles to settle.

3. The main ponds utilize water reeds and sedges to remove micro-toxins, resulting in clearer water with fewer pollutants.

During the excursion, the class aimed to understand the effectiveness of these methods in different areas of the wetlands.

Impact on the Urban Environment

Situated in an urban area, the Urrbrae wetlands also contribute to flood mitigation and habitat provision. Covering 380 hectares, they manage rainwater from a vast area, significantly reducing flooding risks during heavy rainfall. The wetlands have a capacity of 17.7 million liters, effectively absorbing excess water and safely returning it to the water table.

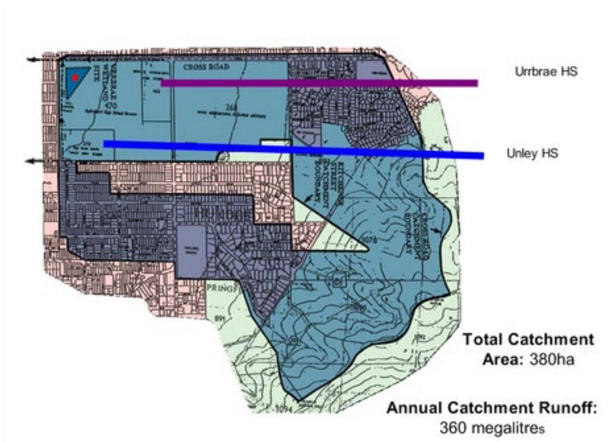



Figure 1: A map of the Urrbrae wetlands *(https://www.urrbraewetlandlc.org/)*

Pollutant levels in urban wetlands can vary based on organic and non-organic content, seasonal trends, human activity, pH levels, and temperature. These factors influence the solubility and mobility of pollutants, thereby affecting sedimentation rates. Consequently, external conditions can cause significant fluctuations in pollutant levels.

The class engaged with the broader community by using the Waterbug Bioblitz App, contributing data to a larger project assessing the health of waterways in South Australia's Murraylands, Hills, and Fleurieu regions. This involvement is part of the Environmental Management Systems (EMS), helping to monitor trends and the effects of revegetation projects. Such efforts support safe water management and contribute to environmental conservation.

Why We Chose This Particular Project

The class chose this project to gain a deeper understanding of wetlands and water cycles, specifically in South Australia. Originally, the science class (901PT) planned to link the citizen science project with FrogWatchSA. However, the timing for observing frogs proved problematic. Despite this, the excursion to the Urrbrae Wetlands proceeded focusing on monitoring, observing, and documenting water quality across the various ponds at the wetlands.

This project has significant scientific merits as it involves the collection of real-time data on water quality and biodiversity. The findings contribute to a broader understanding of the relationship between water quality and ecosystem health, particularly in urban wetlands. By examining parameters such as flow rates, turbidity, salinity, and pH levels, students engage in hands-on scientific research that enhances their knowledge and skills.

Citizen involvement, including school participation in wetland monitoring, plays a crucial role in raising community awareness about the importance of water quality and the role of wetlands in urban environments. This project not only educates students but also contributes valuable data to ongoing environmental monitoring efforts. By involving younger generations, the project fosters a sense of responsibility and stewardship for local ecosystems.

The Urrbrae Wetlands are an integral part of the local environment, providing habitat for various species and playing a crucial role in water management. Understanding the dynamics of these wetlands is essential for maintaining their health and ensuring they continue to provide their ecological benefits. By focusing on the Urrbrae Wetlands, the project highlights the local relevance and significance of wetlands in South Australia's urban landscape.

In summary, the class chose this project for its scientific value, potential impact on community awareness, and its local relevance. Through this project, students gained practical experience in environmental science while contributing to the broader effort of preserving and understanding urban wetlands.

## Steps Followed to Participate in the Project

1. Project Selection:

The class held a vote to decide which citizen science project to participate in. Initially, the class chose Frog WatchSA, a project aimed at monitoring the health and population of frog populations.

2. Reevaluation and Decision:

Upon discovering that FrogWatchSA required data collection during early morning or late evening, which was not feasible, the class decided to pivot. Given our focus on ecology, we opted to explore the importance of man-made urban wetlands.

