CARBON ASSESSMENT REPORT

Tunley Engineering

"Engineering A Decarbonised Future"

University of Essex

TUNLEY ENGINEERING®

Land Sequestration Report

for

The University of Essex

December 2022

Contents

Nomenclature 4
Executive Summary 4
Introduction 4
Methodology 6
Carbon Sequestration Data 7
Suggested Improvements 8
Overview 8
Re-Wet Marshland (96 tCO_2e/yr) 8
Grass – Best Management Practices (57 tCO_2e/yr) 8
Tree Planting (50 Trees = 0.75 tCO_2e/yr) 8
Conclusion 8
References 9
Tunley Engineering's Report Emission Statement 9
Approval (Internal use only) 10
IMPORTANT NOTICE: 11

Nomenclature

Carbon Equivalent is the effect on global warming of a greenhouse gas (GHG) relative to that of CO_2.

Scope 1: Direct GHG emissions are those that occur from sources that are owned or controlled by the company such as emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc., emissions from chemical production in owned or controlled process equipment.

Sequester: Capturing and storing carbon dioxide. Often expressed as CO_2e per year.

$kgCO_2e$ is the notation for kilograms of carbon dioxide equivalent emissions.

tCO_2e is the notation for tonnes of carbon dioxide equivalent emissions.

Executive Summary

Climate change poses a significant challenge to the environment, necessitating mitigating measures at international, national, and local levels. It impacts businesses, natural systems, and communities. This is caused by global warming as a result of an increase in greenhouse gas (GHG) emissions, known as carbon emissions.

The University of Essex has requested an assessment for the quantity of CO_2e absorbed by university owned land (sequestered) per year. This report has reached a figure of 424 tCO2e/yr. This includes suggested changes in land management practices which would increase this figure by 154 tCO_2e/yr. If fully implemented, the University of Essex would be able to sequester 578 tCO_2e/yr. In a business carbon assessment for the University as a whole, these sequestration values would be covered under scope 1 as an emission sink, effectively acting as an offset against the emission sources.

Introduction

Tunley Engineering was approached by the University of Essex to quantify the amount of CO_2e sequestered by Land owned by the University of Essex on an annual basis. Furthermore, Tunley Engineering were tasked with identifying any opportunities to increase the CO_2e sequestration. Understanding the sequestering capabilities of owned land could contribute to a wider assessment of the whole University's carbon footprint.

Where information and data were limited, Tunley Engineering made reasonable assumptions based on our expertise and external sources of data; Tunley Engineering discussed the assumptions with the University of Essex to ensure data accuracy.

The University of Essex have identified land types owned by the University. These include marshland, green mowed grass, heathland, lakes, and sports pitches. These are summarised in Figure 1. Furthermore, a tree survey previously has identified 2372 trees, which are also included in this report.

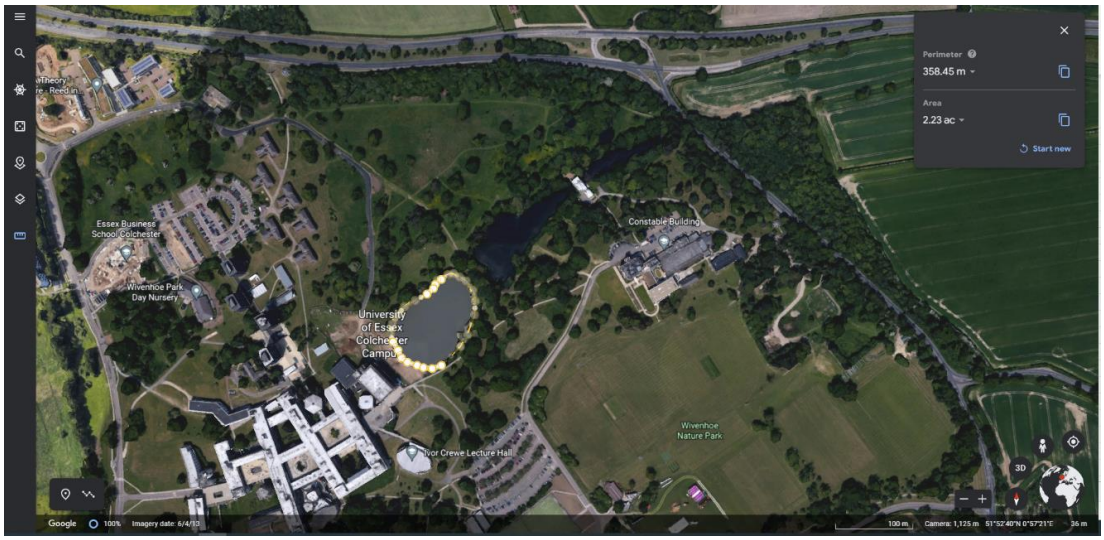
Figure 1: Schematic of different land areas

Methodology

This assessment was completed as a unique study for the University of Essex. Various resources, mainly scientific papers, were consulted to ascertain the most realistic sequestration values for different land types.

