Temiskaming Crops Coalition/Cochrane District Soil & Crop Improvement Association

# Rapid Development of Farmland from Boreal Forest and an Evaluation Relative to Traditional Clearing Methods

# Rapid Development of Farmland from Boreal Forest and an Evaluation Relative to Traditional Clearing Methods: Interim Project Report

## Introduction

This three year project has two main objectives: (1) to assess and mitigate the soil impacts and crop growth potential resulting from a mulching/subsoiling process and (2) develop a business case that will evaluate mulching and other methods of traditional land clearing. Based on outcomes from this project, mulching and its role in agriculture will be better understood and producers will have sound information necessary to make informed decisions regarding their land management practices. Year 1 of the project focused on clearing and preparing the land while Year 2 and Year 3 will incorporate cropping practices to assess crop potential.

## Project Background

Northern Ontario contains a vast amount of Class 2, 3 and 4 land which is not currently in production (4+ million acres). Some of this land was farmed in the past, but has lain idle for a number of years and has grown in up in scrub bush. Other blocks have had mature trees harvested and are now covered in successional scrub and trees, while other areas contain mature tree stands.

In order to convert these areas into productive farmland, the tree stems and large branches have to be physically removed, burned or mechanically processed in place. Stumps and roots may be excavated or raked out and removed from the site, piled and burned, left in the ground to rot or mechanically processed on site.

The use of large industrial shredder/grinders to process standing stems, slash, and root beds is increasing in the North. Information on the long term effectiveness, cost efficiency, and suitability for agricultural purposes of these machines is lacking. Some of this cleared land has seen successful crop growth afterwards and some has not – this could be attributed to a number of factors including method of mulching, tree composition, volume of woody material incorporated, etc. It is anticipated that this study will provide initial information related to these variables and how they could potentially impact future crop growth.

## Site Selection

Three sites were selected for inclusion in this project. Sites were selected based on amount and type of tree cover, location, potential for agricultural development (tile drainage installation, readiness for planning, etc.) and any other characteristics that were deemed relevant by the site selection committee. Three sites were selected:

1. Temiskaming District, William Runnalls: 12 acres of scrub brush with some large rotted stumps, this site was logged and stumped in 2012 and 2013 and as such, had the least woody debris remaining on site.
2. Cochrane District, Carl Dodds: 10 acres of standing trees, density varied from decade old scrub brush to 50-60 year old stands; larger trees removed June-August 2015; site was the densest with respect to forest cover.
3. Cochrane District, Jason Desrochers: 12 acres of mostly tag alders, included in project as an addition to study the impact of cattle and mulching.

A map with the location of the three sites can be found in Figure 1.