3. Identifying a Suitable Program:

We found a suitable program at the Urrbrae Wetlands that aligned with our educational goals.

4. Excursion Planning:

The class organized an excursion to the Urrbrae Wetlands. Detailed plans were made to ensure a productive and educational visit.

5. Wetland Exploration:

During the excursion, we walked around the wetlands to observe and understand their purpose and importance in the urban environment

6. Data Collection:

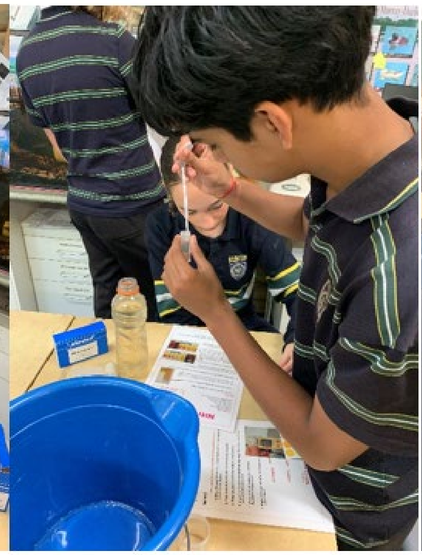
We measured several water quality parameters, including oxygen levels, temperature, turbidity, salinity, pH levels, and water flow rates. These measurements were crucial in assessing the quality of the water in the wetlands.

7. Sample Collection and Analysis:

We collected water samples from three different parts of the wetlands. Using microscopes, we analyzed these samples to identify the macroinvertebrates present. The class used a checklist and a sheet of paper to document and identify the species found.








8. Data Interpretation:

Finally, we calculated the taxa richness and pollution index of the wetlands, which helped us determine the overall health of the ecosystem (signal score).

The project involved several levels of collaboration:

Class Collaboration: Students worked together in groups to collect data, measure water quality parameters, and analyze samples. This collaboration fostered teamwork and ensured comprehensive data collection.

Program Collaboration: By participating in the Urrbrae Wetlands program, the class collaborated with the wetland staff, who provided guidance and educational resources.

Community Engagement: The project also included community engagement, as our findings contribute to the larger citizen science initiatives and help raise awareness about the importance of wetlands in urban environments.

This collaborative effort not only enhanced our understanding of wetland ecosystems but also contributed valuable data to ongoing environmental monitoring projects.

Findings

*Table 1: Water quality at different locations was tested to determine if the quality of water is suitable to sustain life and to determine if the wetland is functioning to clean the water.*

- *Temperature and oxygen levels were taken on site.*

| | Inlets | | Main Pond | | |
|---|---|---|---|---|---|
| | Kitchener St Sed. Pond | Cross Rd Sed. Pond | Learning Centre | The Outlet | Tap water |
| Temperature (°C) | No water | 13.2 | 14.6 | 14.7 | |
| Oxygen (mg/L) | - | 4.3 | 3 | 3.7 | On site |
| Turbidity (NTU) | - | 20 | <10 | <10 | <10 |
| Salinity (ppm) | - | 390 | 195 | 195 | 350<br>Rain = 50 |
| pH | - | 7.4 | 7.8 | 7 | 7.4 |
| phosphates (mg/L) | - | 0.215 | 0.215 | 0.215 | 0 |
| Nitrates (mg/L) | - | <0.22<br>15 | 0 | 0 | 1.772 |

The way we recorded the data was we took a water samples from all different bodies of water in the wetlands, and once we took them to the main education center, we searched for the macrovertebrates in the water and then later took them out and put them in a dish to later review them under the microscope.

