Lake Joondalup Environmental Impact Statement

Introduction

Lake Joondalup is in the Yellagonga Catchment Area, which lies on the Swan Coastal Plain and is located roughly 20 km north of central Perth. An area of about 400 hectares extends to the surface water catchment area, which impacts on the park. The catchment is linked to the park by surface flows via drainage infrastructure and groundwater flows and surrounds land on either side of the park located in the Cities of Joondalup and Wanneroo, and includes medium to high-density residential, commercial and light industrial development diversified with green areas. Lakes Joondalup and Golleal, and Beenyup and Walluburnup swamps, are the aquatic environments that receive water from the catchment through surface and groundwater flows.
The government has proposed a plan to manufacture a four laned bridge across the middle of Lake Joondalup, linking Wanneroo and Joondalup together, which will aid in easier access to Joondalup and will cut traveling times by a few hours. Is it estimated that the bridge will be crossed by cars, trucks, and buses approximately 52,000 times per day. Therefore, must be durable to withhold the necessary weight. Thus, it has been estimated that 900m^3 of mud, soil and rock will need to be removed in order to place 6 large pillars, which will be used for the bridge to sit on. Once the mud, soil, and rock has been removed, it will be left to dry for a month in order to fill with concrete. The bridge will be completed over the course of 20 months.

Variables

The independent variables in this case, is the year of each sample taken. The samples were collected every 3 years over the course of 20 years. This included years 1999, 2001, 2004, 2007, 2010, 2013, 2016, and 2019.
The dependent variables are what were being measured using samples from the water. This included the abundance of macroinvertebrates in the water, temperature (°C), pH levels, salinity(ms/cm), turbidity(NTUs), dissolved oxygen(%), phosphates(Ppm/mgL), petroleum(mg/L), and nitrates(Ppm/mgL).
The variables that will be controlled includes the time of the day, as it can alter the temperatures of the water, which affects the water quality, and must therefore be investigated during an appropriate time of day. For example, collecting the sample on a sunny day when the temperature of water is neutral. The time of year can also affect results, as the season changes every 3 months, thus, altering the water quality and resulting in an increase of decrease of data. Lastly, the area that the water is collected must remain the same through each sampling years, as that area might be more or less abundant with macroinvertebrates and will give a more accurate outcome for a longitudinal design of research.

Results

There is an outlier among the data recorded for the abundance of macroinvertebrates. Which can be seen in graph 3, as it shows the abundance of the Water Boatman increasing by 40, reaching it's peak, in the year 2010, while at the same time, macroinvertebrates Stonefly nymph, Damselfly nymph, Water mite, Dragonfly nymph, Caddispfly larvae, and Ostracod all decreased to 0. This may have happened because it's predator may have not been abundant enough to control the abundance of the Water Boatman, thus, leading it to over-populate.

Analysis

The number of species of predatory invertebrates recorded can be used as an indication of the state of the aquatic food chain.
Graph 1 includes data of salinity, turbidity, phosphates, and nitrates. When plotted into the graph, the turbidity, nitrates, and phosphates all seem to be within the same range with no outliers, indicating that the levels are normal, as they begin to increase more after 2010. The increase in turbidity might be due to the movement of the particles in the water from rain, boats, wind, or people in the water. The increased nitrates might be from an overuse of chemical fertilizers, or improper disposal of human and animal waste. The salinity remains on the lower side of the graph, with its values remaining within 2 - 3 ms/cm. An increased level of salinity may be due to an accumulation of salt from rainfall over many thousands of years or from the weathering of rocks. In this case, there aren't much rocks and erosion that occur near the lake to result in accumulated salts, which may have helped to maintain the salinity level.

