Nitrous Oxide Emission Reduction Protocol (NERP)

How does the Protocol work?




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NERP Developers

- Canadian Fertilizer Institute
- International Plant Nutrition Institute
- Alberta Agriculture and Rural Development
- The Fertilizer Institute
- Government Representatives from SK, MB, ON
- Industry
- Climate Change Central
- ClimateCHECK
- (Quantification support from AAFC)

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Implementation of NERP

- NERP resonates with issues uppermost in modern agriculture
  - Optimize yield in the context of social, economic, and environmental sustainability;
  - Focus on comprehensive, precise, and landscape-directed management of nutrients.
- Canadian Fertilizer Institute will support implementation of the NERP (roll-out Spring '11)
  - Train and accredit Accredited Professional Advisors;
  - Fund research to better understand GHG mitigation potential

Only developers with expert understanding of agronomic practice and N dynamics are qualified to use NERP.

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NERP Fundamentals

- N stewardship plan is ‘gateway’ to NERP.
  - Comprehensive Right Source, Right Rate, Right Place, Right Time (4R) N plan is new BMP .
  - BMPs are economic, but substantive barriers to implementation.
- Basic, Intermediate & Advanced Levels.
  - Based on sophistication of BMPs and intensity of data with increasing degree of landscape-directed management.
  - Based on all performance areas — must get all 4Rs ‘right’ to be eligible.

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Performance Level	Right Source	Right Rate	Right Time	Right Place	Reduction Modifier
Basic	• Ammonium-based formulation;	• Apply N according to recommendation of 4R N stewardship plan*, using annual soil testing and/or N balance to determine application rate.	• Apply in spring; or • Split apply; or • Apply after soil cools in fall	Apply in bands / Injection	0.85
Intermediate	• Ammonium-based formulation; and • Use slow / controlled release fertilizers; or • Inhibitors; or • Stabilized N	• Apply N according to qualitative estimates of field variability (landscape position, soil variability)	• Apply fertilizer in spring; or • Split apply; or • Apply after soil cools in fall if using slow / controlled release fertilizer or inhibitors / stabilized N	Apply in bands / Injection	0.75
Advanced	• Ammonium-based formulation; and • Use slow / controlled release fertilizers; or • Inhibitors; or • Stabilized N	• Apply N according to quantified field variability (e.g. digitized soil maps, grid sampling, satellite imagery, real time crop sensors.) and complemented by in season crop monitoring	• Apply fertilizer in spring; or • Split apply; or • Apply after soil cools in fall if using slow / controlled release fertilizer or inhibitors / stabilized N	Apply in bands / Injection	0.75

Sample NERP Workflow

1. Grower submits general information to developer/aggregator.
   a) Location and area of enrolled land.
   b) Proof of ownership of offsets.
2. Grower engages Accredited Professional Advisor
   a) APA may be independent or employed by developer;
   b) APA will possess accreditation from CFI training.
3. Grower submits baseline documentation to developer
   a) Calculations of N_2O per crop , evidence to support calculations;
   b) Sign-off by APA.
4. Grower and APA design and implement 4R nitrogen plan
   a) Use 4R framework (economic, environmental, social);
   b) Design and implement at selected performance level;
   c) Sign-off by APA.

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Sample NERP Workflow (cont.)

5. Grower submits project documentation to developer
   a) Record implementation, including post-harvest assessment;
   b) Calculate N_2O reductions (CO_2e per kg crop)
   c) Sign-off by APA
6. Developer combines documentation for baseline and project from all growers and engages verifier.
   a) Implement data management system to ensure documentation and calculation from all farms is verifiable;
   b) Submit project documents to verifier, and manage engagement;
   c) Register required documentation with GHG program (project plan, verification report, offset claim, etc.);
7. All participants (grower, APA, developer) retain own documentation in anticipation of site visit from verifier.

2-pronged Quantification

- **Reductions related to N rate decrease**
- Tier II method for direct and indirect N_2O emissions from ag soils (derived for Canada's National Inventory Report).
  - Accounts for Tier I sources (N fertilizers, animal manure, crop residues, and mineralization of soil organic matter).
  - In addition:
    - Emissions calculated at regional scale (10^4 to 10^6 ha);
    - Emission factor determined as function of climate;
    - Calculations account for tillage, summerfallow, irrigation ;
    - Emissions during winter and spring thaw included; and
    - Influence of landscape position and texture accounted for*.

Tier II method used to quantify baseline & project emissions

**texture more of an influence in the moister regions of Canada*

2-pronged Quantification

- **Reductions related to N management change**
- Reduction Modifiers (RM), consensus of expert judgment.
  - Conservative — assigned according to reduction potential for single BMP (must use suite of BMPs).
  - Reduction Modifier (and conservativeness) justified by case study data.
  - Emissions estimated by Tier II method, then multiplied by Reduction Modifier to estimate project emissions.
  - Basic RM = 0.85; Intermediate and Advanced RM = 0.75

Reduction Modifiers used only to quantify project emissions.

