Easterday Ranches Inc.

5235 N. Industrial Way, Pasco, WA 99301 Office: (509) 547-9600 Fax: (509) 547-3890

March 5, 2014

Gregory Flibbert
State of Washington
Department of Ecology
4601 N Monroe Street
Spokane, WA 99205-1295

Re: NOC Application for Easterday Ranches North Lot.

Dear Mr. Flibbert,

Enclosed is the Notice of Construction Application for the Easterday Ranches North Lot on Blanton Road in Franklin County. There are three copies, complete with support documents and an electronic copy.

Please contact me with any questions or concerns at (509) 547-9600

Sincerely,

Cody Easterday
Easterday Ranches Inc.

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ECOLOGY

Notice of Construction Application
Part 2: Technical Information

The Technical Information may be sent with this application form to the Cashiering Unit, or may be sent directly to the Ecology regional office with jurisdiction along with a copy of this application form.

For all sections, check the box next to each item as you complete it.

III. Project Description

Please attach the following to your application.

- [x] Written narrative describing your proposed project.
- [x] Projected construction start and completion dates.
- N/A [ ] Operating schedule and production rates.
- [x] List of all major process equipment with manufacturer and maximum rated capacity. See Appendix A Table-2
- N/A [ ] Process flow diagram with all emission points identified.
- [x] Plan view site map.

- N/A [ ] Manufacturer specification sheets for major process equipment components.
- N/A [ ] Manufacturer specification sheets for pollution control equipment.
- N/A [ ] Fuel specifications, including type, consumption (per hour & per year) and percent sulfur.

IV. State Environmental Policy Act (SEPA) Compliance

Check the appropriate box below.

- [x] SEPA review is complete:
  Include a copy of the final SEPA checklist and SEPA determination (e.g., DNS, MDNS, EIS) with your application. See existing NOC Application on file at Ecology.

- [ ] SEPA review has not been conducted:

  - [ ] If review will be conducted by another agency, list the agency. You must provide a copy of the final SEPA checklist and SEPA determination before Ecology will issue your permit.
    Agency Reviewing SEPA:

    _____

  - [ ] If the review will be conducted by Ecology, fill out a SEPA checklist and submit it with your application. You can find a SEPA checklist online at www.ecy.wa.gov/programs/sea/sepa/docs/echecklist.doc

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V. Emissions Estimations of Criteria Pollutants

Does your project generate criteria air pollutant emissions? ☑ Yes ☐ No

If yes, please provide the following information regarding your criteria emissions in your application.

☑ The names of the criteria air pollutants emitted (i.e., NO_x, SO_2, CO, $PM_{2.5}$, PM_{10}, TSP, VOC, and Pb) NO_x, SO_x, CO, $PM_{2.5}$, PM_{10}, VOC

☑ Potential emissions of criteria air pollutants in tons per hour, tons per day, and tons per year (include calculations) See Appendix A, Table-2

☑ If there will be any fugitive criteria pollutant emissions, clearly identify the pollutant and quantity See Appendix A, Table-2

VI. Emissions Estimations of Toxic Air Pollutants

Does your project generate toxic air pollutant emissions? ☑ Yes ☐ No

If yes, please provide the following information regarding your toxic air pollutant emissions in your application.

☑ The names of the toxic air pollutants emitted (specified in WAC 173-460-150[1]) H_2S, Ammonia

☑ Potential emissions of toxic air pollutants in pounds per hour, pounds per day, and pounds per year (include calculations) See attached Memorandum

☑ If there will be any fugitive toxic air pollutant emissions, clearly identify the pollutant and quantity H_2S, Ammonia. See attached Memorandum

VII. Emission Standard Compliance

☑ Provide a list of all applicable new source performance standards, national emission standards for hazardous air pollutants, national emission standards for hazardous air pollutants for source categories, and emission standards adopted under Chapter 70.94 RCW.

Does your project comply with all applicable standards identified? ☑ Yes ☐ No

VIII. Best Available Control Technology

☑ Provide a complete evaluation of Best Available Control Technology (BACT) for your proposal.

IX. Ambient Air Impacts Analyses

Please provide the following:

☑ Ambient air impacts analyses for Criteria Air Pollutants (including fugitive emissions)

☑ Ambient air impacts analyses for Toxic Air Pollutants (including fugitive emissions)

[1] http://apps.leg.wa.gov/WAC/default.aspx?cite=173-460-150

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☑ Discharge point data for each point included in air impacts analyses (include only if modeling is required) See attached Memorandum

- ☐ Exhaust height
- ☐ Exhaust inside dimensions (ex. diameter or length and width)
- ☐ Exhaust gas velocity or volumetric flow rate
- ☐ Exhaust gas exit temperature
- ☐ The volumetric flow rate
- ☐ Description of the discharges (i.e., vertically or horizontally) and whether there are any obstructions (ex., raincap)
- ☐ Identification of the emission unit(s) discharging from the point
- ☐ The distance from the stack to the nearest property line
- ☐ Emission unit building height, width, and length
- ☐ Height of tallest building on-site or in the vicinity and the nearest distance of that building to the exhaust
- ☐ Whether the facility is in an urban or rural location

Does your project cause or contribute to a violation of any ambient air quality standard or acceptable source impact level? ☐ Yes ☑ No

BioContractors, Inc.
Applied Biotechnology and Environmental Consulting

MEMORANDUM

TO: Gregory Flibbert, Washington Department of Ecology

CC: Robert Koster, Washington Department of Ecology

FROM: Dr. Keith Thomsen, BioContractors, Inc.

RE: Calculation and modeling of emissions from Easterday North Feedlot

DATE: March 6, 2014

To support the new Notice of Construction (NOC) being submitted to the Washington Department of Ecology (DOE), we have calculated the emissions of ammonia, hydrogen sulfide and dust from the Easterday North Feedlot and the discussion below documents that work.

Manure is routinely generated only in the pen areas of the feedlot operation (see Fig. 1), which include:

- the feeding pens (majority of the feedlot area),
- hospital pens, and
- calf pens.

The average head of beef produces 45 - 50 pounds of manure and urine per day, with an as-excreted moisture content of 87% - 90%. By the time the manure is removed from the feedlot, its moisture content has dropped to 20% - 25%. The nutrients excreted in the manure from these cattle have a fertilizer value (primarily the nitrogen and phosphorus) of approximately $750,000 every year. These nutrients are carefully managed (per the certified Nutrient Management Plan) to ensure that they are an economic benefit rather than an environmental liability to Easterday Ranches.