Google Earth was used to ascertain land area values, with the example of the furthest southeast lake given in figure 2.

Figure 2: Southwest Lake area shown on Google Earth



Scientific literature estimates CO_2e sequestration properties for each land type, however, this is widely variable. For example, weather, climate, local biodiversity, predator population, foot traffic, fertiliser usage, mowing frequency, soil moisture content all have an impact on these values. Other reasons are outside the scope of this report. The consequence of this variability is a wide range (for example 72% for marshland).

This large range is also applicable to the suggested changes in land management practices. Despite these ranges, the changes in land management practices will certainly be beneficial and increase the sequestered carbon by University of Essex land.

Values for carbon sequestered per unit area for marshland, grass, heathland and lakes were obtained from scientific papers[1]–[4]. The figure of 15 $KgCO_2e$ per tree is from Dr Richard Kipling from the University of Aberystwyth[5].

Carbon Sequestration Data

The total CO_2e sequestered per year has been calculated by multiplying the amount of CO_2e sequester per hectare by the area. These figures are summarised in Table 1.

Table 1: Area and sequestration values

Land Type	Area (Acres)	Sequestered tCO_2e/Yr	Range %
Marshland	47	155	72
Green Mowed Grass	94	159	70
Untouched Heathland	15	7	41
Lakes	134	0.48	N/A
Mowed Sports Pitches	40	67	70
Trees	2372 Trees	36	35
Built Area	24	0	N/A
Total	**229**	**424**	**66**

The total amount of CO_2e sequestered per year equates to 424 tCO_2e.

Suggested Improvements

Overview

An examination of scientific literature yielded three options viable for the land owned by the University. No suggestions for lakes or heathland were identified, however marshland, mown grass and the trees could all sequester more carbon

Re-Wet Marshland (96 tCO_2e/yr)

Re-wetting marshland would have the largest impact of any measure the University of Essex could undertake. This is because wet marshland locks in carbon, and prevents that carbon being lost to the atmosphere upon decomposition. Mason [1]estimates that re-wetting marshland would increase the annual sequestration rate of marshland to be in the region of 5.1 $tCO_2e/ha/yr$. This corresponds to 96 tCO_2e/yr.

Grass – Best Management Practices (57 tCO_2e/yr)

Grass sequesters carbon as it grows, so any process to encourage growth will increase the ability of that grass to sequester carbon. Zirkle [2] suggests using the application of fertiliser and pesticide four times a year, mowing every week and regular irrigation when rainfall is insufficient. The increase in the ability of the grass to sequester carbon ranges from 7% to 298%, depending on climate, how well managed the land already is etc. After discussions with the University, Tunley Engineering understands that the grassland is already well managed with regards to fertiliser, pesticides and mowing. However, Essex has relatively low rainfall (when compared to the rest of the UK). Introducing a suitable irrigation system would increase the sequestration rate by an estimated 25%, correlating to 57tCO_2e/yr.

Tree Planting (50 Trees = 0.75 tCO_2e/yr)

Tree planting sequesters, on average, 15 $KgCO_2e/yr$ [5]. Depending on how many trees the University of Essex plant, this can be multiplied by the number of trees. The example of 50 trees results in 0.75 CO_2e/yr. This figure was chosen for illustration purposes only. Tunley Engineering appreciated that factors other than sequestered carbon have an influence on land use.

Conclusion

Current total sequestered carbon each year is 424 tCO_2e/yr. When combined with suggested changes to land management techniques, this figure could rise to 578 tCO_2e/yr. These figures have an associated range of approximately 66%.

References

[1] V. G. Mason, K. A. Wood, L. L. Jupe, A. Burden, and M. W. Skov, 'Saltmarsh Blue Carbon in UK and NW Europe-evidence synthesis for a UK Saltmarsh Carbon Code', 2022.

[2] G. Zirkle, R. Lal, and B. Augustin, 'Modeling Carbon Sequestration in Home Lawns', 2011.

[3] C. D. Field, C. D. Evans, N. B. Dise, J. R. Hall, and S. J. M. Caporn, 'Long-term nitrogen deposition increases heathland carbon sequestration', *Science of The Total Environment*, vol. 592, pp. 426–435, Aug. 2017.

[4] A. Skwierawski, 'Carbon Sequestration Potential in the Restoration of Highly Eutrophic Shallow Lakes', *International Journal of Environmental Research and Public Health*, vol. 19, no. 10. MDPI, May 01, 2022.

[5] Richard Kipling, 'Land use change for carbon sequestration: assessing the influence of carbon trading', *The Farming Forum*, https://businesswales.gov.wales/farmingconnect/news-and-events/technical-articles/land-use-change-carbon-sequestration-assessing-influence-carbon-trading (accessed Dec. 12, 2022).

Tunley Engineering's Report Emission Statement

Tunley Engineering's GHG emissions from completing this assessment were 1.704 kgCO_2e.

Approval (Internal use only)

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