An estimation of the potential carbon sequestration in John's Forest

Summary

In 2007, the Carbon Farmer Inc. afforested* 0.5 ha (1.2 ac) of land with White Spruce and a further 2.3 ha (5.8 ac) was planted with Lodgepole Pine in 2010. The land is situated approximately 1.0 km east of Manning, Alberta†. Approximately 2.0 ha (5.0 ac) of the land was originally cleared for farming in the 1940's, with the remaining 0.8 ha (2.0 ac) cleared in the early 1980's. In each case after clearing the land was cultivated for crop production until 2007 when the afforestation project began.

It is estimated that John's Forest will capture 484.0 tC and saves 1,774 t CO_2e by 2070 (or 28.2 t CO_2/year on average).

Introduction

In 2007 and 2010, The Carbon Farmer Inc. afforested a combined 2.8 ha (7.0 ac) of land situated approximately 1.0 km east of Manning, Alberta (Supplementary material, Figure 3). The land was originally cleared for farming during the 1940's (approximately 2.0 ha or 5.0 ac) and during the early 1980's (the remaining 0.8 ha or 2.0 ac) and was in crop cultivation until 2007. The land was afforested by the Carbon Farmer Inc. and a local tree planter using seedlings from Woodmere Nursery Ltd. In total, 3,822 lodgepole pine (in 2010) and 540 white spruce (in 2007) seedlings were planted on the site.

Assumptions

To estimate the amount of carbon sequestered by the afforestation, one needs to estimate the carbon that would have accumulated without the afforestation (baseline) and subtract that amount from the amount of carbon that accumulates with the afforestation (project).

---

* I am using here the term used in Alberta for afforestation. The internationally accepted definitions of afforestation and reforestation are different. Internationally afforestation is the conversion of land which has been non-forest land for more than 50 years to forest, while reforestation is the conversion of land which has been non-forest for less than 50 years. Replanting of land that was forest and was harvested, but was not converted to grassland or cropland is called forest management. Using the internationally accepted definition, this land has been **reforested**.

† John's Forest is part of a parcel of land which has the legal land description:

THE WHOLE OF LEGAL SUBDIVISIONS ONE (1), TWO (2) AND EIGHT (8) AND THAT PORTION OF LEGAL SUBDIVISION SEVEN (7) LYING TO THE SOUTH AND EAST OF THE RIGHT BANK OF THE NOTIKEWIN RIVER ALL OF

SECTION TWENTY SEVEN (27)

TOWNSHIP NINETY ONE (91)

RANGE TWENTY THREE (23)

WEST OF THE FIFTH MERIDIAN

AS SHOWN ON A PLAN OF SURVEY OF THE SAID TOWNSHIP SIGNED AT OTTAWA ON THE 27TH DAY OF FEBRUARY A.D. 1919

CONTAINING 62.2 HECTARES (153.70 ACRES) MORE OR LESS

EXCEPTING THEREOUT: HECTARES ACRES (MORE OR LESS)

A) PLAN 4736PX ROAD 0.417 1.03

Baseline

The land was cultivated fallow farm land in 2007 and as part of the project in 2010 the land in conjunction with the trees was planted with native grasses (35% Bearded Wheat Grass, 25% Fringed Brome Grass, 25% Green Needle Grass, 10% Slender Wheat Grass, 3% Fallow Blue Grass and 2% June Grass). In the baseline it is assumed that the land would have remained fallow. For the ease of modelling, I have assumed that this is grassland. This may be a conservative assumption since the grasslands have relatively high amount of soil organic carbon and the land may have occasionally been tilled to keep that grass under control. To model the grassland, I have assumed a net annual production of 1.7 bdt / ha with a root-to-shoot ratio of 2.8[1]. A 50% annual mortality was selected to give a long-term average soil organic carbon of 103 tC / ha. This is very close (109 tC / ha) to the value used by the Canadian Forest Service in estimate the soil organic carbon in Luvisolic soils in this region[2].

Project

The project consists of afforestation on the land with white spruce and lodgepole pine. As we have no prior information as to the site quality from a forestry perspective, I have assumed mid-range yield curves (SI 17.5 for white spruce and SI 20 for lodgepole pine) in the Prince George Region, Fort St. John Forestry District, BWBS ecosystem using the TIPSY 4.1 program[3]. For both species, I assumed no special forest management (e.g., thinning) during the 60 years of the carbon simulation.

Estimate

Using a version of the GORCAM model[4] that is modified to include temperature and precipitation dependent decomposition[5] [6], stand level carbon models (per hectare) were developed for the two selected yield curves (Supplementary information, Figure 4).