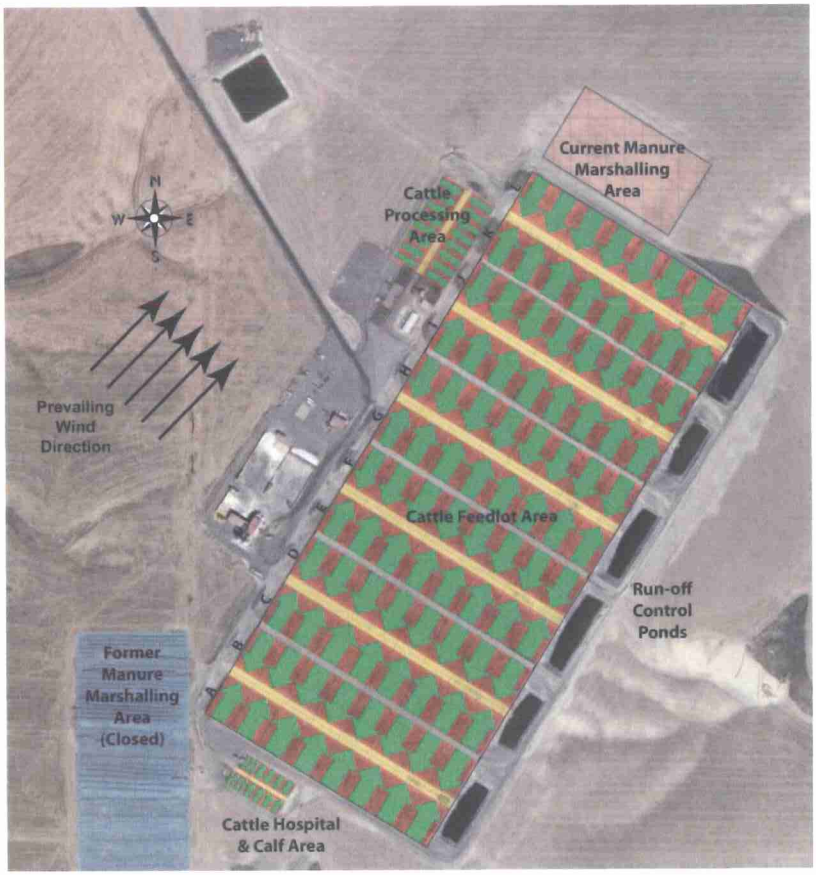


Figure 1
North Feedlot

20136 State Road ❖ Cerritos ❖ California ❖ 90703
Phone: (562) 402-2521 ❖ Fax: (562) 402-2551

Easterday Ranches employs a broad range of BMPs to control all types of emissions. In the pen areas of the feedlot, the BMPs routinely being implemented include, but are not limited to, the following:

- dietary manipulation;
- phase feeding;
- pH control,
- aeration control, and
- enzyme addition.

In the manure marshaling area, the BMPs include, but are not limited to, the following:

- aeration control (and moisture content via aeration);
- enzyme addition; and
- pH control

In the run-off lagoon areas, the BMP includes, but is not limited to, the following:

- BiOWiSH™ Odor enzyme addition.

One of the primary purposes of many of the BMPs in the feedlot pen areas, as well as the manure marshaling area, is proper maintenance to ensure proper grading to facilitate drainage and the periodic removal of animal manure. All pen areas are designed per NRCS guidelines and are sloped per the attached design drawings (Midwest Plan Service, 1987). Each pen area is equipped with overhead sprinklers to suppress dust during dry weather. Current practice calls for manure removal on a quarterly basis. Pen areas are scraped and contoured to maintain proper manure pack thickness (per the NRCS guidelines), and manure necessary for maintaining proper pen floor maintenance is retained at the rear of the pens (area shown in yellow). Manure is scraped and dried in the pens and may be used to maintain pen grading, transported off-site for beneficial reuse or hauled to the manure marshaling area (shown in blue, Fig. 1).

AERMOD MODELING

Easterday Ranches used the U.S. Environmental Protection Agency (EPA) Regulatory Model (AERMOD) model. The AERMOD modeling services were provided by Kennedy/Jenks Consultants of San Francisco, CA. For the AERMOD dispersion modeling, per the Washington Administrative Code (WAC), Section 173-460-150, the acceptable source impact levels (ASIL) using a 24-hour averaging period for each compound of concern (at 25°C and 760 mmHg pressure) were assumed to be:

- Ammonia: 70.8 $\mu g/m^3$ (0.10170407 ppm)
- Hydrogen Sulfide: 2 $\mu g/m^3$ (0.001435739 ppm)

The emissions rates for ammonia, hydrogen sulfide and dust were each modeled using emissions factor estimates commonly found in the literature (Iowa DNR, 2004; USEPA, 2004a; USEPA, 2004b; USEPA, 2004c; USEPA, 2004d; USEPA, 2005a). The ammonia and hydrogen sulfide emissions from the North feedlot were modeled as three separate area sources consisting of:

1. The feedlot pen areas,
2. The manure management area; and
3. The run-off lagoons

Modeling of Emissions of Ammonia and Hydrogen Sulfide

The base emissions rate estimates for ammonia and hydrogen sulfide were obtained from a review of the literature (Commonwealth of Australia, 2006; Iowa DNR, 2004; USEPA 1999a; USEPA 2001a; USEPA, 2010; USEPA, 2005b; USEPA, 2011) as follows:

	Ammonia		Hydrogen Sulfide	
Baseline Emissions Rate	**lb/head/day**	**g/head/day**	**lb/head/day**	**g/head/day**
Feedlot Area	0.074359	33.72873	0.00040	0.181
Manure Marshaling Area	0.00978	4.438	0.00007	0.032
Run-off Lagoon Area	0.00252	1.141	0.00002	0.008

Table 1
Baseline Emission Factor Estimates

At the request of DOE staff, Easterday has accounted for the use of wet distillers grain (WDG) by increasing the assumed quantity of manure excreted per animal. As noted in the studies cited, while the use of WDG increases overall manure volumes by 7-10%, ammonia concentrations per unit volume remained unchanged. Quantitatively, this may result in potentially greater net ammonia emissions. To account for this phenomenon, we increased the initial estimated emissions factors for ammonia by 10%, as follows:

33.72873 g/head/day + (33.72873 g/head/day x .10) = 37.10160 g/head/day

As nothing in the literature indicated that the feeding of WDG has any reported effect on dietary excretion or volatilization of sulfur, no adjustment of the hydrogen sulfide emission factor was deemed necessary.