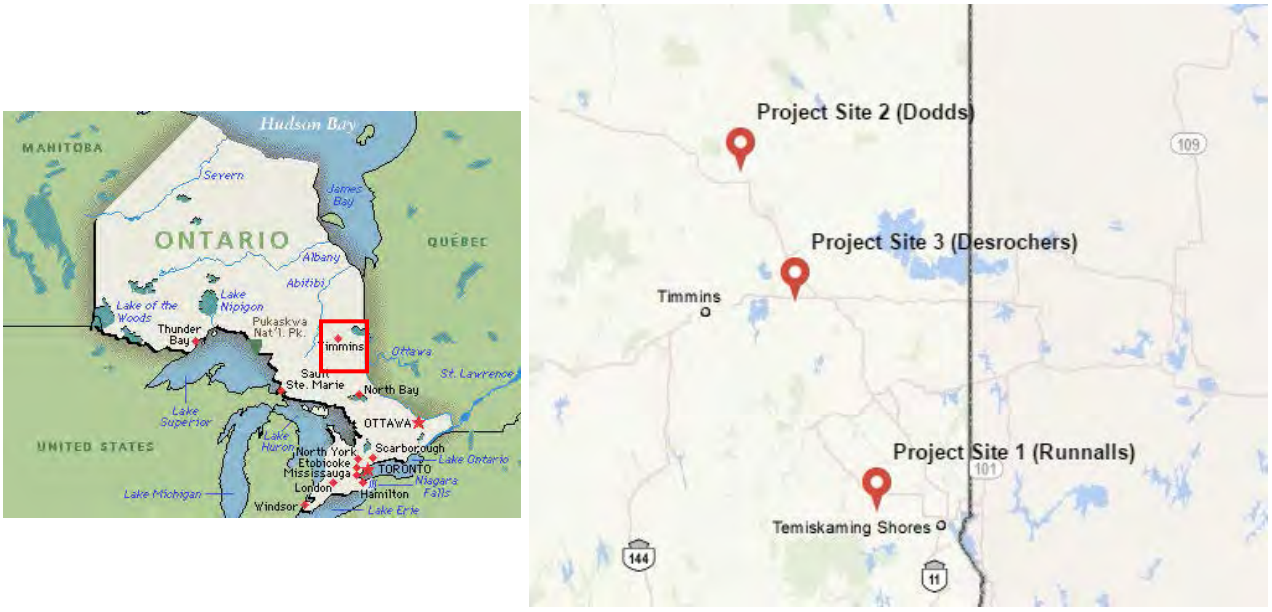



**Figure 1: Location of 3 Project Sites**

## Project Outline

All 3 sites will undergo land preparation and baseline sampling in 2015. Project Sites 1 & 2 will have a mixture of clover planted in 2016 to help with nitrogen fixation and facilitate further decomposition of the incorporated woody material. In 2017, three replications of two cash crops, at this time anticipated to be buckwheat and oats, will be planted and further soil and leaf tissue tests will be taken to assess crop health. Yield measurements will also be taken. This will hopefully be compared to an area that was traditionally cleared in 2015 for comparison.

Project Site 3 will also look at the effectiveness and cost efficiency of alternative methods of converting treed land into pasture, but with cattle rather than crops. This site has strips of surface mulching and strips of surface/subsoiled ground and forage will be established by either feeding cattle overwinter on site, machine seeding in spring (broadcast from a 4-wheeler) or feeding cattle overwinter on site plus machine seeding in spring. Seeding and fertility treatments will be applied in parallel strips with untreated areas between, cutting across the single mulched and double mulched areas. Approximately 200 cattle will be fed on the site in one group, using feed placement to ensure that the cows feed and rest in all areas of the 'cattle permitted zone'. The tentative work plan can be found in Appendix 3.

This report will focus on the land preparation and baseline sampling, as that was the project plan for Year 1.

## Land Prep

The land was cleared using a two-step process. First, the surface mulching was completed using a CMI C400L and a CMI Twister II C175 (Figure 2), which mulched the surface woody material (no deeper than 1" into the ground) using impact hammers rather than blades to extend the longevity of the equipment. The surface mulching took place from July 13-July 19, 2015 and took an average of 1.4 hours per acre,

with Project Site #1 posing some difficulty with the above-ground stumps adding time for the mulcher to secure them prior to mulching.

