RESEARCH ABSTRACT

ENVIRONMENT

Title: Developing a Decision Support Tool to Optimize Swine Production Facility Layout to Minimize Downwind Air Quality Impacts - **NPB #05-118**

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Abstract

One of the most significant and persistent environmental concerns regarding swine production is the transport of odor constituents (e.g. ammonia and hydrogen sulfide), trace gases (e.g. greenhouse gases like methane and nitrous oxide), and particulates from animal production and manure storage facilities. This project involved a series of wind tunnel tests to determine how swine production building orientation and distance between buildings and above-ground slurry tanks or lagoons affect transport of odor constituents (measured as evaporated water). Scale models of swine finisher units, above-ground slurry tanks, and lagoons were constructed and deployed in a series of orientations and spacings. Air flow characteristics (velocity and turbulence intensity) near the models were measured with a hot film anemometer system and evaporation from the slurry tanks and lagoons was monitored with a position transducer.

Although building models perpendicular to air flow reduced air velocity downstream much more than parallel models, evaporation from the model slurry tanks with parallel or perpendicular models were with ~10%. The strong reduction in evaporation at the 2h separation distance (2 x's building height) with 4 building models suggests that velocity reduction by the buildings has a potential "odor trapping" effect over a short distance. Conversely, a strong increase in evaporation at 5h suggests that reattachment of flow may be occurring at that distance that may enhance odor transport. These results indicate relatively strong differences in air flow and evaporation over short distances. As these results were obtained under carefully controlled laboratory conditions, it is uncertain how likely these patterns would be reproduced under field conditions with variable wind speed and direction. Results for the lagoon models offer a strong contrast to the slurry tank results. In this case, evaporation is increased in the majority of runs (all runs with 1 model) regardless of building orientation. A likely explanation is that, even though the building models reduced air velocity, turbulence near the surface in their wake significantly enhanced air mixing and evaporation from the water surface. Over all the runs, evaporation from the lagoon models was, on average, 73% greater than from the slurry tank models. A limited number of runs with model trees and a model hill indicated increased evaporation for most building/manure storage model combinations. This result was unexpected and, as hot film anemometer measurements were not made for these runs, it is difficult to interpret these results. The most likely explanation is that the tree models, even though they reduced the mean velocity, may have increased turbulent mixing near the surface. The hill model upstream did not create a protective "odor trapping" wake zone over the manure storage models but instead enhanced transport.