To account for the implementation of best management practices (BMPs), the baseline emissions factors for ammonia and hydrogen sulfide were adjusted according to the assumed effectiveness for the BMP being implemented. The resulting emissions factors were then used as the inputs for the AERMOD model and calculations. In each case, we used the most conservative (lowest) effectiveness for each BMP listed. The emissions factors were calculated using the following formula:

Base emissions rate ± (base emission rate x emissions adjustment) = adjusted emissions rate

The adjustments were made using a step-wise technique to avoid "double counting" any reduction potential due to any individual BMP or adjustment factor. Also, the applied anticipated reductions were based on generally conservative estimates for each factor, as Easterday Ranches has committed in their CUP application to employing ongoing, continuous and aggressive implementation of BMPs for reducing all types of emissions from the CAFO. The results are shown below:

	BMP Effect (+/-)	% Adjmt.	Ammonia		% Adjmt.	Hydrogen Sulfide	
			lb/head/day	g/head/day		lb/head/day	g/head/day
Feedlot Area Initial Adjusted Emissions Rate			**0.08179**	**37.10160**		**0.00040**	**0.18100**
Feedlot Area BMPs							
Dietary Manipulation	**Decr.**	**30%**	0.05726	25.97112	**5%**	0.00038	0.17195
Phase Feeding	**Decr.**	**19%**	0.04638	21.03661	**N/A**	0.00038	0.17195
pH Control	**Decr.**	**25%**	0.03478	15.77746	**N/A**	0.00038	0.17195
Aeration Control	**Decr.**	**N/A**	0.03478	15.77746	**25%**	0.00028	0.12896
Enzyme Addition	**Decr.**	**50%**	0.01739	7.88873	**50%**	0.00014	0.06448
Final Adjusted Emissions Rate			***0.01739***	***7.88873***		***0.00014***	***0.06448***
Manure Marshaling Area Base Emissions Rate			**0.00978**	**4.43800**		**0.00007**	**0.03200**
Manure Marshaling Area BMPs & Other Adjustments							
Aeration Control	**Decr.**	**N/A**	0.00978	4.43800	**25%**	0.00005	0.02400
pH Control	**Decr.**	**50%**	0.00489	2.21900	**N/A**	0.00005	0.02400
Enzyme Addition	**Decr.**	**50%**	0.00245	1.10950	**50%**	0.00003	0.01200
Final Adjusted Emissions Rate			***0.00245***	***1.10950***		***0.00003***	***0.01200***
Run-off Lagoon Area Baseline Emissions Rate			**0.00252**	**1.14100**		**0.00002**	**0.00800**
Run-off Lagoon Area BMPs & Other Adjustments							
Enzyme Addition	**Decr.**	**25%**	0.00189	0.85575	**25%**	0.00001	0.00600
Final Adjusted Emissions Rate			***0.00189***	***0.85575***		***0.00001***	***0.00600***

Table 2
Emissions Factors after Implementation of BMPs

The results of the AERMOD modeling showed that the emissions of both ammonia and hydrogen sulfide, using the peak 24-hour average and the worst weather day based on the previous 5 years of weather data were below the respective ASILs specified in the WAC (ammonia = 70.8 $\mu g/m^3$; hydrogen sulfide = 2.0 $\mu g/m^3$). We do note that based on the AERMOD modeling data, the most significant causal factor for maximizing the concentration of both ammonia and hydrogen sulfide, and thus also odors, appears to be the minimum daily wind speed. The data clearly show that more than 95% of the maximum concentration events, which though below the ASIL for both ammonia and hydrogen sulfide, can be expected to occur when the minimum wind speed is below 10 mph, and that 100% of such maximum concentration events are predicted when the minimum wind speed is below 15 mph. The data also showed that the conditions needed to create a maximum concentration event tends to increase with higher temperatures, as would be expected since ammonia and hydrogen sulfide gas emissions are directly related to microbial metabolic activity, which doubles with every 18°F (10°C) temperature increase.

Modeling of Odors

Although not required by regulations, DOE staff requested that Easterday Ranches include modeling to help evaluate the potential for downwind odor dispersion. We used AERMOD and ammonia and hydrogen sulfide as "proxy odor compounds". Initially, consideration was given to modeling odor as a nearly instantaneous emission of one of the regulated gases (ammonia and/or hydrogen sulfide), but as these gases, and indeed, most odorous compounds are the direct result of microbial metabolic activity, such a peak in emissions is not only unlikely, but nearly impossible. We next considered what would happen if one or more of the BMPs were less than effective, however, due to the number and conservative

nature of the decrease in emissions that the selected BMPs will have, this also was considered unlikely to result in a spike in emissions.

Thus, to model odor perceptions, we decided to use a method for odor that uses the peak annual average, multiplied by a factor of 10 to obtain the peak 1-hour average. The peak 1-hour average is then multiplied by a factor of 2 to obtain as estimate of the "likely" peak instantaneous concentration. These emissions factors were then used to calculate the final emissions. To obtain the likely odor "perception", Ecology staff recommended detection thresholds of 0.01 – 0.30 ppm (15.0 $\mu g/m^3$ – 450 $\mu g/m^3$) for hydrogen sulfide and 1.10 ppm (825 $\mu g/m^3$) for ammonia. To provide a more sensitive analysis of odor potential, we used a lower detection threshold for each, in the case of hydrogen sulfide, we used 0.0005 ppm (.75 $\mu g/m^3$) and for ammonia we used 0.55 ppm (412 $\mu g/m^3$). The isoquant plots attached show the odor emission perception potential for the feedlot using this methodology.

The results of the updated AERMOD air dispersion modeling are presented as color contour maps of odor concentrations in air. As anticipated, the data show that, under the proper conditions, odors from the feedlot may be detectable by someone with an acute sense of smell at various distances from the feedlot (see Appendix A). Due to difference in odor detection thresholds, other compounds may also be detectable at even greater distances. Not only are emissions from the feedlot expected to be below regulatory levels, a review of the literature indicates that emissions will be at levels considerably more protective of human health.

Modeling of Dust

The dust emissions for the feedlot were modeled using National Ambient Air Quality Standards (NAAQS) limits for particulate matter (PM). These standards are considered to be protective of public health (primary standards) and public well-being (secondary standards) (USEPA 1997; USEPA 1999a-b; USEPA 2001a-b; USEPA 2005a-b; USEPA 2005a-b; USEPA 2006; USEPA, 2008). The guidelines are expressed as "no-observed-adverse-health effects" which represent concentrations below which no adverse effects have been observed during human and animal laboratory and clinical studies. The emissions factors used were derived from the literature (USEPA, 2012; Wanjura et al., 2008; Watts et al., 1994; Western Governors Association, 2006). Currently, the NAAQS PM-10, 24-h average standard is 150 $\mu g/m^3$.