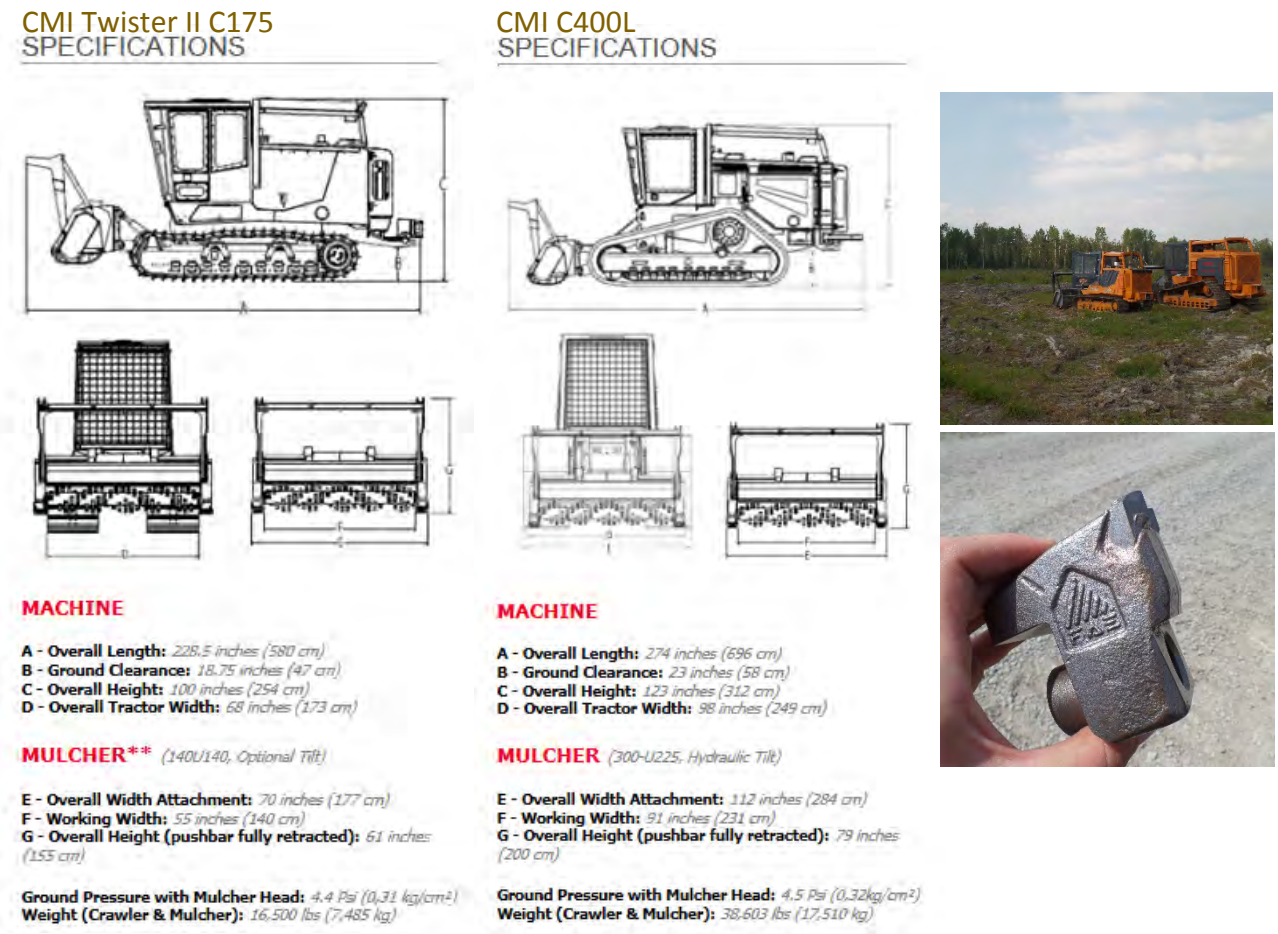



**Figure 2: Surface Mulching Specifications, Onsite in Temiskaming, Impact Hammer**

The second step involved an FAE SRM 225 subsoiler passing over the mulched areas. The SFM is a soil stabilizer that can incorporate forest residues into the soil and is mainly used after the marketable trees have been harvested and forest residues have been ground into pieces by a forestry mulcher. The subsoiling took place at Project Sites #1 & #2 from August 31- September 4 and from September 28-30 at Project Site #3 (delayed due to wet site conditions). The time between the two steps allows the woody residue to dry, which allows for a more thorough incorporation into the soil and an accelerated decomposition.

Subsoiling took an average of 2 hours per acre and went to a depth of 6-8 inches, depending on the site. This further broke down the existing mulch and remaining root systems. Project Site #2 required two passes (backwards & forwards) due to the amount of woody residue while Project Site #1 required only

one. Before, after mulching and during/after subsoiling for each Project Site can be seen in Figure 3, Figure 4 & Figure 5.