*Table 2: Aquatic macroinvertebrate habitat comparison – a biological survey of the Urrbrae Wetlands was completed and the richness of aquatic macroinvertebrates present at different habitat areas was compared. This included:*

- *Vegetation vs no vegetation*
- *Shallow or deep water (from the bank or from the jetty)*
- *Inlet and outlet areas*

This will enable you to see the total result across the wetland and compare individual sites.

| Common Name | Habitat type 1 Board walk no vegetation | Habitat type 2 Main Pond with vegetation | Habitat type 3 Sediment pond – edge but low amount of vegetation | Habitat type 4 Outlet with vegetation |
|---|---|---|---|---|
| Water flea - NR | 1 | 1 | | 1 |
| Copepod - NR | 1 | | | 1 |
| Seed Shrimp - NR | 1 | | | 1 |
| Stonefly Nymph – 10 | | | | |
| Mayfly Nymph. – 9 | | | | |
| Caddisfly Larvae – 8 | | | | |
| Riffle Beetle Larvae – 7 | 1 | 1 | | |
| Water Mite - 7 | | | | 1 |
| Marsh Beetle Larvae – 6 | | | | |
| Crane Fly Larvae - 5 | | | | |
| Biting Midge Larvae – 4 | 1 | 1 | | |
| Freshwater Limpet – 4 | | | | |
| Water Strider – 4 | 1 | 1 | | |
| Whirligig Beetle Adult – 4 | | | | |
| Whirligig Beetle Larvae – 4 | | | | |
| Yabby – 4 | | 1 | | 1 |
| Crawling Water Beetle - 3 | | | | |
| Damselfly Nymph - 3 | | | | |
| Dragonfly Nymph - 3 | | | | |
| Freshwater Shrimp - 3 | | | | |
| March Fly Larvae - 3 | | | | |
| Needle Bug - 3 | | 1 | | 1 |
| Non-biting midge Larvae - 3 | 1 | 1 | | 1 |
| Scud - 3 | | | | |
| Small Water Strider - 3 | 1 | | | |
| Round Worm - 3 | | | | |
| Water Measurer - 3 | | | | |
| Water Scorpion - 3 | | | | 1 |
| Flatworm - 2 | | | | 1 |
| Fishing Spider - 2 | | | | 1 |
| Hydra - 2 | | | | |
| Predacious Diving Beetle Adult - 2 | | | | |
| Predacious Diving Beetle Larvae - 2 | 1 | | | |
| Segmented Worm - 2 | | | | |
| Soldier Fly Larvae - 2 | | | | |
| Water Boatman - 2 | 1 | 1 | | 1 |
| Water Scavenger Beetle Adult - 2 | | | | |
| Water Scavenger Beetle Larvae - 2 | | 1 | | |
| Backswimmer - 1 | 1 | 1 | | 1 |
| Leech - 1 | | | | |
| Mosquito Larvae/Pupae - 1 | 1 | 1 | | 1 |
| Pouch Snail - 1 | | | | |
| Springtail – 1 | | | | |
| | | | | |

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Figure 2: Macroinvertebrates collected in the water samples taken.