Dust emissions were modeled using the calculations shown in Appendix A, Table A2, for dust emissions from a variety of sources within the feedlot, including: 1) the primary CAFO operations areas (the pens); 2) roads and other vehicle surfaces; 3) the manure marshaling area; 4) the feed mill/hay grinder area; and 5) the feed mill and boiler operation area. Using these data, Kennedy/Jenks used the AERMOD model to calculate the net PM-10, 24-h average dust emissions as shown in Figure 3. The AERMOD results indicate that the dust emissions from the feedlot are below the regulatory standard of 150 $\mu g/m^3$ at the property boundary.

APPENDIX A

GENERAL MANURE MANAGEMENT

Proper construction and maintenance of the feeding pen surface areas is important for animal health, welfare, and productivity. The pen areas will be groomed to maintain a smooth, firm surface (typically 2 – 6% slope) that will drain well. The trampling action of cattle and the accumulation of manure and urine will cause four distinct layers to develop in the pen areas as shown in Figure 1A.

From the bottom, these four primary layers are; 1) the initial pen surface (natural soil); 2) a compacted soil/manure layer; 3) the gleyed or hard pan layer; 4a) the consolidated manure pack; and 4b) the loose manure pack at the surface. Proper management of these layers helps control runoff, prevents seepage of nutrients down into the ground and provides a clean comfortable surface for cattle. During the feeding cycle in the feedlot pen areas, cattle compact a layer of soil and manure (layer 2, Fig. 2). This layer of soil mixed with organic matter develops quickly in a new pen. At the first wet spell, the soil softens and manure is worked deeper into the soil. The characteristics of this layer are somewhat independent of the pen surface soil. The depth of this layer depends on the feedlot, but is typically 2" - 6" (5 - 15 cm) thick.

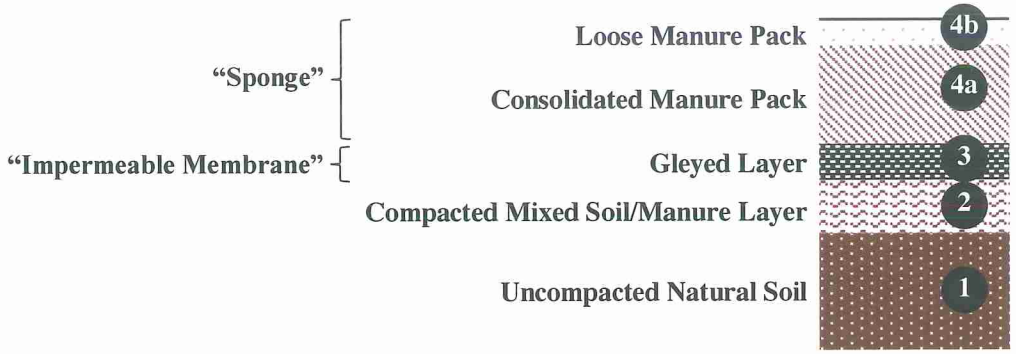


Figure 1A
Feedlot Pen Surface Layers

One of the most important aspects of proper pen maintenance is to develop and maintain the gleyed layer (layer 3, Fig. 1A). The gleyed layer develops between the soil/manure layer and the manure pack and has a high resistance to water infiltration or penetration and when dry, resembles charcoal in texture, strength and the ability to stain. When wet, as in an active feedlot, the gleyed layer has a felt-like texture. The gleyed layer helps limit downward movement of moisture and air, and maintains constant soil moisture and anaerobic conditions in the compacted soil/manure layer below, while also helping to ensure that the manure pack above remains aerobic. Under these conditions nitrate turns into nitrogen gas, which is released into the atmosphere, thus limiting the leaching of nitrogen compounds deeper into the ground water and reducing the occurrence of ammonia emissions. Typically, the gleyed layer is 2" – 4" (5 - 10 cm) thick, depending on the feedlot soils, climate and stocking density.

The manure pack refers to the layer that contains accumulated manure and bedding from the livestock (layers 4a and 4b, Fig. 1A). It actually consists of two related zones. The upper most zone (4a, Fig. 1A)

consists of relatively loose and uncompacted region of fresh manure that is constantly being churned and broken up by the hoof action of the cattle. Beneath this zone is a second zone (4b, Fig. 1A) which is comprised of older manure that has become lightly compacted by the hoof action of the cattle. Together, these two zones are referred to as the manure pack. The manure pack acts like a giant sponge, absorbing rain and snowmelt and works to protect the gleyed layer. It can hold up to 1½" (30mm) of rainfall and a feedlot pen area with a proper manure pack will absorb rainfall until it becomes saturated. The manure pack also serves as a "wear" layer that is churned by the hooves of the cattle and protects the gleyed, or hardpan, layer. When the manure pack is saturated, runoff begins and excess water drains from the pen areas into the storage ponds. Typically, rain storms can trigger anywhere from immediate runoff to a 24 hour delay after a storm before pen runoff begins, depending on the depth of the manure pack, the degree of compaction and the moisture content before it becomes saturated. There is additional minor storage created in the pens by the depressions created by the cattle's hooves, as well as natural variability in the pen slope.

As the cattle excrete manure and urine, it accumulates on top of the manure pack (the urine is general absorbed into the manure pack). The method and timing of manure removal markedly influences odor and dust emissions. To help minimize odors, Easterday Ranches frequently scrapes the manure off of the manure pack and moves it to the back of the pens to allow it to dry more rapidly. At the same time, the manure removal activity helps groom the pens to maintain proper slopes and drainage. This combines to give much better odor control than infrequent or no cleaning of pen manure. In a feedlot pen, fresh manure and urine is mixed and compacted by machinery or hoof action of cattle into the top 1" or so of the manure pack. However, hoof action of cattle may also promote dust emissions if the manure pack is allowed to become too dry. This hoof churning action is most significant during the daytime when unstable air conditions prevail. Dust and odor potential are closely related to the pen surface moisture content. Frequent pen scraping helps remove loose manure that contributes to dust production and may carry odorous gases. In addition, Easterday Ranches expends considerable effort to maintain pen moisture content and reduce excess manure accumulation to control odor and dust from cattle feedlots.

