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Date: May 22, 1999

To: Baumgartner Environics
2510 W. Lincoln, Suite 4
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From: Dwaine S. Bundy, Ph.D., P.E.

Re: Odor evaluation at two swine lagoon sites

Description of the facilities

Two swine unit sites were evaluated on May 19, 1999 for odors downwind. One site was a breeding, gestation, and farrowing facility (Farm #1). The farm consisted of a 40 ft by 260 ft total confinement gestation-breeding barn to house 464 sows and 66 boars. A second building was 40 ft by 290 ft total confinement barn to house 544 gestating sows. The third barn was a 65 ft by 214 ft farrowing barn to house 240 sows. The manure was removed from the buildings and emptied into a two stage earthen anaerobic treatment lagoon system. The primary cell was 202 ft by 252 ft by 17 ft deep. The secondary cell was a 202 ft by 252 ft by 17 ft deep lagoon. Both cells are covered with a Bio-Cap cover manufactured by Baumgartner Environics, Inc. This facility was near Renville, Minnesota. The berms were only a few feet above the natural terrain.

The second site was a breeding, gestation, and farrowing facility (Farm #3). The farm consisted of two farrowing barns 71 ft by 214 ft and two 77 ft by 340 ft barns to house 2,116 gestating sows and 130 boars. The manure was removed from the buildings and emptied into a two stage earthen anaerobic treatment lagoon system. Each of the lagoons were 322 ft by 427 ft by 17 ft deep. Neither cell is covered. The lagoons are bermed up about 15 ft on the north side and at ground level on the south side.

Description of measurement equipment

The scentometer used to measure downwind was a 6 port instrument. The instrument was manufactured by Barnebey and Sutcliffe Corp. The bag samples were measured using a single port triangular forced choice olfactometer using eight trained panelist. The hydrogen

sulfide was measure by a Jerome meter. Odor threshold is defined as the number of volumes of fresh air needed to mix with one volume of odorous air to just be detectable.

Description of surrounding area

The scentometer readings were taken downwind. The distances were measured by stepping off the distance. The distance between measurements were approximately 100 ft. At Farm #1, the terrain was flat with grass vegetation at approximately 1 ft high. Other odor sources in the area included a sugar beet plant to the south and the ventilation exhaust from the barns. Care was taken to stay out of the odor plume of the sugar beet plant which had a much higher odor level than the lagoon or the swine barns. The odor from the barns on the day of measurement was much higher than the odors from the primary stage of the lagoons. The wind was from the south during the time of the odor readings.

The primary lagoon at Farm #3 was to the north of the swine facilities. The wind was from the SSW which allowed the odor data from the lagoon to be taken without having interference from the swine facilities. There were no other odor sources in the downwind direction of the lagoons. The terrain was reasonably flat with sloping upward to the north from the lagoon. The field was freshly tilled and planted in corn. The corn was about 1 to 3 inches high.

Weather conditions

The temperature was in the high 60's and low 70's during the data collection period. The wind was 15 to 25 mph from the south to the south-south-west. The skycover was sunny with some high floating clouds. The atmospheric stability would be classified as unstable which would allow odors to dissipate rapidly in the vertical direction from molecular dispersion (from lagoons) and travel further from the exhaust air from the swine units due to particulate dispersion.

Discussion of data

Table 1. Scentometer readings data taken downwind from the primary lagoon at Farm #1

distance* (ft)	Time					Average
	10:35 a.m.	11:00 a.m.	11:22 a.m.	11:40 a.m.	11:55 a.m.	
odor threshold	odor threshold	odor threshold	odor threshold	odor threshold	odor threshold	odor threshold
5	7	7	15	15	15	11.8
70	7	2	7	2	7	5
170	2	1.5	1.5	1.5	2	1.7
270	1.5	0.5	1.5	1.5	1.5	1.3
370	0.5	0.5	0.5	0.5	0.5	0.5
470	0.5	0.5	0.5	0.5	0	0.4
570	0	0.5	0	0	0	0.1
670	0	0	0	0	0	0
870	0	0	0	0	0	0

* distance from lagoon liquid surface to observation point.

Weather conditions:

Temp: 65 to
70 F

wind: 15-25 mph from South

skycover: sunny (PC)

Table 2. Scentometer readings data taken downwind from north swine Building at Farm #1

distance* (ft)	Time		
	10:35 a.m.	11:00 a.m.	Average
5			
70			
170			
270			
370			
470	2	2	2
570	2	2	2
670	2	2	2
870	1.5	2	1.75

* distance from north building exhaust fans to observation:

Weather conditions:

Temp: 65 to 70 F

wind: 15-25 mph from South

skycover: sunny (PC)

Table 3. Scentometer readings data taken downwind from Primary lagoon at Farm #3

distance* (ft)	Time					Average odor threshold
	1:35 p.m.	1:55 p.m.	2:15 p.m.	2:32 p.m.	odor threshold	
5	31	170	170	31	100.5	
45	31	31	31	31	31.0	
150	31	31	31	15	27.0	
250	15	15	15	15	15.0	
350	15	15	15	15	15.0	
450	7	7	7	7	7.0	
550	7	7	7	2	5.8	
650	2	7	2	2	3.3	
750	2	2	2	2	2.0	
850	2	2	2	2	2.0	
950	2	2	1.5	2	1.9	

* distance from lagoon liquid surface to observation

Weather conditions:

temp: 70-75 F

wind: 15-25 mph from S to SSW

skycover: sunny (PC)

Table 4. Olfactometer and hydrogen sulfide data from tedlar bag samples taken on the windward side of the primary lagoon near the liquid surface.

Sample	Farm	odor threshold	hydrogen sulfide (ppm)
1	#1	75	0.015
2	#1	63	0.014
3	#3	456	0.14
4	#3	219	0.15

Table 1 and 3 show data collected from the covered lagoon and uncovered lagoon, respectively. Table 4 shows the data taken and evaluated at the Iowa State Olfactometer Laboratory. All scentometer data was taken about 4.5 ft above the ground.

The olfactometer data was taken about 6 inches off the ground. The olfactometer data showed a 5 fold reduction at the surface of the lagoon with the cover. Similarly, the hydrogen sulfide data showed a 10 fold reduction. This was based upon the tedlar bag samples evaluated within 24 hours in the Iowa State University laboratory.

The scentometer data showed that the odors downwind from the covered lagoon was non-detectable at 370 ft with the scentometer. The 0.5 odor threshold readings are values detectable to the human nose, but not detectable with the scentometer. At distances greater than 570 ft no odor was detected from the covered lagoon. The odors were still detectable at 870 ft from the exhaust air of the swine buildings at an odor threshold of 1.5 and 2 (Table 3). At the uncovered lagoon, the odor threshold averaged 100.5 at a height of 4.5 ft above the top of the lagoon berm. The odor threshold averaged 1.9 at 950 ft from the uncovered lagoon.

The higher readings from the olfactometer resulted from the height of the sample. It shows that mixing occurs rapidly with height. This is enhanced with high wind speeds.

The Bio-Cap cover showed excellent odor reduction compared to open lagoons. The cover was maintaining integrity. The cover was staying on the surface with the high winds on the day of data collection.