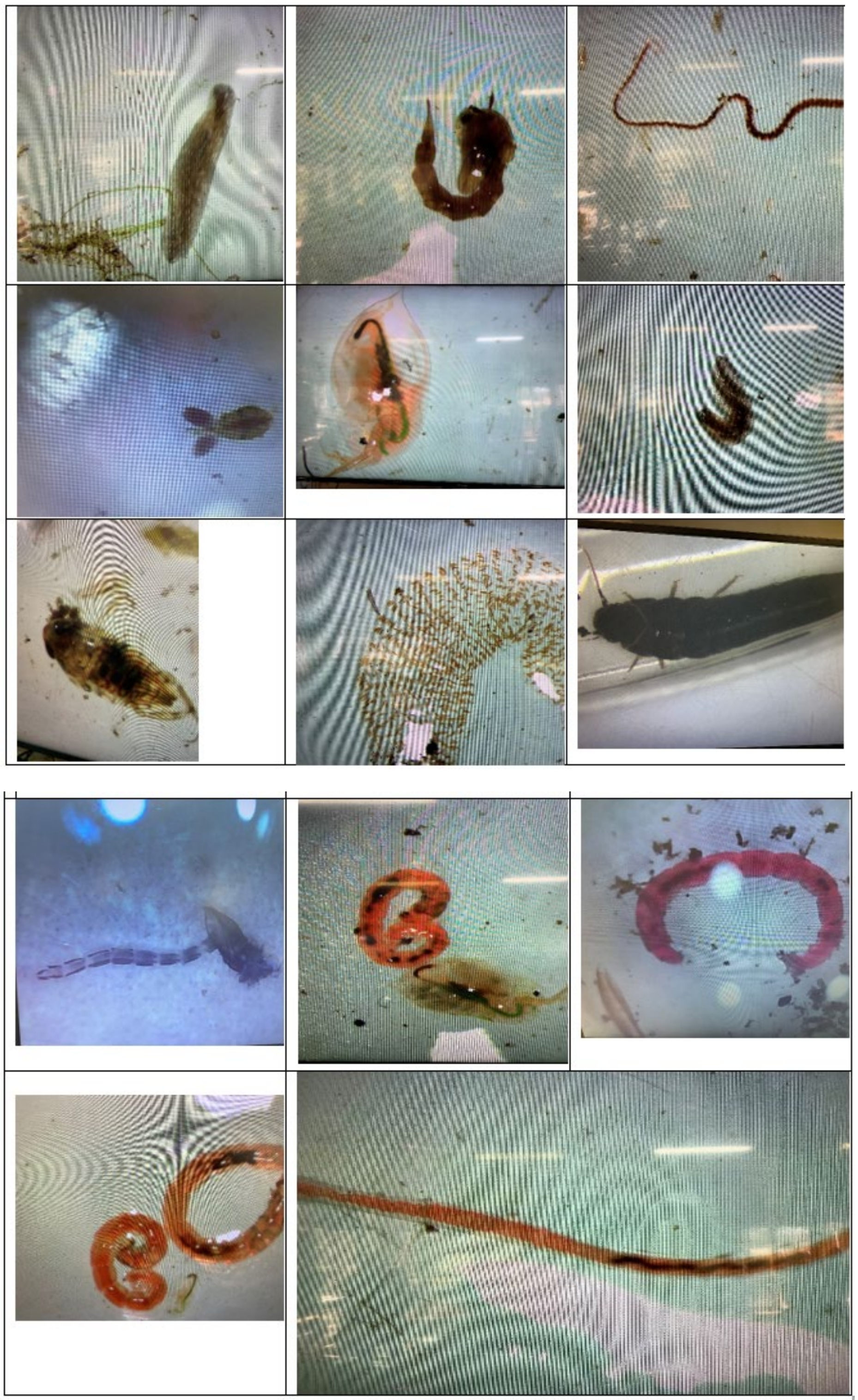
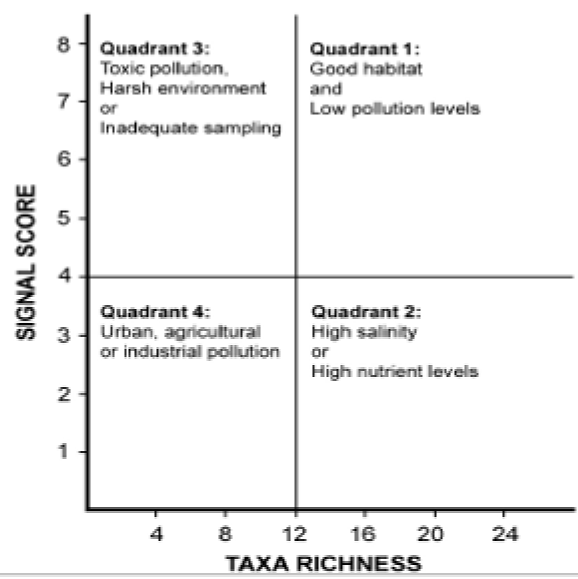


*Table 3: The taxa richness, pollution index and signal score for each habitat tested.*

| | Habitat type 1 | Habitat type 2 | Habitat type 3 | **Total for Wetland** |
|---|---|---|---|---|
| **Taxa Richness** = Number of *DIFFERENT* invertebrates | 12 | 11 | 13 | 36 |
| **Pollution Index** = TOTAL (sum) of all sensitivity ratings | 24 | 31 | 28 | 83 |
| **Signal Score** = Pollution Index DIVIDED BY Taxa Richness | 2 | 2.81 | 2.15 | 6.96 |

*Table 4: Pollution indicator graph can be used to assess the pollution type using the signal score and the taxa richness.*




*Most bodies of freshwater are home to aquatic macroinvertebrates and they all play a vital role in the wetland ecosystem. Aquatic Macroinvertebrates are sensitive to different abiotic factors including chemical and physical conditions within the water such as water flow, salinity, dissolved oxygen, pH, temperature and turbidity levels. Some can tolerate a wide range of conditions while others are very sensitive and can only tolerate narrow ranges. As a result, different species have been assigned a pollution sensitivity rating giving scientists an indirect measure of water quality. The higher the number, the more sensitive the species.* (https://www.urrbraewetlandlc.org/)

How is water quality related to the diversity of macroinvertebrates found in each of the catchment areas?

