Modeling Tools for Supporting Agricultural Odor Management in Canada

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EXECUTIVE SUMMARY

Odor is perceived to be an offensive environmental problem in many agricultural communities, particularly where residential and farming uses are adjacent. The impacts of agriculture odor on residential area mostly are determined by the distance between source and communities. One of the current ways to quantify this distance is by defining setback distances. However, as odor emissions from animal production facilities are a function of species, housing types, feeding methods, manure storage and handling methods, the size of the odor sources, and weather conditions, defining this setback distance becomes difficult because the setback distance depends not only on the source of facilities, dispersion and movement process of odor emissions, but also on meteorological conditions, odor sensitivity and tolerance of the neighbors. In addition, judging by complaints over agricultural odor issues, additional odor control measures or practices may be needed to control odors when existing operations meet odor setback distances.

Therefore, to define a setback distance will require a thorough understanding of the characterization of source, atmospheric volatilization, transport and dispersion processes involved in transporting odor emissions to receptor as well as various in-situ control measures used to mitigate the emissions of odor before it is released to atmosphere. Thus, an accurate setback distance can only be obtained through an integrated modeling approach which simulates the generation, dispersion and transportation of odor under complex meteorological and topographic conditions. Moreover, risks of environment and health from specific pollutants in the odor and risk of annoyance to community should be reflected in determining the setback distance of odor and annoyance.

Previously, a number of modeling tools were developed to estimate the setback distance. However, few models have been widely used because all of them have their strength and inherent limitations when applied to determine setback distance. This leads to the difficulty for decision maker in choosing suitable tool for supporting odor management. The variation of capability and applicability could be caused by a number of reasons, for example, (1) some models were developed specially for simulating the dispersion of one chemical, while others simulating all fractions of odor; (2) some models provided the simulation of the dispersion process of odor from one source, others may cover all odor sources; (3) some models were developed based on empirical formula, others were based on dispersion model; (4) all these models were built in different topographic context and were validated in different country; (5) simulating the dispersion process of odor is fraught with uncertainties.

Therefore, in view of the advantages and disadvantages of these models and to reflect the uncertainties in simulating odor dispersion process, it is encouraged to use the results from more than one model for supporting odor management. This encouragement motivates this study with objective of scoping a suite of tools or models that could be used to recommend minimum distance separations per agricultural practice for a range of Canadian geographic and environmental conditions. This objective entails:

- Investigate the potential odor sources and build inventory of odor emissions that would provide accurate information as model input. Identify the most suitable odor measurement methods overall estimation of inventories
- Explore various odor control practice and management that could be or potentially be used for odor emission reduction in Canada.
- Assess tools currently used to model agricultural odor control practice impacts from point and areal sources
- Analysis risks of environment and heath and odor annoyance free frequency of the neighbors.
- Examine a number of models that currently used for setback distance determination.
- Evaluate the University of Minnesota suite of tools for agricultural odors controls and guidelines.

In this study, based on the review of the characterization and classification of odor source and control practices, the methodology of odor estimation and monitoring, the inventory of odor emission, odor dispersion simulation, risk analysis, several models were evaluated and assessed within a Canadian context. The analysis demonstrates that the OFFSET is capable of simulating the complex process of odor generation and dispersion and supporting the analysis of odor annoyance free frequency, but it is still required to be modified or enhanced to adapt to Canadian topography and climate conditions. In addition, it is recommended to use the results from more than one tool for determining setback distance and recommend minimum distance separation. Moreover, this study suggests that an integrated decision support system would be more effective to for supporting odor management by integrating odor inventory, emission estimation tool, metrological modeling tool or database, air dispersion model and risk assessment in a system framework.

This report consists of five chapters. Chapter 1 is an introduction. Chapter 2 provides literature review and background of this study. Chapter 3 presents overview of agricultural odor sources and control practices as well as the approach for odor estimation and inventory construction. Various dispersion modeling for support agricultural odor management are given in Chapter 4. Chapter 5 provides an evaluation of the OFFSET model which was developed by University of Minnesota. Chapter 6 is devoted to a summary of this project and some recommendations based on this study effort.