The total net carbon sequestration to 2070 is shown in Figure 1. John's Forest captures 484 tC during this time. The majority of this (70%) will be stored in living trees and roots. The remainder will be stored in decaying matter in the dead wood, litter and soil. Up to 2080, John's Forest saves 1,774 t CO_2e or approximately 28.2 t CO_2e per year (Figure 2).

Since the forest site index is not known, a range potential of total sequestration has been provided (Supplementary information, Figure 5). The range between minimum and maximum is rather large. The minimum was estimated assuming that the White Spruce had a SI 7.5 and the Lodgepole Pine had a SI 10. The maximum estimate assumes that the forest grows with SI 27.5 and SI 30 for White Spruce and Lodgepole Pine respectively.

Figure 1: Total net carbon sequestration

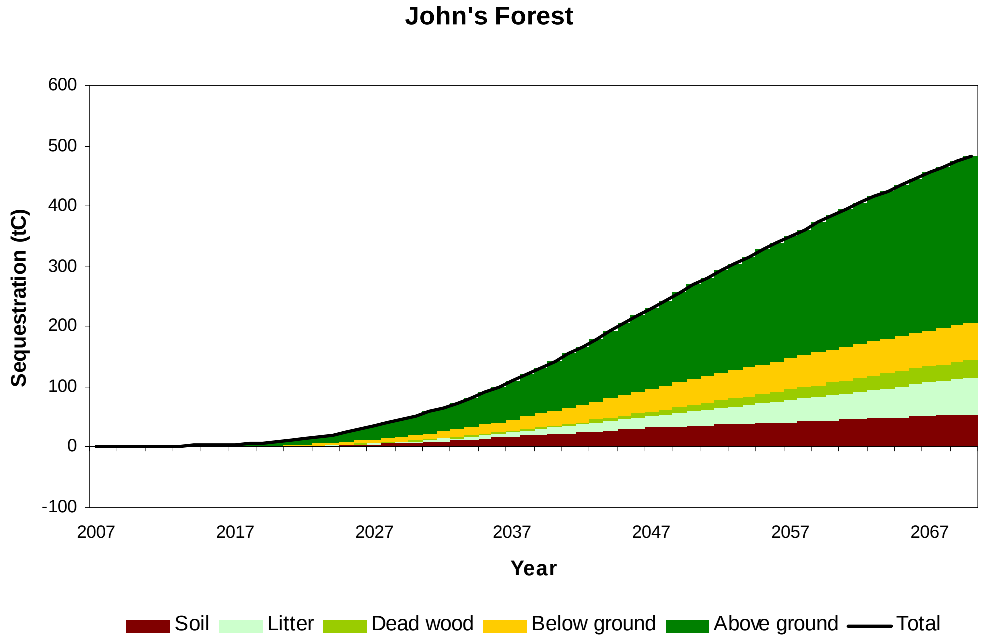
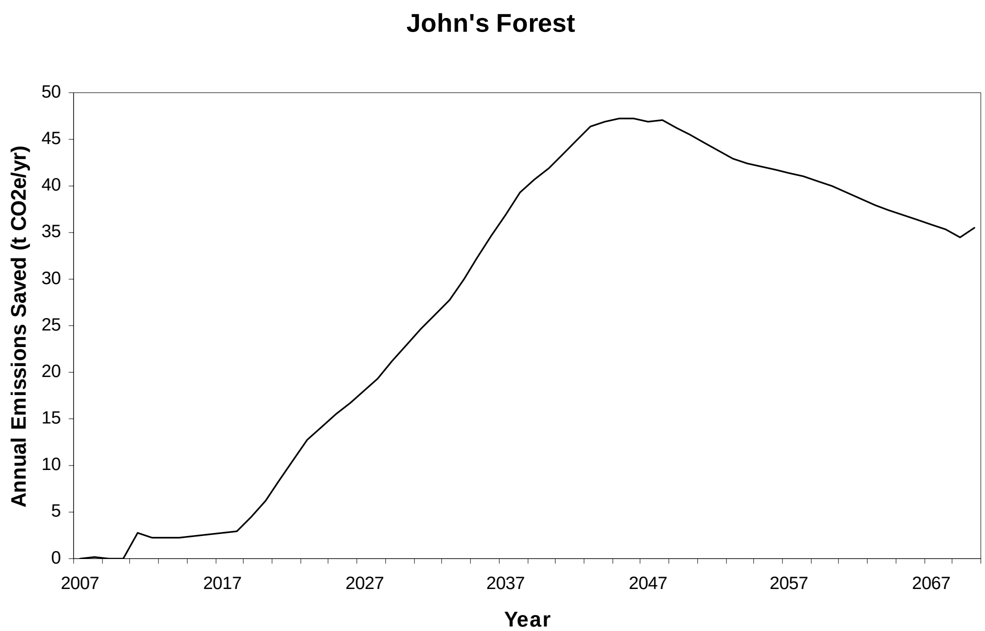