**Figure 3: Project Site 1 (Runnalls); Pre, Mulching, Subsoiling**

**Figure 4: Project Site 2 (Dodds); Pre, Mulch, Subsoiled**

**Figure 5: Project Site 3 (Desrochers); Mulch, Split between Mulch & Subsoil**

# Baseline Sampling

## Forest Inventory

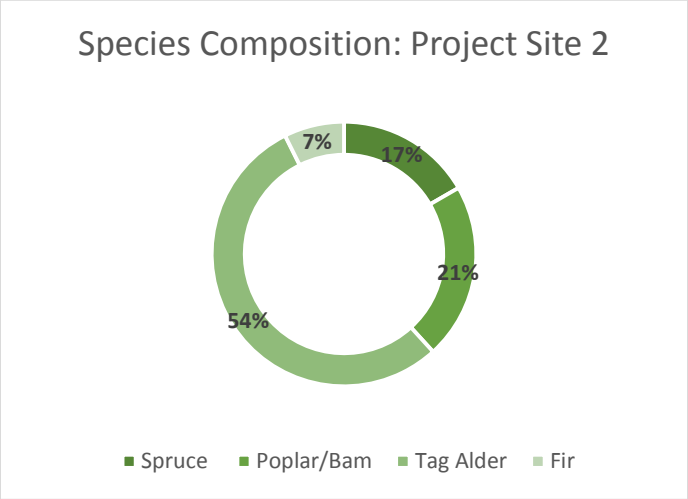
A forest inventory was completed for Project Site 2 in Cochrane on July 26, 2015. Fixed area sampling was used to project information about the volume, species composition and density of the trees in the total area. Based on information provided in the Ontario Woodlot *A Forest Services Directory for*

*Landowners*, a sampling intensity from 2% to 10% is common – for this project site, 8 plots with a circular plot size of 0.03 ha (300 m²) were selected to achieve a 4% sampling intensity, appropriate for natural stand conditions with variable tree species and age distribution.

Each plot was marked with a 9.77 m radius circle, using GPS to locate the centre point. Every tree was inventoried within this radius, with the exception of saplings (circumference of less than 2 cm). Measurements taken include:

- Diameter at breast height (DBH) – circumference of each tree was measured using a soft measuring tape at a height of 1.3 m above the ground. The circumference was converted to diameter by dividing by 3.14.
- Tree Height (TH) – an application called Smart Measure, which is a telemeter that measures the distance and height of a target, was used to calculate the height of the trees.

The number of trees and respective species were used to determine species composition while the DBH & TH were used to calculate basal area and tree volume. A detailed breakdown of tree species & volume for each plot can be found in Appendix 2.




*Trees per hectare: 853*

*Basal Area: 2.33 m²/ha*
*(Cross-sectional area at breast height)*

*Stand Volume: 3.94 m³/ha*
*Approx. 10% coniferous*

## Soil Sampling

Based on recommendations from A&L Labs, a soil sampling plan was developed using a 1 acre grid for Project Site 1 (June 26, 2015) and 2 (June 24, 2015). Twenty cores were taken within each acre with a soil probe advancing to 6" below the ground. The cores were combined and a sample was drawn and submitted for analysis of OM, P, K, MG, Ca, Na, soil pH, buffer pH, Zn, Mn, B, Fe, Cu and S. Project Site 3 (July 19, 2015) was split into 4 quadrants with twenty cores taken from each quadrant and used to submit a total of 4 soil samples. A summary of the results can be found below and project site maps with grid results can be found in Appendix 1. Full soil results can be found in Appendix 4.

## Project Site 1: Runnalls

**PROJECT SITE 1 (RUNNALLS), SAMPLED JUNE 26, 2015**

| GRID | OM % | Phos ppm* | K ppm | pH | BpH |
|---|---|---|---|---|---|
| **T1 – T12** | 5.0 – 8.9 | 4 – 6 | 28 – 54 | 7.0 – 7.8 | |
| **AVERAGE** | 7.1 | 4.7 | 40.8 | 7.4 | |

*T10 had phosphorous levels 3 times higher than those of other grid samples (likely due to sampling irregularity) and has been removed from summary based on OMAFRA recommendations

*Soil recommendations per Dan Tassé, OMAFRA:*

At a glance! When we look at the 12 samples from the grids we can make the following assessments; Organic matter levels are very good as expected and well over the levels of cultivated farm land of the area. Levels of 3.0-3.5 % are quite common on area farms depending on crop rotations and tillage practices. The levels of this site are from 5.0-8.9%. Phosphorous levels are low with a 5ppm average which is normal of virgin soils of the area. Note: I would remove sample T-10 with a 14ppm from the analysis since it 3 times the levels of the other 11 samples. This could be due to sampling or lab error. Potassium levels are lower than expected of the clay soils of the area but on the other hand the pH level are very good with a range of 7.0- 7.8 averaging 7.4. No lime will be required.

