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# 2. Introduction

The physical geography of Lake Kate Sheppard (LKS) is of particular interest to the Avon-

AvON is a network of individuals and organisations with a vision of creating a natural reserve from the Residential Red-Zone around the Avon River. AvON aims to restore and re

This project was supported by Bryan Jenkins, representing the Avon-, and technicians from the University of Canterbury Geography Department, specifically Justin Harrison.

## 3. Theoretical framework and literature review

Literature reviews were focused on investigating hydrological dynamics of water bodies in similar situations to LKS. The AvON does not have any current LKS hydrology information, therefore it was important to find literature of all aspects related to LKS. However, lake research for this project was primarily experimental and finding literature to support the process was challenging. The majority of literature used for this project is referenced during results analysis.

Barendregt & Swarth (2013) produced a report on the dynamics of tidal freshwater wetland systems. LKS is affected by tidal input from the Avon River, the information about

## 5. Results

*Figure 1* shows the tidal influence seen within LKS for August, maximum height was 900mm, on August 15th, and minimum was 29.4mm, on August 26th.

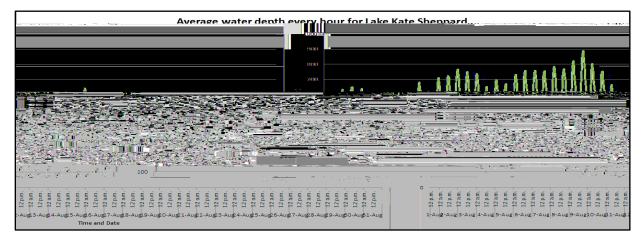


Figure 1.CT2X water height measurements over the month of August.

*Figure 2* shows LKS water height changes from 1st to 24th September, with a minimum of 72mm and a maximum of 832mm.

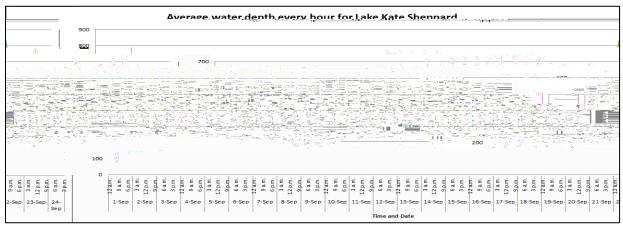


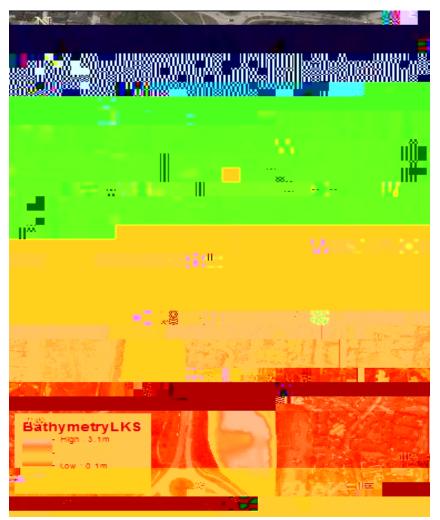
Figure 2. CT2X water height measurements during September.

*Figure 3* shows conductivity and water depth measurements for LKS during a period in August, the largest flux in conductivity is during the 15th to 16th of August.

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*Figure 5.* A 3-D side view of LKS bathymetry, illustrating the deeper southern basin and the shallow northern reaches, captured using a jet boat containing a 500 Tri-Tex echo sounding radar and Trimble R8 GNSS surveying system.



*Figure 6.* Plan view of raster surface draped over aerial image. Green indicates ground covered in interpolation; yellow, pink, to white indicate lake bathymetry.

*Table 1* shows the results of the volumetric analysis. The surface area of LKS was calculated to be 42, 210.8 m2, and the water volume was calculated to be 31,102.8 m3. This volume represents the specific tidal period during data collection.