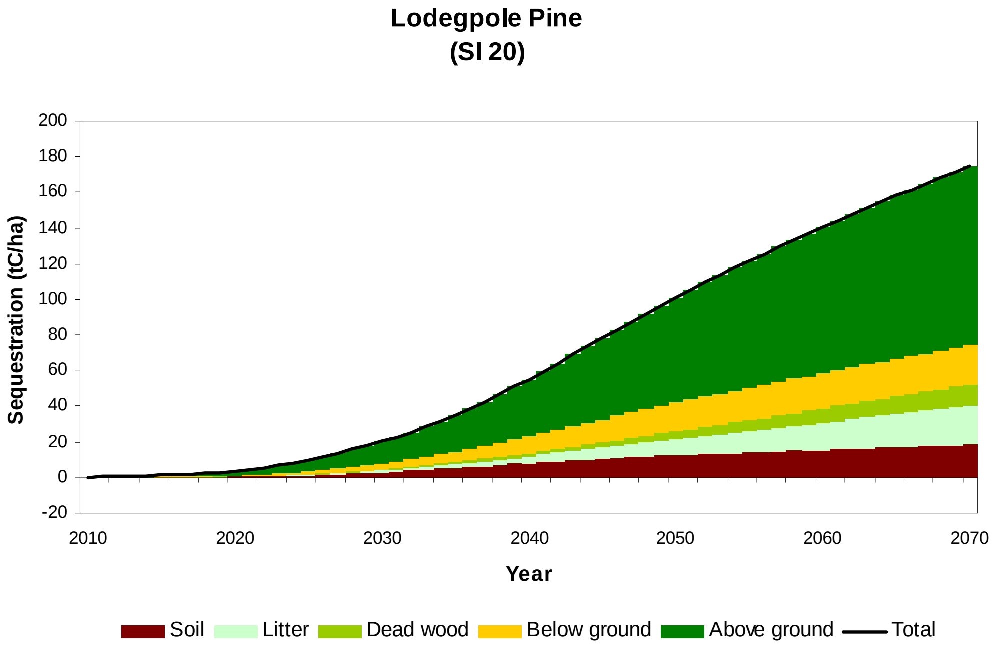
Figure 2: Annual emissions saved



Supplementary material

Figure 3: Location of John's Forest

Figure 4: Stand level net carbon sequestration



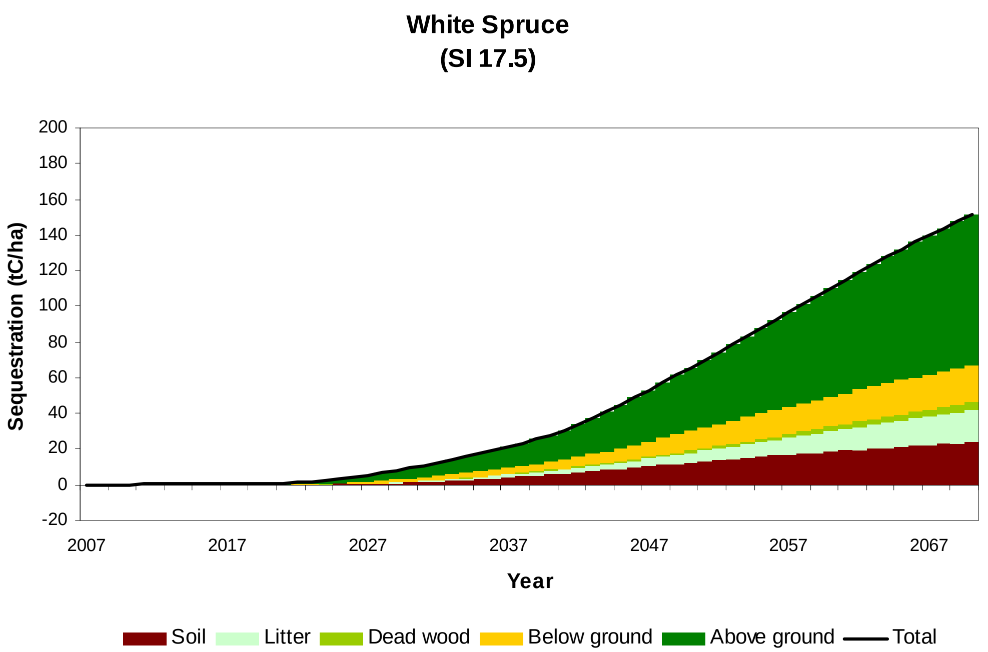
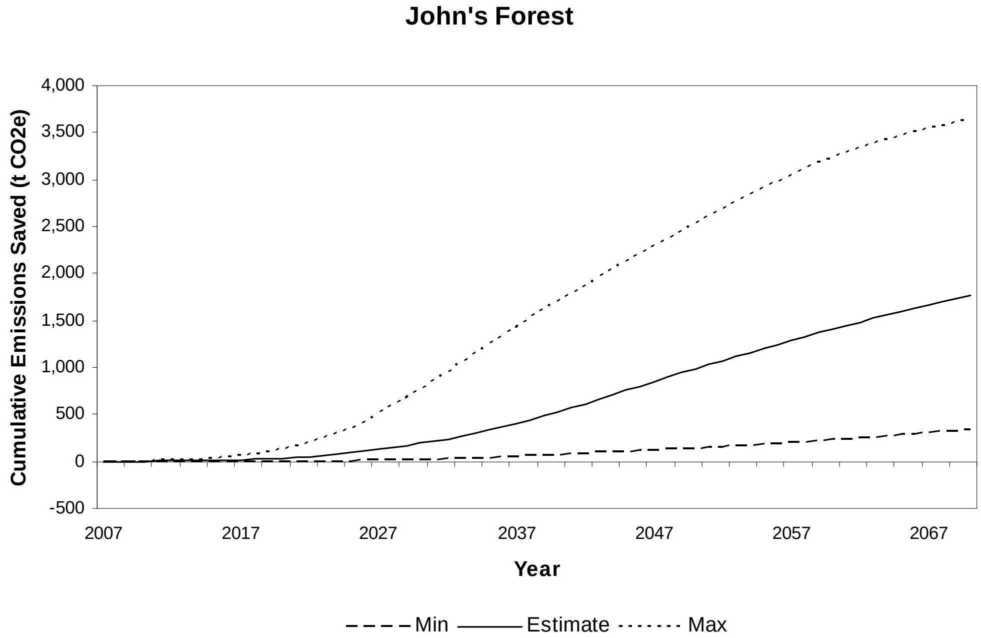


Figure 5: Cumulative emissions saved



Woodrising Consulting Inc.

This analysis has been provided by Neil Bird (Woodrising Consulting Inc.) Woodrising is a Canadian environmental consulting company that has developed expertise specifically in the areas of carbon sequestration from land use, land-use change and forestry activities, and landfill gas generation and capture. Since 1993, they have worked on projects in Africa (Kenya and Uganda), Latin America (specifically Bolivia, Chile, Ecuador, Honduras, Mexico, and Peru), India, Pakistan, China and Canada. Since 2007, Neil Bird has been a member of the CDM Executive Board's Afforestation / Reforestation Working Group.

References

[1] Intergovernmental Panel on Climate Change (IPCC), 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Published by the Institute for Global Environmental Strategies (IGES) for the IPCC. http://www.ipcc-nggip.iges.or.jp Tables 3.4.2 and 3.4.3

[2] Shaw, C.H., E. Banfield and W. Kurz. 2008. Stratifying soils into pedogenically similar categories for modeling forest soil carbon. Can. J. Soil. Sci. 88. 501-516.

[3] http://www.for.gov.bc.ca/hre/gymodels/tipsy/index.htm

[4] Schlamadinger B and G. Marland. 1996. The role of forest and bioenergy strategies in the global carbon cycle, Biomass and Bioenergy 10: 275-300.

[5] Siltanen R, Apps M, Zoltai S, Mair R and W Strong. 1997. A soil profile and organic carbon data base for Canadian forest and tundra mineral soils, Canadian Forest Service, Northern Forestry Centre.

[6] Moore T, Trofymow J, Taylor B, Prescott C, Camiré C, Duschene L, Fyles J, Kozak L, Kranabetter M, Morrison I, Siltanen M, Smith S, Visser S, Wein R and S Zoltai. 1999. Litter decomposition rates in Canadian forests, Global Change Biology 5: 75-82.