*OMAFRA Agronomy Guide Recommendations:*

2015 crop: land cleared –vegetation mulched, tiled, virgin soil,

Soil type: Cns - Cane Sand, less 2% slope, stone free

**2016 crop: Red Clover** – with possibly a companion crop i.e. oats, low seeding rate

Organic Matter: 5.0% - 8.8% average 7.0% excellent

PH: range 7.0 -7.8 average 7.4 neutral to slightly alkaline. Does not require any lime.

Phosphorous ppm: range 4-6 ppm (very low) average 5 ppm requires 110kg/ha or 100lb/ac of phosphorus.

Potassium: range 28-54ppm average 41ppm requires 70kg/ha or 60lbs /ac of potassium.

Fertilizers: required nutrients units; **Nitrogen 15 – Phos 100 – Potassium 60**

In the drill 200lbs /ac of 11-52-0 = 22-104 – 0

+ broadcast incorporated 100 lbs of 0-0-60

** Soil test again in the fall ***

| *Recommendations for Anticipated Year 2 & Year 3 Crops* | | | | |
|---|---|---|---|---|
| | *Phos* | *Potassium* | *pH* | *Nitrogen?* |
| ***Red Clover*** | 100 lbs/ac | 60 lbs/ac | Good | 0N + inoculant |
| ***Oats*** | 55 lbs/ac | 35 lbs/ac | Good | 50 lbs/ac |
| ***Buckwheat*** | 55 lbs/ac | 35 lbs/ac | Good | 50 lbs/ac |

## Project Site 2: Dodds

**PROJECT SITE 2 (DODDS), SAMPLED JUNE 24, 2015***

| GRID | OM % | Phos ppm | K ppm | pH | BpH |
|---|---|---|---|---|---|
| **C4-C15** | 5.5 – 9.9 | 2 – 5 | 55 – 97 | 6.4 – 7.0 | 6.9 |
| **AVERAGE** | 6.6 | 3.5 | 86.1 | 6.6 | |

*Soil recommendations per Dan Tassé, OMAFRA:*

At a glance! When we look at the 12 samples from the grids we can make the following assessments; Organic matter levels are very good as expected and well over the levels of cultivated farm land of the area. Levels of 3.0-3.5 % are quite common on area farms depending on crop rotations and tillage practices. The levels of this site are from 5.5-9.9 %. Phosphorous levels are very low with a 3.5ppm average which is normal of virgin soils of the north. Potassium levels are in the medium range with an average of 86ppm. PH level are good (slightly acidic) with a range of 6.4-7.0 averaging 6.6. No lime will be required for most crop recommendations.

*OMAFRA Agronomy Guide Recommendations:*

2015 crop: land cleared –vegetation mulched, tiled, virgin soil,

**2016 crop: Red Clover** – with possibly a companion crop i.e. oats, low seeding rate

Organic Matter: 5.5% - 9.9% average 6.6% excellent

PH: range 6.4- 7.0 average 6.6 neutral to slightly acidic. Does not require any lime for most crops.

Phosphorous ppm: range 2 -5 ppm (very low) average 3 ppm requires 130kg/ha or 115lb/ac of phosphorus.

Potassium: range 55-97ppm average 86ppm requires 30kg/ha or 25lbs /ac of potassium.

