Is there any spatial variability of soil types, plant species & terrain characteristics within Riccarton Bush, and is it linked to the inefficiencies of the current irrigation system?

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GEOG309: Research for Resilient Environments and Communities

October 20, 2023

1.0 Execu t ve Summary

- Pūtaringamotu/Riccarton Bush is a small remnant Kahikatea Forest of the ancient Canterbury plains, that holds

2.0 Introduc t on

Riccarton Bush is a site of profound historical, cultural, and ecological signi f cance, which has undergone substan t al transforma t ons in recent years. These transforma t ons include the reduc t on of its forested expanse and the diversion of natural springs, resul t ng from more than a century of drainage and urban development. Consequently, the ecosystem has become signi f cantly drier than its original, moisture-rich condi t on. Over the last three decades, the Riccarton Bush Trust has proac t vely employed irriga t on to restore and recreate the moisture-rich condi t ons that once characterised the environment. Nevertheless, the exis t ng irriga t on system faces substan t al challenges and exhibits signs of deteriora t on, resul t ng in ine f ciencies in water resource management. A signi f cant limita t on of the current system lies in the fact that it causes pooled surface water throughout the bush, meaning the ranger must delegate a signi f cant amount of his t me to monitoring the standing surface water levels in the bush.

This research is dedicated to iden t fying whether there is any spa t al varia t on in soil types, vegeta t on species and terrain features within the bush, which may be associated with irriga t on ine f ciencies. The approach is rigorous and systema t c, incorpora t ng core and auger sampling techniques, followed by par t cle size distribu t on analysis facilitated by a Par t cle Size Analyser. The primary objec t ve is to unravel the intricate correla t ons between varia t ons in soil proper t es and their corresponding par t cle size and their ensuing hydrological impacts on the surrounding vegeta t on. This report aims to provide a comprehensive understanding of the Riccarton Bush. context and objec t ves of our research, encompassing a literature review, methodologies, results, and a discussion to contribute valuable insigh ű ʻ th ƽ ace

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A map of the site from Molloy (1995) served as the basis for a systematic partitioning into

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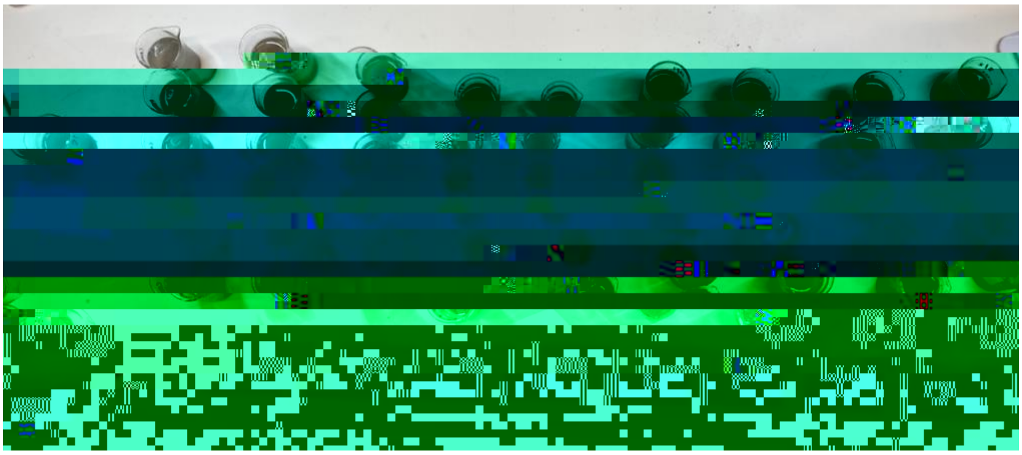
Like the core methodology, the auger was positioned perpendicularly to the ground. A controlled rotation initiated the auger’s penetration into the soil, achieving a depth of approximately 15 centimetres each time. Extracted soil was carefully removed using a



There were two methods available to analyse the samples. The first proposed method was a pipette analysis of muds from analytical sedimentology (Lewis & McConchie, 1994); this involves using a hydrometer, which would produce useful data on grain size. However, this method is time-consuming and takes more than 8 hours to complete per sample; it was therefore unreasonable to use due to the time restrictions of this project.

The other method utilises a Particle Size Analyser (PSA), a digital-based method centred around the distribution of particle sizes for a given sample. The PSA machine used was the Mastersizer Hydro LV 3000 (MSLV) in the University of Canterbury's civil engineering soil lab (Figure 7). The MSLV utilises Mie's theory of laser diffraction (Malvern Panalytical, 2021) to determine the distribution of particle sizes in each sample - this was the method chosen.

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Figure 8 shows the average sediment particle size against their relative abundance (%) in each of the 10 samples taken from Riccarton Bush. The average distribution curves were generated in excel via MasterSizer data processing and sorting of the volumes of each particle size at each incremental sample and calculating the average for the entire sample.

The curves observable in Figure 8 indicates that the particle size distribution of all the core samples is uniform. Eight of the ten core samples display a mean particle size value of 6.5-7.5 Phi. The AMS Core 3 and Auger 3 samples display lower mean values of approximately 5-5.5 Phi. The lower displayed mean value of these samples indicates a greater quantity of coarser sediment particles present in the two sample sites. The standard deviations associated with each of the 10 samples (Appendix D) returned values of greater than 1 for all. Values greater than 1, relate to and correspond with poor sorting characteristics of a medium.

Due to dense tree canopy, the LiDAR data lacked accuracy for bare earth returns. While the data identifies a higher elevation side, this change is minor at the Riccarton House side of the bush. A more accurate small-scale analysis of topography could assist in explaining differences in soil moisture content. In the context of this project, it is unrealistic to try to gather primary LiDAR data of Riccarton bush. While a total station would be a reasonable way to gather a topographic profile, Riccarton bush is too densely vegetated for an unobstructed path from the total station to the reflector when taking these measurements. Terrestrial laser scanning (TLS) solves the dense tree canopy issue by achieving the accuracy of LiDAR. It can be taken under the tree canopy, providing the spatial resolution that cannot be achieved with standard airborne LiDAR collection. (Baltensweiler, et al, 2017).

7.0 Conclusions

Finally, the distribution of surface water present in Riccarton Bush after periods of irrigation and rain is not significantly influenced by soil or vegetation distribution themselves, as these appear constant. However, a possibility could be that a combination of ineffective irrigation not accounting for plant needs and water infiltration impedances due to the soil density is the issue.

8.0 Recommenda t ons

The f ndings from this report must be made clear to the community partner and the engineers tasked with designing and establishing a new irriga t on system. The GIS Map results provide a concise and comprehensive overview of soil, plant, and terrain features and results. By making this informa t on easily accessible, projects of a similar nature can u t lise the pre-exis t ng informa t on—lastly, some future sugges t ons for the community partner to consider for inclusion in Riccarton Bush.

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The current rotary sprinkler system in Riccarton Bush provides a uniform water distribu t on and is typically set to run for an unspeci f ed amount of t me-based on the weather. Alterna t ve sprinkler heads, such as targeted drip irriga t on or mis t ng sprinklers, could be more e f ec t ve, as some plants poten t ally demand less or more water than others. Drip irriga t on delivers water directly to the plant's root zone, ensuring that each plant receives su f cient water, whilst mis t ng sprinklers can replicate a damp, rainy climate. Likely bene f ts include increased t me and water e f ciency and the ability to become automated.

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