During scraping and maintenance activities, Easterday personnel are careful not to remove too much of the manure pack layer or to damage the gleyed layer with equipment or aggressive pen cleaning. Great care is exercised to ensure that the pens are scraped to remove all but approximately 1" – 2" of manure in each pen. Great care is taken to avoid exposing the gleyed layer during scraping, which may result in offensive odors. During the year, manure is scraped and piled to allow it to dry in areas near the back of the pens. Dry manure is typically removed two or three times each year. Manure is gathered and piled near the back of the pens (the areas shown in yellow, Fig. 1) whenever the total depth of the manure pack is more than 8" – 12" inches (20-30 cm) in depth over the pen surface. A box or blade scraper is used to avoid removing too much of the manure pack which in turn minimizes damage to the gleyed layer. A scraper will ride on a properly prepared gleyed layer without gouging it or breaking through it. If the gleyed layer is removed or damaged by scraping or cleaning, a new layer will develop over several months, if cattle are in the pen. Easterday Ranches continually evaluates new manure practices intended to reduce both regulated emissions and odors. One recent improvement is the reduction in the frequency that manure is handled and/or removed from the pen areas. The purpose of this new manure handling method is to reduce the opportunity for odors to become aerosolized, thus reducing odor potential. These practices have proven to be effective and will be continued.

PEN AREA BMPs

Aeration Control

The production of hydrogen sulfide is an anaerobic (without oxygen) process. Therefore, maintaining proper aerobic conditions in the pen area surfaces is highly effective in preventing the formation and

emission of hydrogen sulfide gas. To maintain aerobic conditions, it is necessary that the loose manure pack, and even the consolidated manure pack, remain aerobic and this can be best achieved by periodic loosening and scarifying (mixing) of the manure pack to ensure adequate amounts of oxygen are available to replace that which is used microbially during the breakdown of the organic material in the manure. Normally, hoof action from the cattle is sufficient to maintain aerobic conditions in the loose layer, and maintaining proper grading will help ensure that the compacted layer remains aerobic. Maintaining proper aeration is also closely tied to maintaining proper moisture control.

pH control

In addition to requiring anaerobic conditions, the generation and emission of ammonia, hydrogen sulfide and several other odorous compounds from cattle feedlots is also closely linked to the pH of the manure pack. The equilibrium relationship between ammonia gas (NH3) and ammonium ions (NH4+) (Fig. 2A; Sawyer and McCarty, 1978), which shows the equilibrium equation and also includes a plot showing the relative concentrations of NH_3 and NH_4^+ as a function of pH. As can be clearly seen, ammonia gas (NH_3) and ammonium ions (NH_4^+) are in equilibrium in water when the pH is approximately 9. Similarly, if the pH is 7.0 or lower (acidic), virtually all ammonia is in the form of ammonium ions (NH_4^+) dissolved in the water and virtually no ammonia gas (NH_3) can volatize. While the actual relationship is somewhat more complicated than this in a feedlot, it serves to illustrate that proper control of pH can significantly reduce ammonia odor issues.

During normal operations, the pH in the pen areas stays around 6.0 – 8.0, and Easterday Ranches monitors pH periodically to ensure that the pH in the pens stays in this range for optimal performance. Although pH adjustment is somewhat unusual, the feedlot can apply either a mild acid or mild base solution to adjust pH whenever operating conditions require it. Normally however, natural buffer capacity of the manure pack will tend to cause the pH to remain between 6 – 8, so adjustment is only required if pH is significantly outside this range for substantial periods of time (more than 2 – 4 weeks).

$$NH_4^+ \longleftrightarrow NH_3 + H^+$$

$$\frac{[NH_3][H^+]}{[NH_4^+]} = 5.7 \times 10^{-10}$$

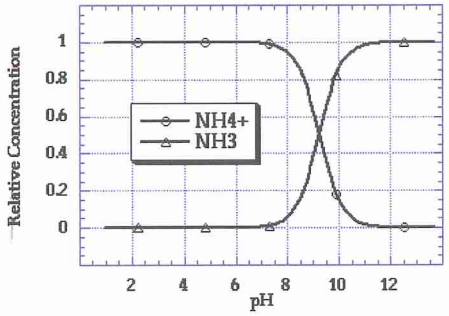


Figure 2A
Equilibrium Relationship for Ammonia and Ammonium Ion

Dietary Manipulation and Phase Feeding

Phase feeding is utilized to reduce the amount of excess nutrients being fed to cattle as they progress through the stages of growth. Modifying cattle feeding sources and schedules also can minimize odor and dust from feedlots. One means of reducing ammonia emissions from the feedlot used by Easterday Ranches is to carefully manage and reduce the amount of nitrogen excreted by the animals, especially the quantity excreted as urea in urine. Urinary pH also can affect ammonia emissions (Cole et al., 2005; Cole et al., 2006a-b; Cole et al., 2008; Hales et al., 2012; Hales et al., 2012). Careful control over the feed ration also makes it possible to manipulate nutritional intake to reduce total nitrogen and urinary nitrogen

excretion while continuing to meet the nutritional requirements and performance expectations of the animals. Recent research shows that annual ammonia losses from beef cattle feedlots are approximately half of the nitrogen consumed by cattle, and summer emission rates are about twice those in winter (Todd et al., 2006; Todd et al., 2009; Todd et al., 2010).

Ration composition can be modified in a variety of ways and has been shown to effectively reduce ammonia emissions by 20-50 percent with only small effects on animal performance (Cole, 2006a; Cole et al., 2008a). Some of the nutritional factors that can be manipulated include crude protein and/or degradable intake protein concentrations (including phase feeding), fat concentration, fiber source and concentration, and cation-anion balance (CAB). Easterday personnel carefully manage the feed ratio of the cattle to balance the need to have the cattle gain as much weight as quickly as possible with the effects of feed rations on odor generation potential. Decreasing crude protein (CP) in beef cattle diets can decrease odor by reducing nutrients, such as fecal starch, protein and lipids, in excreted manure. Excess protein and incomplete fermentation of fecal starch in livestock manure are the primary constituents which lead to the generation of compounds responsible for most malodors (Von Essen and Auverman, 2005). However, formulating feed rations that reduce malodor production without compromising cattle performance can be challenging. In spite of these challenges, Easterday has found that careful management of CP in beef cattle diet provides a very practical means to reduce odor and other gases, such as volatile fatty acids, phenols, and ammonia from the feedlot. Easterday uses an animal nutritionist to formulate and manipulate ration size and composition based on stage of growth, sex, age, and breed to design the feeding regimen needed for optimal growth and minimal excretion of nutrients.

Stocking Density

During pen water sprinkler system outages, Easterday Ranches can also control stocking density to help control dust production and emissions. The proper stocking density in dry feedlot pens can help reduce cattle activity, leading to decreased dust concentrations and odor carried with dust downwind of the feedlot. Managing the stocking density may also require that Easterday increase the pen surface scraping frequency to decrease the amount of manure buildup in pens. Finally, the pens can also be watered to control dust during these periods using the spray-bar equipped watering truck. As noted, however, these activities are required only in the event of an outage in the sprinkler system.