Fertilizers: required nutrients units; **Nitrogen 15 – Phos 115 – Potassium 25**

In the drill 150lbs /ac of 0-46-0 = 0-70– 0

+ broadcast incorporated 150 lbs of 8-32-16 = 12-50-24

| *Recommendations for Anticipated Year 2 & Year 3 Crops* | | | | |
|---|---|---|---|---|
| | *Phos* | *Potassium* | *pH* | *Nitrogen?* |
| ***Red Clover*** | 100 lbs/ac | 25 lbs/ac | Good | 0N + inoculant |
| ***Oats*** | 90 lbs/ac | 25 lbs/ac | Good | 50 lbs/ac |
| ***Buckwheat*** | 55 lbs/ac | 20 lbs/ac | Good | 50 lbs/ac |

**PROJECT SITE 3 (DESROCHERS), SAMPLED JULY 19 2015**

| GRID | OM % | Phos ppm | K ppm | pH | BpH |
|---|---|---|---|---|---|
| **JD1-JD4** | 25.4 – 36.7 | 5 – 7 | 29 – 46 | 6.4 – 7.2 | 6.8 – 6.9 |
| **AVERAGE** | 32.3 | 5.8 | 38.3 | 6.7 | |

*Project Site 2 was initially 15 acres – during the land clearing, only 10 acres were completed so the 3 grid samples that were submitted but not part of the revised project site were not included in the totals as they remain forested.

### Addition of Previous Mulching Site

Two additional soil samples were taken at a property in Cochrane that was mulched in 2014 – later in the season in 2014 and in 2015, crop establishment was unsuccessful though weeds have begun to grow in areas of the property. The two soil samples were taken from a series of cores, one series in a mulched area and the second series from the existing tree stand directly adjacent to the mulched area. These samples were taken in an attempt to determine if the mulched material impacted the soil health and composition in any way or if lack of growth could perhaps be contributed to the high density of woody material on the surface of the field. It is important to note that this site was mulched using a different method which may not have incorporated the woody residue as well.

**2014 MULCH SITE**

| | OM % | Phos ppm | K ppm | pH | BpH |
|---|---|---|---|---|---|
| **FOREST** | 6.3 | 4 | 114 | 7.3 | |
| **MULCHED** | 6.2 | 4 | 105 | 6.5 | 6.9 |

## Communications

### Demonstrations

Three on-site demonstrations were held in Temiskaming and in Cochrane. During the demonstrations participants were able to watch the machinery complete the work and talk with representatives from Young Forestry (mulching) and GB Equipment (subsoiling) to answer any questions. Two demonstrations were held at Project Site #2 on July 16, 2015 and August 31, 2015 to showcase both steps of the land clearing process and were attended by approximately 30-40 people. A demonstration was held on September 3, 2015 at Project Site #1 to showcase the subsoiling and was attended by approximately 20 people.

### News

A press release was issued to local news outlets after the project was announced. News articles were also released in the Cochrane Times Post and the Temiskaming Speaker.

### FarmNorth

Information on the project can be found at www.farmnorth.com, under Associations, NEOSCIA. Updates to the project, including videos, pictures and reports will be added to allow interested stakeholders easy access to the most relevant and up-to-date information.

## 2016 Work Plan

The steering committee will establish concrete plans for 2016 over the winter – Site 1 & 2 are expected to be planted with a clover mixture to help with nitrogen fixation. The business case for a comparison of land clearing methods, costs associated and best practices for land clearing will begin at the end of Year 2 and into Year 3. External funding for this business case will be sought during 2016.

## Conclusion

The land preparation necessary for the project was completed in 2015 along with a baseline analysis of soil health, which will provide a comparison for any changes due to incorporating the woody material. Work completed in Year 2 & Year 3 are expected to provide concrete data specific to the impacts of mulching for agricultural potential.

**This project would not have been possible without the support and commitment from project partners:**

*GB Equipment*, located in Sainte-Brigitte-des-Saults, Quebec, provided both rounds of land preparation (surface mulching & subsoiling) as an in-kind contribution. Further information on GB Equipment and their services can be found at www.gbequipment.ca

*Carl Dodds, William Runnalls & Jason Desrochers*: the 3 producer cooperators have donated acres for the duration of the project and have donated their time and equipment for various activities, including timbering, planting, harvesting, etc.

*OMAFRA: Dan Tassé, Tom Hamilton, Barry Potter*

*Project Steering Committee*

*Funding for this project was provided through a Tier Two grant supported by the Ontario Ministry of Agriculture, Food and Rural Affairs and the Ontario Soil and Crop Improvement Association.*