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*Table 1.* Volumetric analysis results from LKS Note, this includes the area covering land (refer to Figure 6 for coverage extent).

5.3a. CT2X continuous measurement

The CT2X measured water temperature every 10 minutes from the 1<sup>st</sup> of August to the 24<sup>th</sup> of September 2014. *Figure 7* over the hour.

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*Figure 9* shows average daily water temperature for the entire study period 1st August through to 24th September.

Figure 9. The average daily water temperature of LKS during the entire study period from

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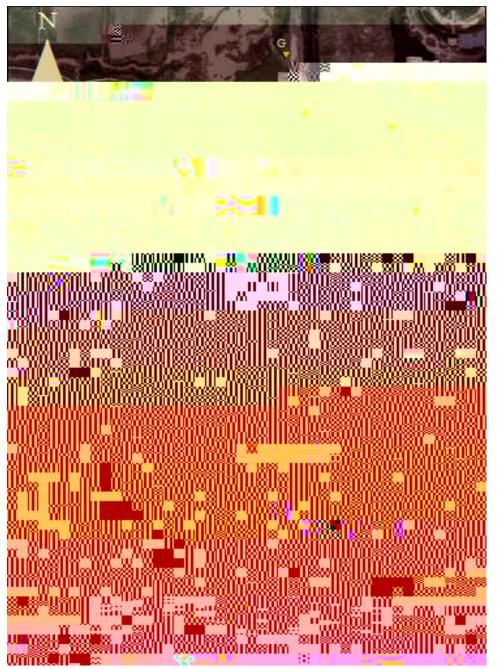


Figure 10. Values A-Jrepresenting the MANTA2 spot-testing locations.

Where MANTA2 spot-testing occurred, temperature, conductivity, dissolved oxygen, pH, nitrate, and oxidation redox potential levels were measured. This data is presented in *Table 2*.

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	Hydrological Charact					s of Lake Kate	
device.	Table 2. The measured variables from the spot-testing locations in a					und LKS using t	
Value	Location			DO (mg/ L)		NO3(mg/L)	
А		9.47	1460	12.33		3.5	
В	Avon Culvert	9.51	1549	10.45		3.7	
С	Avon River	9.4				3.7	

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Conductivity: Figure 12 shows conductivity in LKS Red represents the higher, while blue represents lower con

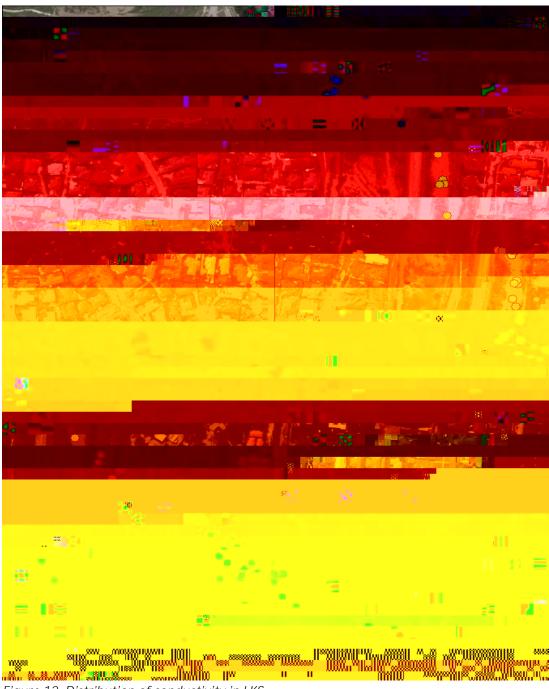


Figure 12. Distribution of conductivity in LKS.

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Oxidation Redox Potential: Figure 16 shows the oxidation reduction potential (ORP) levels recorded in LKS Red represents the lower (and negative) values, while yellow represents the higher (and positive) values. The maximum recorded value was 149 mV, and the minimum ORP value was -57 mV.