In catchments, macroinvertebrates play an integral role in determining water quality. Due to their varying tolerance levels of pollutants and environmental conditions, macroinvertebrates, such as insects, crustaceans, molluscs, and worms, can serve as sensitive indicators to water quality.

Different species of macroinvertebrates have different levels of sensitivity to pollutants. This varied sensitivity to pollutants have assisted scientists in the research of catchment areas as they serve as an indicator for water quality. Macroinvertebrates such as mayflies, stoneflies, and caddisflies are highly sensitive to pollution and are typically found in clean, well-oxygenated waters that scientists consider ‘clean’. In contrast, organisms like worms and certain fly larvae can tolerate more polluted conditions giving an indication to scientists that the water quality is affected by pollution to a greater extent. The presence or absence of sensitive species provides a clear indication of the water quality that can be in different catchment areas.

The water quality in a catchment area affects the oxygen levels, which can determine how many ‘sensitive’ macroinvertebrates there are creating which creates an opportunity for scientists to understand water quality. In general, high-quality, and cleaner water will have higher dissolved oxygen levels, which, in turn, will support a wider diversity of sensitive oxygen-dependent species like macroinvertebrates in the water. Some examples of these macroinvertebrates are mayflies, stoneflies, and caddisflies, which are intolerant to polluted water but show up in more oxygenated water, showing the connection between the two. There is a lower diversity of macroinvertebrates in polluted waters because bacterial decomposition occurs more often in polluted waters, resulting in lower oxygen levels in polluted waters as well.

Excess nutrient levels in catchment areas can cause eutrophication, this is the process of excessive growth algal growth. When surface runoff from nearby agricultural land becomes too severe, Eutrophication can cause a decline in macroinvertebrate diversity. Fertilizers like nitrogen and phosphorus can cause excessive algal blooms, which can reduce the quality of the water and oxygen levels for animals that are intolerant to these substances. The excessive growth of algae causes many water bodies to become dead zones, as they no longer have macroinvertebrates to decompose matter into food, leaving other animals hungry and starving.

Monitoring macroinvertebrate diversity and survival in catchment areas provides valuable insights into water quality. High diversity and the presence of sensitive species in a catchment area generally indicate good water quality, while low diversity and dominance by tolerant species suggest the water quality in the area is poor. Therefore, assessing the macroinvertebrate community is a practical and effective method for gauging the health of aquatic ecosystems and can be done by citizens of non-scientific communities.

Looking at the data its shows us that water quality can vary depending on its environment and can have significant impacts on macroinvertebrates. This is evident through the change of macro invertebrates lives between different environments. Evidence of this can be shown through the records from the Urrbrae wetlands.

Habitat 1: *Cross Rd Sed. Pond*

Habitat 1 (Cross Rd Sed. Pond) had a temperature of 13.2, oxygen level of 4.3, turbidity of 20, salinity of 390, pH level of 7.4, phosphates of 0.215, and nitrates level of sub-0.05<. From the data given, the only unexpected result is the temperature being slightly below average which might be a result of the weather at the time the data was recorded. There is an increase in phosphates to 0.215 mg/L which is supposed to be below 0.07 mg/L is well above the average. This data has resulted in a macroinvertebrate population varying due to the results which can be seen in table 2. This resulted in the signal score sitting in Quadrant 2 which identifies high salinity and high nutrients.