Enzymes and Pen Additives

Easterday Ranches uses a patented microbial enzyme product known as BiOWiSH™ Odor. This product is a microbially-derived enzymatic product that has a dual action that works on both gaseous emissions as well as on the actual substrate. It is a fast acting product that begins working in minutes, reacting biochemically with odor-causing molecules, breaking down volatile organic compounds upon contact into their final inert (and odor-free) compounds (Fig. 3A). As verified by staff of the Washington State Department of Ecology during a site visit on Aug. 23, 2012, the BiOWiSH™ Odor product has been able to achieve a nearly complete elimination of gas and odor emissions from the pond areas at the North Feedlot.

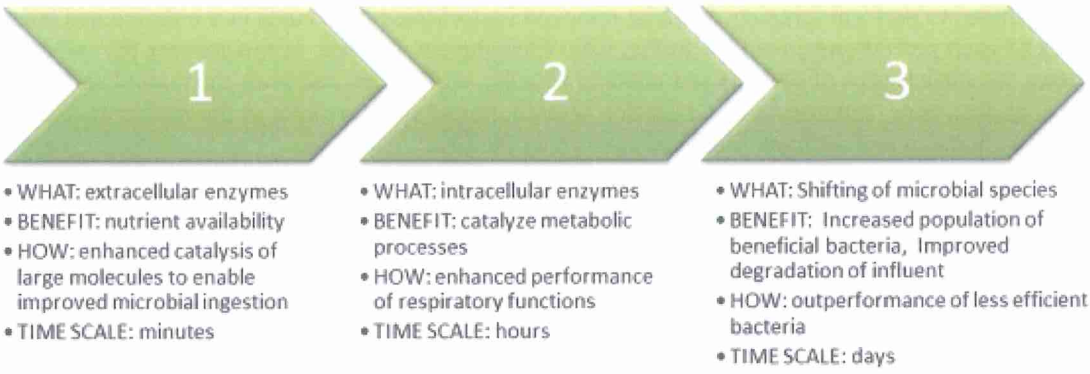


Figure 3A
BiOWiSH™ Odor Mechanisms of Action

The manufacturer states that the BiOWiSH™ Odor product accelerates the decomposition of manure and reduces ammonia and hydrogen sulfide emissions by up to 80%, and VOCs (chemical compounds associated with feedlot odors) by up to 90%. As noted previously, the BiOWiSH™ Odor product is a composite biocatalyst made from a unique blend of microorganisms, enzymes, and co-factors. It is manufactured using a highly-refined, proprietary fermentation process that enhances biochemical reactions at a faster and more efficient rate than available alternatives over a wide range of environmental conditions. Unlike other biocatalysts, BiOWiSH™ Odor has proven to have broad functionality. According to the manufacturer, use of this product in this fashion will reduce the ammonia and hydrogen sulfide emissions by more than 70-80% and VOCs by up to 90%.

To achieve consistent reduction in the emissions or regulated gases and odors, Easterday Ranches will apply the BiOWiSH™ Odor product during the summer months (the period of peak emissions and odor production), which is usually when the average daytime temperatures exceed 80°F - 85°F (periods of peak soil temperatures, and thus peak microbial activity): roughly July through September or October of each year. Under normal conditions, the product has a long activity period and the manufacturer recommends applying the product every 2-3 weeks, depending on site and weather conditions. To ensure compliance with the WAC with regard to the ASIL limits for ammonia and hydrogen sulfide, Easterday Ranches will apply the BiOWiSH™ Odor product every two weeks (14 days), or as needed based on detection of an increase in odor by the feedlot manager.

Moisture Control

Emission of ammonia, hydrogen sulfide and other odorous gases and compounds from cattle feedlots is closely associated with moisture content and warm temperatures. As a result, the emissions of regulated gases, odors and dust vary considerably due to seasonal effects. Easterday Ranches actively grooms the pens as required to eliminate standing water or excessive moisture and to maintain aerobic conditions in the top layer of the pens. In addition, greater potential for odors occurs during warm weather due to greater microbial activity at higher temperatures and during these periods particular care is exercised to maintain proper moisture levels.

When a layer of loose manure is maintained at between 25% - 40% moisture content, particularly during the warmer months, the combined problems of dust and odor can be minimized. Increasing or decreasing animal numbers in a pen can also help to maintain this moisture level. In warm, dry periods pen surfaces can support increased headcount while maintaining proper pen moisture content due to more rapid evaporation of urine. The limits to animal numbers per pen are feed bunk space, watering space and pen area per animal. Scraping of feed pens is done using a box scraper pulled behind a tractor, or a front-end

loader equipped to perform scraping. Material removed is stockpiled in mounds in the designated areas at the back of each pen (shown in yellow in Fig. 1A). Cleaning pen surfaces in this manner (by mounding) decreases the surface area of the exposed material as a dry crust forms and seals the mound and reduces the level of dust, odor, and insects in the feedlot. Overall, proper moisture control during the warm season can reduce ammonia and hydrogen sulfide emissions by 50-70%.

During winter, moisture control may become difficult, however, as metabolic activity drops due to lower ambient and soil temperatures, it is also less important. During this time, moisture management becomes more of an issue of maintaining animal comfort and cleanliness. During this period, bedding (chopped straw) may be added to the pens to increase animal comfort and assist in keeping the cattle free from 'tag' or manure cover. Maintaining clean, dry animals is one of the keys to good health and productivity, as research has shown that there is a 7% difference in cost of gain between clean and slightly muddy cattle (Alberta Agriculture, 2004; USEPA, 2011; Varel et al., 2010). During warm periods in the winter, Easterday personnel may employ more frequent pen scraping to keep the surface clean, or may build up manure mounds to help with pen drainage and initiate the decomposition of pen material.

Seasonal Effects On BMPs

As noted previously, there are two primary regional seasons: 1) a warm, dry season (summer), and 2) a cold, wet season (winter). The spring and fall transition periods typically occur very fast, usually within a window of approximately 4-6 weeks. Normal climatic variation causes some years to have a very short transition period (e.g., 2-3 weeks), while in other years, the transition is more gradual due to prolonged unsettled atmospheric conditions. The two seasons, as well as the transition periods, may cause changes in how BMPs are implemented.

Summer Warm/Dry Season

This season is typically the longest in duration and may begin as early as April and last through September or October. The timing and duration of the warm/dry season varies and during this season, manure management activities focus on maintaining the proper pen conditions as well as use of the BMPs needed to both prevent the creation of excessive dust and odors. While simple in concept, pen management and implementation of control BMPs is a complex process that requires careful attention to many parameters, including moisture content, pH level, and compaction and grading design within each pen area.

