SPECIFIED GAS EMITTERS REGULATION

ADDITIONAL GUIDANCE FOR INTERPRETATION OF THE QUANTIFICATION PROTOCOL FOR TILLAGE SYSTEM MANAGEMENT FOR CARBON OFFSETS IN ALBERTA

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Alberta ENVIRONMENT

ALBERTANS CLIMATE CHANGE

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1.0 Introduction and Background

This document is for project developers who are using the Alberta Tillage System Management protocol to develop projects for greenhouse gas (GHG) emission removal. It provides further guidance on how to interpret complex management scenarios encountered in reduced tillage systems in Alberta.

The Alberta Tillage System Management protocol quantifies rates of soil carbon sequestration resulting from agricultural projects where there is a practice change from reduced tillage management relative to a baseline condition of full tillage. The protocol was developed around quantification methods that were designed to achieve acceptable levels of assurance, as prescribed by the Alberta Offset System for Greenhouse Gases (Alberta Environment, 2007).

The science-based quantification methods developed by Agriculture and Agri-Food Canada (AAFC) to meet Canada's GHG reporting requirement under the UNFCCC were used to identify coefficients to calculate annual rates of carbon sequestration with tillage management changes from full tillage (FT) to either reduced tillage (RT) or no tillage (NT), based on measured changes in levels of soil organic carbon (McConkey et al. 2006). Reductions in nitrous oxide emissions from soils as a result of changes in tillage management (Rochette et al. 2006) were also included. The protocol also includes GHG emission reductions associated with changes in energy use as a result of changes in tillage management that derived from the GHG Model Farm (Helgason et al. 2005). The results of measurements and simulation modelling were averaged across larger reporting zones to accommodate differences in site and management conditions, as it was assumed that the average represents the best regional value for use in greenhouse gas reporting and quantification. The resulting coefficients were adopted as the default values in the Alberta Tillage System Management protocol.

The activity definitions for NT, RT and FT that were used to develop the default coefficients were based on consultations with tillage and annual crop system experts across Canada to identify and resolve management scenarios and issues related to tillage systems. The results of a number of pilot projects and monitoring programs were used, including tillage surveys conducted by the Prairie Farm Rehabilitation Administration (PFRA) Branch of Agriculture and Agri-Food Canada and the Pilot Emissions Reductions, Removals, and Learnings (Environment Canada 2004) initiative, as outlined by the Soil Management Technical Working Group (SMTWG, Haak et al. 2006).

Further clarifications and adaptations of the activity definitions were needed to address conditions specific to Alberta. Experts on tillage and management practices in Alberta consulted with members of the SMTWG, as well as AAFC developers of the default coefficients, to arrive at the criteria listed in this guidance document.

2.0 Identification of Protocol Areas

The scientific community widely recognizes the Parkland and Dry Prairie regions of Alberta as being distinct ecoregions for a wide variety of agricultural interpretations (e.g. cropping systems, yield). Since the GHG removal coefficients were similar within, but differed between these regional areas, the regions were used to determine the appropriate protocol areas for use in the Tillage System Management protocol. The boundary between the protocol areas is based on the following criteria:

1) Soil zone: The Black–Dark Brown soil zone boundary is an important demarcation of soil organic matter levels and thus potentials to sequester or emit carbon, based upon management.
2) Moisture regime: The boundary coincides with the –300 Climatic Moisture Index (precipitation minus evapotranspiration).
3) Historical precedence: Crop and fertilizer recommendations, research analysis and coefficients have historically been separated by soil zone boundaries.

The precise location of this boundary has been identified using Alberta's digital soils database (AGRASID, Brierly et al. 2001) and is illustrated in Fig. 1. For the purposes of this protocol, the boundary is considered to be the fence-line on the Dry Prairie side of the quarter sections that represent the boundary. The quarter sections of the boundary are considered to be in the Parkland and the adjacent quarters toward the drier part of the province (usually south or east) are considered in the Dry Prairie zone.