Figure 16. Distribution of ORP levels in LKS.

related to warming air temperature (Stenseth et al., 2002). *Figures 7* and 8 show how average water temperatures oscillate over a 24-hour period, warming throughout the day.

#### southerly. The warmest temperature was

2014). It can be inferred that the water temperature of LKS will continue to increase during summer. The maximum rang

completely below the waterline during testing; the lowest tide recorded 10 mm over the sensor plate, however the shallow water height would have absorbed and emitted more radiation, resulting in greater temperature flux.

#### Eureka MANTA2 spot and continuous-testing (Table 2):

The locations were chosen to represent the relationship of LKS and the surrounding water bodies. Spot and continuous testing was completed during high-tide. The continuous testing was completed over a two hour period and while the measurements only characterise a specific time period, the data is representative of the general spatial distribution of variables within the lake. Each variable is discussed below;

*Water Temperature (Figure 11):* The warmest temperatures are located in the northern section of the lake. The shallow and narrow channel holds less volume; warming faster than the southern basin. The colder temperatures in the south are also influenced by influx of cooler water from the Avon River during high-tide.

Spot-testing reveals that river water temperature was warmer than LKS upstream from the culvert (*Table 2*). This was due to the effect of urban heat island from the central city (Li et al., 2004).

*Water Conductivity (Figure 12):* The highest surface water conductivity is found at the Avon River culvert; the only source of saline water into the system. Levels gradually decrease moving north, increasing with distance from the culvert. It is important to note that conductivity increases with depth; saline water has a higher density. Measurement of the entire water profile would show a different conductivity spatial distribution in LKS. This may explain why conductivity is less in the shallower northern areas; the saline water is more likely to pool in the deep southern basin, pushing less saline water upwards to flow north. Spot-testing of conductivity (*Table 2*) showed there is varying levels throughout the surrounding water body system. This shows how conductivity levels are influenced by tidal changes, dilution from rainfall and depth.

*Dissolved Oxygen (Figure 13):* The dissolved oxygen (DO) level in water bodies is important for sustaining aquatic life (Utah State University, 2014). When DO levels drop below 5.0 mg/L the environment is considered to be stressed (Utah State University, 2014). DO levels

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The temperature readings show that LKS has a reasonably large temperature range during the winter and spring seasons (*Figure 7 & 8*). These temperatures create a range \_nanga spawning and

the development of juvenile nanga occurs over the summer period, between spring and autumn (Richardson & Taylor, 2002). *Figure 8* displays a warming trend, it is likely that nanga over the

summer season.

The near neutral pH profile of LKS (*Figure 14 & Table 2*) provide favourable conditions for nanga.\_nanga do not spawn in pH 10.5 and above (Richardson & Taylor, 2002).

Previous experience with equipment was limited. Foreknowledge regarding appropriate times, locations, and methods for data collection may have assisted in time saving. Therefore, more relevant data may have been collected.

Time was a large determinant in the research. With more time, a greater quantity and quality of data could be collected.

Considering the limitations listed above, the conclusions drawn from this research

## 7. Conclusion

Investigation revealed significant tidal oscillations in Lake Kate Sheppard. These fluctuations were mirrored by changes to various aspects of water quality, in particular salinity. Temperature, conductivity, dissolved oxygen, pH, nitrate and oxidation redox potential levels showed various spatial distribution patterns, affected by changes in bathymetry. A bathymetric map was produced of the lake, this revealed a deeper southern basin and tidal island. The lake gradually becomes a shallow channel moving northward. The total volume of Lake Kate Sheppard during a high-tide is 31,102 m<sup>3</sup>. Lake Kate Sheppard is linked to a larger waterway network; there are culvert connections to the Avon River, Travis Wetland, and Anzac Drive Reserve.

These findings are base-line representations of the hydrological characteristics in Lake Kate Sheppard. This will supply the Avon Network with initial hydrological

required to ensur

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### 8. Acknowledgments

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