Habitat 2: *Main Pond*

Habitat 2 (learning centre) had an approximate temperature of 14.6, an oxygen level of 3mg/L, a turbidity of 40, a salinity of 190, a pH of 7.8, 0.215 in phosphates, and no recorded nitrates. The data showed that the only results that was abnormality were the temperature being slightly below average, the oxygen being deficient and phosphates being very high. This data has resulted in a varying macroinvertebrate population due to the environment which is recorded and shown table 2. This resulted in the signal score sitting in quadrant 2 which identifies high salinity and high nutrients.

Habitat 3: *The Outlet*

Habitat 3 (the outlet) had a recorded temperature of 14.7, an oxygen level of 3.7mg/L, a turbidity of <10, a salinity of approximately 200, a pH of 7, no recorded nitrates, and a phosphates level of 0.2149. The results of the data showed that temperature and oxygen levels were slightly below average while, phosphate levels were over 3 times the average. This data has resulted in the macroinvertebrate recorded in each habitat varying which can be seen in table 2. This resulted in the signal score sitting in quadrant 2 which identifies high salinity and high nutrients.

In a comparison of all Habitats, the results of all habitats showed many similarities and what that means for the future of the water quality and the health of the Urrbrae wetland. The results between all habitats showed that all temperature levels were slightly below average but with these results being recorded during winter in which temperatures drop it is nothing alarming. Something alarming was the phosphates level being almost 3 times the stable amount. ''If Phosphates levels are high it can lead to algal blooms blockage of sunlight needed by organisms and plants in the water and degraded habitat conditions for benthic macroinvertebrates and other aquatic life'' (according to the EPA United States Environmental Protection Agency n.d). This can also lead to the dissolved oxygen levels which has drastic impacts on macroinvertebrates and other life in the wetlands which is evident through the data shown showing lowering oxygen levels across all Habitats tested.

As seen from the information above there are high phosphate levels throughout the wetlands which can be shown through the signal score as it sits in quadrant 2 showing high phosphate levels. The reason phosphate levels are drastically increasing is due to aspects such as water flow waste, and plant decomposition which are natural but human-introduced things such as fertilizer, pet waste, agricultural and urban runoff, and industrial and domestic sewage have also shown from past events that they have had a drastic impact on wetlands life. In summary, the overall health of the wetlands from the results has shown a balanced environment in many aspects. The increase in phosphates has started to impact other parts of the ecosystem in the wetland such as a lowering in oxygen which with increasing phosphates stays a threat to macroinvertebrate life and other lifeform life meaning that action must be done to preserve the future of the water quality and the health of the Urrbrae wetlands.

## Relevance and Impact of the Results

This investigation helped us understand the importance of wetlands and how various organisms thrive in these environments. It also highlighted the impact and consequences of human actions on smaller ecosystems. The results provided insight into how litter entering catchments can harm organisms and how climate and temperature are crucial for maintaining habitats.

By analyzing the data we collected, we can better understand how to mitigate the damage that wetlands receive. Even minor changes can significantly improve the health of our ecosystems and benefit society. For instance, by reducing pollution and implementing better waste management practices, we can protect these vital habitats and ensure they continue to support diverse species.

## Future Investigations

Future investigations could focus on long-term monitoring of wetland health to track changes over time. Additionally, studies could examine the effectiveness of various conservation strategies to find the most effective methods for protecting and restoring wetlands. By continuing to engage in citizen science projects, we can contribute valuable data to these efforts and help promote the sustainability of our environment.

## Future Directions

Citizen science projects are a great way to educate people about environmental matters, like keeping wetland ecosystems healthy. They also help provide important information and statistics that can help environmental organisations. This information helps the organisations to gain a better understanding of how we can help different wetlands and improve their health in the future. Besides citizen science, there are many other ways we can protect wetland ecosystems in the future. A great suggestion would be to start volunteer projects for local communities to bring people together and provide people with a sense of ownership over the local environment through empowering communities. Making sure to educate people on the importance of wetlands is also important to keep the ecosystems healthy. This could be through social media or through teaching students at school. All these are ways that we can protect the unique biodiversity and keep the water quality good in wetland ecosystems.

## References

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*Please note: Each individual section of the report was written by different groups of students in the class without any assistance. However, ChatGPT was used to refine the way the report read using the student's work (https://chatgpt.com). This was used to unify each section, taking into account the different writing styles of the students that contributed.*