Moisture management and control is, perhaps, the most challenging. As noted previously, excessively low (<25%) moisture conditions, while helpful for reducing the rate of generation of odorous compounds, can lead to excessive dust generation. Dust particles, which are regulated emissions, also have the potential to selectively adsorb odor compounds, potentially carrying odors much farther down wind than they might otherwise travel. To control this, Easterday Ranches actively controls dust generating conditions by carefully monitoring and controlling the moisture content of the manure pack. Each pen has an overhead sprinkler that is used to add moisture whenever the moisture readings indicate that it is needed. At the same time, it is critical to avoid adding excessing amounts of moisture (>40%) as that can enhance microbial action and lead to the development of anaerobic conditions (due to saturation, decreased oxygen transfer and improved nutrient transport) in the manure pack, which will also exacerbate odor generation. To ensure optimum environmental performance, Easterday Ranches manages moisture content to ensure that the feedlot pen area moisture content ranges between 25 – 40% (except during periods of wet weather conditions).

Easterday Ranches also monitors the manure pack pH level. The objective is to maintain pH in the 6 – 8 range. A high pH (>8.0) can lead to excessive volatilization of ammonia and other odor-causing

compounds. When the pH is significantly outside the 6-8 range, conditions may interfere with proper metabolic activity and normal aerobic organisms may be suppressed. If pH adjustment is required, then a dilute acid or base (as appropriate) can be used. It is important to note that the natural buffer capacity of the manure and soil mixture that constitutes the manure pack naturally resists shifts in pH, and tends to keep the pH within the 6.0 – 8.0 range without significant active management. Adjustments are only made when pH is outside the target range for prolonged periods (longer than 2 – 4 weeks).

To maintain the pens properly, Easterday regularly grooms the manure pack. Manure used to maintain pen floor grading is typically moved to the back of each pen to allow it to dry and stabilize and may be removed as needed (typically once or twice during the season). In addition, the manure pack in the pen areas are scarified to ensure that the manure pack remains loose to avoid excessive surface compaction, which can lead to anaerobic conditions and the generation of odors. Soil may also be added periodically to each pen, as needed, to maintain proper grading and drainage and to repair any low areas to prevent ponding of water.

Fall Transition Season

During the fall transition period, temperatures cool, reducing evaporation losses and requiring less frequent use of the sprinkler system for dust control and to maintain proper moisture levels in the manure pack. Periodic rainfall is usually expected to begin during this period, but the intensity and duration of these events is generally short and seldom requires significant activity other than pen grooming to maintain slopes and drainage. Because of the reduced temperatures, microbial metabolic activity will begin to reduce and odor control becomes somewhat simpler, with an expected reduction in odor perception in most years.

During the fall transition season, Easterday Ranches continues to monitors both the pH and moisture levels of the manure pack, and adjusts them as needed, but generally on a less frequent basis than during the summer season. During the fall transition, Easterday Ranches will continue to groom and adjust the manure pack. During this season, Easterday may use compaction equipment to increase the consolidation of the manure pack to enhance the creation of a more durable "wear" surface for the winter season and to increase the amount of "sponge" depth available to absorb rainfall during the winter. The dry manure used to maintain pen floor grading located at the back of each pen may, if no longer needed, be moved to the marshaling area or removed and used offsite. In addition, the manure pack areas are carefully sculpted and contoured to enhance drainage and to provide a dry bedding area in the middle of the pens for the cattle to use once the winter season begins (pen mounds). Additional soil, if required, may be added to each pen to maintain proper grading and drainage and to repair any low areas to prevent ponding of water.

One essential activity during this period is grooming and adjusting the central mounds in each active pen area. These pen mounds provide a relatively dry area for the cattle to sleep and stand on and helps keep the pens from becoming excessively muddy, which not only can adversely affect the health and welfare of the cattle, it can also exacerbate odor issues. The mounds are created by moving part of the manure pack toward the center of the pen, or by importing soil from the stockpile area, to create a large central mound.

Shaping each feedlot pen to minimize mud problems is an important part of the fall transition season activities. Proper shaping also reduces the number of fly breeding areas within the pen, adding to summer comfort and gains. The following are points that are considered by Easterday Ranches in shaping pens for maximum cattle performance:

1. Soil for the mounds can come from the lot itself or be brought in from off-site sources, as needed. On sites with less than a 2% slope away from bunks, soil may have to be hauled in to provide adequate mounds. Mounds can be built from a mixture of manure and dirt, but if there is an inadequate supply, or

if the material contains too much old manure and not enough soil, then additional soil may be brought in from the stockpile area. The mounds are built by placing 8- to 12-inch thick layers which are then compacted as they are built. The mound area are large enough to permit use of heavy equipment to aid in compaction. Rough ground may need to be smoothed occasionally so cattle can move freely during freezing weather. Most mounds may need reshaping and soil may need to be added each year.

2. The basic goal of using mounds is to remove water as quickly as possible from the pen with minimum erosion of the manure pack. This requires short relatively steep slopes in the mound itself, with less slope in the valley, yet good drainage out of the pen. If long slopes are too steep, erosion of soil and manure will cause problems in management of runoff from the feedlot. Generally, Easterday Ranches prefers to use either soil or well-aged material from the manure pack. Less aged manure pack material will tend to absorb and hold moisture, which will defeat the purpose of the mound. Clay soil is the preferred material for mounds. When packed, it sheds moisture well.
3. The beginning of the mounds is near the top end of each pen, nearest the feed bunk apron. The mounds tend to be oriented perpendicular to the apron, as shown in Fig. 8. Where mounds must be built on side slopes, they should join the bunk apron diagonally with the valley on the high side of the mound having good drainage the full length of the pen.
4. Easterday Ranches incorporates most of the pen in the mounds and valleys. Normally, Easterday builds one mound in the center of the lot with the watering trough just behind the bunk apron and two slight valleys on either side of the central mound. Having the fence on the crest of the small mounds on the fence side of each drainage valley results in manure working away from the fence, eliminating manure buildup under it which would become a fly breeding area during the summer months.

Winter Cold/Wet Season

During the winter cold/wet season (typically November, December, January and February), weather conditions are generally much colder than during the summer or fall transition period. Average high temperatures seldom are higher than 40°F (4.4°C) during the day, and nighttime lows are frequently well below 32°F (0°C). Also, the winter accounts for most of the precipitation that falls in the area, frequently as snow. The rainfall events are generally of higher intensity and longer duration than during other periods of the year, and pen maintenance becomes a very challenging activity. Due to the low temperatures and high moisture levels, controlling the moisture content of the manure pack in the pen areas becomes very difficult. The manure pack becomes saturated and if it is not allowed to drain and dry to some extent, the pens will become very muddy.