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Documentation — Baseline

- Proof of: Crops grown, Total area under each crop, Fallow area, Rate of N applied for each crop, and Yield achieved for each crop.
- Need
  - Aerial or digital maps of fields.
  - Purchase receipts for seed, fertilizer.
  - Sales and/or delivery records for crops.
  - Spreading records for fertilizer and/or manure.
  - Sign-off by APA on calculations.
- Baseline emission is 3-year average per kg of each crop.

Documentation — Project

- Proof of: Crops grown, Fallow area, Crop event area, N rate recommendations, Fertilizer used (source, rate, time, place), Other N inputs, Crop yield, Test results (soils, tissues, manure, etc).
- Need (illustrative list)
  - Aerial or digital maps of fields or sub-fields.
  - Purchase receipts for seed/fertilizer.
  - Sales and/or delivery records for grains and oilseeds.
  - Spreading records for fertilizer and/or manure .
  - Test results at scale required for selected performance level for soil, plant tissue, manure, crop yield.
  - Fertilizer opener type and row spacing of seed.
  - Signed-off 4R nitrogen management plan.
- Project reductions per kg crop.

Accredited Professional Advisor (APA)

- APA signs off on the Baseline calculation.
  - Review documentation for Baseline practices to evaluate conclusions, and
  - Attest to the accuracy of calculations.
- APA designs, signs off on 4R plan.
  - 4-R plan address all fields and all crops at the performance level selected by the grower.
- APA signs off that the 4R nitrogen plan was implemented as designed.
  - Involves post-harvest assessment (including responses to disruptions) of yield data and of testing results.
  - Assessment informs next year's 4-R nitrogen plan.

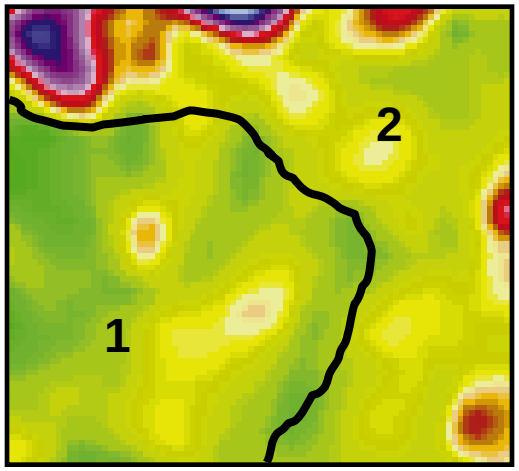
Crop Event – Key to Implementation

- *Operational unit* , N_2O intensity (*N_2O per kg crop*) calculated for Baseline and Project.
  - Three elements of crop event — crop type, crop year, and management zone.
    - The crop type is annual or perennial crop.
    - For annuals, crop year from harvest of previous crop to harvest of current crop. And, for perennials (and for baled or silage crops), crop year from last harvest of previous year to last harvest of current year.
    - Grazed lands excluded.
    - The management zone varies depending on Baseline and Project, and with the selected performance level for which the 4R plan is designed.

Crop Event – Key to Implementation

- Crop event more numerous for each crop type with increasing performance level.
  - Management zone of baseline, all fields of crop.
  - Management zone of Basic level is a whole field of crop.
  - Management zone of Intermediate level is each sub-field.
  - Management zone of Advanced level is digitized area delineated for landscape-directed management.
- N_2O emission intensity in the Baseline and Project is calculated as the N_2O emissions per kg crop produced averaged over all crop events.

Management Zones for Project



- **Basic level**
  - Field-scale zone includes all colours.
- **Intermediate level**
  - Sub-field-scale zones: Zone 1 — higher yield; Zone 2 — lower yield.
- **Advanced level**
  - Multiple zones: each area of each colour is a management zone.

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Offsets — Sample for Ontario corn

Fertilizer (kg N ha^{-1})	Corn Yield (kg DM ha^{-1})	Reduction (kg CO_2e kg^{-1} DM)	Reduction (Mg CO_2e ha^{-1})
170.0	7750	0.047	0.366
127.5 (↑NUE)	7750	0.099	0.767
127.5(↑NUE, ↑DM)	9300	0.125	1.165

Baseline — fertilizer 170 kg N ha^{-1} (150 lb N ac^{-1}) and yield 7750 kg DM ha^{-1} (145 bu ac^{-1}); N_2O of 2.44 Mg CO_2e ha^{-1} and 0.314 kg CO_2e kg^{-1} DM corn.

Project — increase NUE and DM yield; Basic NERP performance level, reduction modifier = 0.85.

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Benefits of NERP

- Drives practice change
  - Comprehensive, professional, 4R plan advances better N management.
  - Support for NERP enhances infrastructure to continue advances in N management.
- Provides leading edge for ecosystem services
  - Documentation prescribed by NERP requires assessment of total farm N balance.
  - Documentation provides proof of claim of management to support water quality trading.

Thank You

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