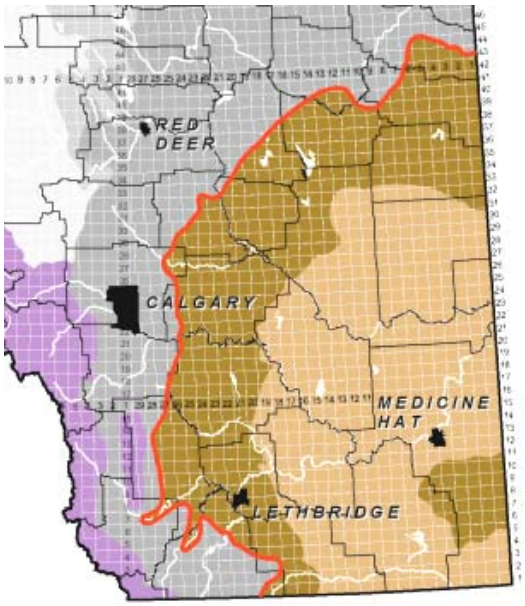

Figure 1. Protocol areas for carbon change coefficients in Alberta. The boundary between Dry Praire and Parkland protocol areas is the Black-Dark Brown soil zone boundary. The Peace River Lowland ecoregion is considered to be part of the Parkland protocol area (not shown.)

3.0 Definitions of Tillage Activity

A fundamental variable in any tillage system impact upon soil organic carbon is the degree of soil disturbance that occurs. Since the intent of this protocol is to sequester carbon in the soil, management needs to be adjusted to accommodate the identified level of soil disturbance in order to qualify. The tillage activity definitions outlined in Table 1 are designed to be clearly understood, and feasible for producer implementation, proponent monitoring, and third party verification.

Table 1: Definitions of tillage systems in the Parkland[1] and Dry Prairie protocol areas.

Tillage System	Cropped Land Period [2]	Fallow Period [3]
No Till	Up to two passes with low-disturbance openers (up to 38%) [4, 5] or one pass with a slightly higher disturbance opener (up to 46%) to apply seed, fertilizer or manure [6], discretionary tillage of up to 10% [5], no cultivation	No cultivations
Reduced Till	Soil disturbance to apply seed, fertilizer, or manure exceeds no till definition and/or one cultivation in fall or spring	One to two cultivations
Full Till	More than one cultivation between harvest and subsequent seeding if no fallow in that period, or, more than three cultivations between harvest to subsequent seeding if fallow	More than two cultivations

Notes:

[1] The Peace River Lowland ecoregion is contained within the Parkland zone.

[2] Cropped land period applies to the management cycle that terminates at harvest, (e.g. harvest to harvest is the cropped land period). This includes land preparation for seeding which may occur in the previous fall.

[3] Fallow period extends from harvest for one full year to the next fall.

[4] Percentage values associated with openers are based on maximum opener width (e.g. 5 inch openers actually measure 5.5 inches) divided by the shank spacing of the implement.

[5] Additional operations with harrows, packers, or similar non-soil disturbing implements are accepted. Where a second low soil disturbance operation is performed it is normally for injection of fertilizer or manure.

[6] Discretionary tillage of up to 10% means that up to 10% of the surface area of a single agricultural field may be cultivated to address specific management issues. These areas are determined on an annual basis, meaning that specific areas may change from year to year.

4.0 Guidance on Specific Management Scenarios

Since annual cropping systems are complex, additional guidance is provided for the variety of management scenarios that occur in Alberta. It is important to remember that the objective is to determine the appropriate tillage system: NT, RT, or FT.