Graph 2 includes data of temperature, pH levels, dissolved oxygen, and petroleum. The temperature remains within 21 - 24 °C over the years, as it peaks to 24.2°C in 2019. This indicates that there is no harsh change to the temperature of the water and has increased by a few degrees over the years, possibly due to climate change, which began to be more noticeable since 2016, as shallow waters are quicker to heat up.
Graph 3 shows the abundance of macroinvertevrates that was collected from samples every 3 years. Water Boatman showed to peak over 100 in the year 2010, while macroinvertebrates Stonefly nymph, Damselfly nymph, Water mite, Dragonfly nymph, Caddispfly larvae, and Ostracod all went down to 0. Considering that a variety of macroinvertebrates decreased, they may have posed a threat to the Water Boatman, causing the Water Boatman to increase rapidly as the threats were limited. The cause of the rapid decrease in abundance of the macroinvertebrates that went down to 0, may have been due to a change in the water quality, as graph 1 shows that in 2010 turbidity, nitrate, and phosphate levels all increased rapidly, comparing to 2007. Graph 2 shows that in 2010 pH levels and dissolved oxygen decreased from 1.0 in 2007, to below 0.5. There was also a rapid increase of petroleum In 2010 and stayed at approximately the same level after that. Stonefly nymph, Dragonfly nymph, and Ostracod began to increase again after 2013. Whereas the Damselfly nymph increased rapidly after 2010. The Ostracod did not have much abundance to begin with, as it started with an abundance of 7, and began to decrease shortly after 2001, and increased again in 2019 with an abundance of 6.
The proposed bridge will affect the abundance of some macroinvertebrates, such as Ostracod, Water Mite, Stonefly nymph, and Caddisfy Larvae, which are the species that are already under threat. Macroinvertebrates such as Springtail, Damselfly nymph, and Water Boatman already have a high abundance and do are not as threatened. However, if macroinvertebrates Stonefly nymph, Damselfly nymph, Water mite, Dragonfly nymph, Caddispfly larvae, and Ostracod begin to decrease again, it may result Water Boatman macroinvertebrates to over populate and exceed the carrying capacity of the lake.
The construction of the bridge will cause the underwater sediments to mix and increase the turbidity rapidly, which will cause the macroinvertevrates to stress.
The wetlands in the park serve as an important breeding ground and summer refuge for a diverse bird population, some of which are trans-equatorial migratory wading birds. A way to maintain the population of indigenous birds and macroinvertebrates in this environment is to, introduce seasonal mowing areas and areas not to be mown to preserve bird, and other habitat and breeding sites, inform residents about the effects of the dumping of animals and fish in the wetlands systems, and lastly, to develop and implement a strategy to minimise wildlife deaths on roads adjoining the park. This means that the proposed bridge will act as a threat on not only macroinvertebrates, but other fauna species too, including birds, reptiles and fish, as it will cause a disruption in the water quality, affecting the overall species within it's surroundings.
As the bridge will help people to travel easier through Waneroo to Joondalup and will cut down the traveling time, it will also threaten the abundance of the fauna, which may lead to a high mortality rate or over population.

Validity and reliability

The reliability of the samples are not very reliable, as the samples are taken every 3 years, which results in varying data records, as there a many abiotic changes that happen over these years. To increase the reliability of the data, the samples can be collected and investigated twice every year, to ensure that there is no harmful threats impacting the quality and life in the lake. This also allows researchers to see any sudden changes in the data and will allow for further investigation in time.
The report was successful in measuring what was intended to measure using the variables temperature, pH, salinity, turbidity, nitrates, phosphates, dissolved oxygen, and petroleum.

Mitigation

The builders need to take into consideration the animals within the environment and surroundings. Animals use sound for a variety of reasons, including to navigate, find food, attract mates, and avoid predators. The sound pollution that will be caused from machines will disturb these regimes and will cause them to stress. Builders may only keep the lights on from 9pm to 12am and they need to ensure that they are putting in remediation methods after the construction of the bridge to make sure any disturbances in the environment is being restored.
To maintain the population of macroinvertebrates and to increase the population of those threatened, the 50 / 500 rule can be applied. 50 of the macroinvertebrates can be collected and

kept under supervision in a tank that replicates the lake's environment. When the bridge has been completed, the macroinvertebrates can be realeased back into the water, without a risk of having a low abundance rate.

Evaluation

The durability of the soil may not be strong enough to withhold the weight of a four laned bridge, and might result in it collapsing or the pillars might slowly start to erode. This may be a huge factor that may impact the infrastructure of the bridge and is a limitation.

The data needs to aim to look at the quality of the soil too, to be able to determine its strength and durability. To maintain the biodiversity of macroinvertebrates, builders can put in less than 6 pillars, and instead make them more wider to provide more support, and at the same time not threatening abundance of macroinvertebrates within the entire river.

Conclusion

The information suggests that the abundance of fauna will be under threat, and can lead to a rapid mortality rate, and some over populating.

Through consideration of the factors including water quality and macroinvertebrates, the proposal of the bridge cannot go forward and is therefore rejected. Many of macroinvertebrates are already under threat and can face extinction due to changes in the water quality, such as the mixture of underwater sediments, the increased nitrates and phosphate levels, which the construction of the bridge will cause. Macroinvertebrates including Dragonfly nymph, Damselfly nymph, Ostracod, and Water Mite are more likely to be less abundant over the years as they are most under threat. The wildlife birds will also be disrupted as the floodlights at night and noise pollution can disrupt their daily food hunting regimes.