1) The timing of nitrogen fertilizer is not quantified in this protocol. Applying fertilizer in the fall may qualify for NT if both the fertilization and subsequent seeding operation both involved low disturbance openers, e.g. meets the first part of the definition in (Table 1).
2) Fall seeding also qualifies for NT if it meets the disturbance criteria. However, these criteria apply to a much narrower period of time between harvest and the subsequent seeding shortly thereafter.
3) Most sweeps would not qualify as NT, because there is normally greater than 46% disturbance.
4) Tillage definitions apply to the normal harvest year for the crop. This would apply to fall seeded crops or situations when weather delays harvest to the following spring.
5) Carbon accumulation is deemed to be on a calendar year basis for the year in which the crop is harvested or the land is fallowed, even though tillage definitions relate to the cropped land period.
6) The carbon sequestration potential of perennial crops is not quantified within this protocol. Tillage practices associated with seeding perennials into annual crop stubble in the spring or fall will qualify if disturbance is within the constraints of the tillage definitions (Table 1). Tillage definitions also apply when perennials are rotated back into annual crops. If the perennial crop is terminated and immediately seeded to an annual crop in fall or spring, apply the coefficient for the current year. If the perennial crop is terminated in the spring, fallowed and then seeded in the fall or the next spring, apply coefficients for two years – the first as a fallow year and the second as a seeding year. If the perennial crop is terminated between June 15 and August 1 and the next crop is seeded the following spring, apply coefficients for 1.5 years – the first as a partial fallow year with the coefficient reduced by one half, and the second year as a seeding year.
7) Since some research supports the fact that irrigation will increase soil organic carbon levels in drier regions (Liebig et al. 2005), the Parkland protocol area coefficient will be used for irrigated land within the Dry Prairie protocol area. To use the Parkland coefficients in lands under irrigation in the Dry Prairie region, project developers should only apply the Parkland soil organic carbon (SOC) and N_20 coefficients, and not the energy coefficients. The rationale is that irrigated soils within the Dry Prairie region will have a higher metabolism because of the extra additions of carbon (higher yields thus more biomass) and nitrogen inputs (fertilizer + biomass) approaching those of the Parkland region. As for the assurance factor, it is appropriate to apply the Dry Prairie assurance factor in the irrigated Dry Prairie, to the Parkland SOC coefficient in this circumstance. The Energy coefficient applied under irrigated Dry Prairie remains the same as the Dry Prairie – project developers should not apply the Parkland energy coefficient, since energy coefficients are derived independent of C and N methodologies. The use of irrigation within the Parkland protocol area will not affect the coefficient since there are no data to support increased soil organic carbon due to irrigation within this region.

8) If a crop must be reseeded, or if a cover or green manure crop is seeded, the NT coefficient applies if one additional low-disturbance operation meets the definition of NT. If tillage is used to incorporate a cover crop or green manure, the definitions provided in Table 1 must be applied and may result in a RT or FT designation.
9) The addition of soil carbon through the application of manure is not quantified within this protocol. Although manure applications are permitted, they must adhere to the definitions of soil disturbance that are outlined in Table 1 in order to qualify as NT or RT.
10) The occurrence of inter-row tillage to control weeds during the growing season in annual row crops such as corn results in a FT tillage practice.

5.0 References

Alberta Environment. 2007. Alberta Offset System for Greenhouse Gases (Available at: http://environment.alberta.ca/documents/Guidance_Document_Alberta_Offsets.pdf. Accessed Jan. 23, 2008).

Brierly, J. A., T.C. Martin and D.J. Spiess. 2001. Agricultural Region of Alberta Soil Inventory Database (AGRASID 3.0). Soil Landscape User's Manual. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sag6903. Accessed Jan. 23, 2008).

Environment Canada. 2004. Pilot Emissions Reductions, Removals, and Learnings Initiative (PERRL): Proponents Application Manual Version 4.0.

Environment Canada, 2005. Offset System for Greenhouse Gases, Technical Background Document.

Haak, D., with Soil Management Technical Working Group for Canada's GHG Offset System. 2006. Tillage System Default Coefficient Protocol based on Canada's Offset System for Greenhouse Gases Technical Background Document (DRAFT).

Helgason, B.L.; Smith, E. 2005. GHGFarm: An assessment tool for estimating net greenhouse gas emissions from Canadian farms, Agriculture and Agri-Food Canada.

ISO 14064-3, 2006. Greenhouse gases -- Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions. Available at: http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=38700. Accessed Jan. 23, 2008).

McConkey, B.G., Brierley A., Martin, T., Vandenbygaart, A., Angers, D., Smith, W. 2006. National Inventory of C Change for Agricultural Soils in Canada, NCGAVS.

Liebig, M.A., J.A. Morgan, J.D. Reeder, B.H. Ellert, H.T. Gollany, and G.E. Schuman. 2005. Review: Greenhouse gas contributions and mitigation potential of agricultural practices in northwestern USA and western Canada. Soil & Tillage Research. 83:25–52.

Rochette, P., Worth, D., Lemke, R., McConkey, B., Desjardins, R., Huffman, E., Pennock, D., Brierley, A., Yang, J., Gameda, S., Hutchinson, J. 2006. National Inventory of N_2O Emissions from Agricultural Soils in Canada, NCGAVS.