To control moisture during this season, managing the manure pack is a significant activity. During the winter, the manure pack often becomes saturated for extended periods of time. During this period, grooming largely consists of scraping saturated portions of the manure pack and moving it to the sides and back of the pens to drain and dry. The dried manure is used to replace the saturated manure when it is removed to maintain the pens. These processes will be repeated as needed (and possible) during the winter period. During an exceptionally wet year, material may be removed from the pen areas and moved to the manure marshaling area to dry out. Dry material from this area may be moved back into the pen areas to replace the wet material that was removed, as needed. In addition, Easterday Ranches may occasionally place dry straw or other bedding material into the pens, usually on the mound area, to provide enhanced animal comfort and to control pen moisture levels. During some periods, such as when the ground is frozen, it may be neither possible, nor desirable, to move the manure pack material until after the ground begins to thaw. At all times, Easterday Ranches personnel are careful not to damage the gleyed layer.

During the winter cold/wet season, whenever average temperatures drop below the minimal microbial metabolic threshold temperature of around 40°F (4.4°C), there is a significant decrease in overall microbial metabolic activity, resulting in a significant reduction in the generation of regulated gases such

as ammonia and hydrogen sulfide, as well as a general decrease in odor generation (typically VOCs, especially phenolic compounds) and perception issues. Regardless, however, during the winter season, Easterday Ranches continues to actively manage the manure pack in the pens to minimize conditions which may generate odors or regulated emissions of ammonia and hydrogen sulfide. Easterday personnel also continue to monitor both the pH and moisture levels of the manure pack (except during periods when the temperatures are below freezing), and perform maintenance activities (e.g., pen grooming, adding fresh soil or dry manure pack material or straw bedding, etc.) that are intended to minimize odors and the emissions of regulated gases. The primary difference during the winter is the need to adjust methods (usually, less frequent grooming, etc.) to account for the increased muddy conditions and the high water content of the manure pack.

Spring Transition Season

During the spring transition period, the temperatures begin to warm, increasing evaporation losses and, in exceptionally warm, dry years, possibly requiring occasional use of the sprinkler system for dust control and to maintain proper moisture levels in the manure pack. During the spring season, rainfall declines fairly quickly, both in terms of intensity and duration. This warming and drying allows Easterday Ranch personnel to reinitiate significant pen grooming activities to return the pen areas to peak operating condition. Because of the higher temperatures, microbial metabolic activity begins to increase and odor control becomes a more significant activity.

During the spring transition season, Easterday Ranches will check the pH and moisture levels as needed to ensure that the manure pack has started to dry out. During the spring transition, as rainfall decreases, Easterday Ranches increases the intensity of pen grooming. During this period, thin areas of the manure pack will be patched, and any damage to the gleyed layer will be repaired. Easterday may also use compaction equipment in the pen areas to increase the consolidation of the manure pack and repair the "wear" surface for the summer season. In addition, the manure pack areas will be carefully graded and contoured to fix any drainage issues and soil may again be added if needed. Any excess manure (beyond what is needed for pen maintenance) may be removed and taken to the marshaling area or taken directly offsite and beneficially reused as discussed in the Nutrient Management Plan.

Extreme Weather Events

Extreme weather events include severe winter snow storms, ice storms, high winds, hail, tornadoes (exceptional, but can potentially occur in this region), lightning, drought, intense heavy rain, floods, heat waves, extreme cold snaps, and unexpected frosts. Natural systems are generally adapted to this variability (although recovery from some types of events can be quite long); however, climate extremes can have significant economic effects and operating impacts on the feedlot. In particular, the extremes of hot and cold, as well as wet and dry, pose the most common challenges at the feedlot.

Analysis of the historical record (1895-1995) indicates an increasing trend in high intensity rainfall events (greater than 2 inches/day) in the CRB region. Model results suggest that the frequency of high intensity rainfall will continue to increase in this region, resulting in more rainfall in shorter periods of time, especially during the summer season. The historical record also indicates that extreme precipitation totals are increasing in the CRB. In models, the frequency of very high temperatures and heat stress events support that the frequency and intensity of such events are likely to increase (Ferguson, 1999; Littell, 2009).

To mitigate these concerns, Easterday Ranch monitors both short-term and long-term weather forecasts and plans operations accordingly. The following lists some, but not all, of the actions Easterday Ranches may implement in the event of extreme or severe weather conditions:

- Severe winter snow, ice storms and extreme cold weather: 1) provide adequate, good-quantity feed so animals can gain weight prior to severe weather if at all possible; 2) wean calves before severe cold to reduce the cows' nutritional requirements and allow cows to gain condition; 3) Protect cattle from the wind using temporary wind fences, if necessary; 3) provide feedlot cattle with warm, dry bedding if required; 4) keep feed bunks reasonably clear of snow; 5) offer better-quality forage in cow rations during severe cold to help compensate for increased energy needs; 6) avoid feeding very high-moisture rations because these feeds can freeze in the feed bunk; 7) sort cows by nutrient requirements and feed them according to need to optimize feed use; 8) feed cattle late in the day during severe cold to increase the animals' heat production during the night; 9) make sure animals have adequate amounts of clean, fresh water at all times; 10) have snow removal equipment ready and in good repair; and 11) enclose cattle trucks when shipping animals in severely cold weather.
- High winds: no additional precautions generally required.
- Tornados: although tornados are a highly unlikely event, they are a potential risk. In the event the National Weather Service issues a tornado warning for the region, personnel at the feedlot have been instructed to seek shelter in sturdy building with a concrete floor and reinforced concrete walls and a sturdy roof as quickly as possible. In the event feedlot personnel are caught out in the open, they will seek shelter in any available nearby sturdy building. If one is not within walking distance, personnel will try to drive in a vehicle, using a seat belt, to the nearest shelter. If flying debris is encountered while in a vehicle, there are two options: 1) staying in the vehicle with the seat belt on, keeping their head below the windows and covering it with their hands or a blanket, 2) if there is an area which is noticeable lower than the roadway, lie in that area and cover their heads with their hands.
- Lightning: 1) lightning rods are strategically located around the feedlot and spaced to protect personnel, buildings and cattle; 2) during lightning storms, personnel are restricted to buildings and shelters with lightning rods or other suitable protection; and 3) any animals killed by lightning are typically removed within 24 hours to prevent odor and reduce potential to create nuisance conditions.
- Drought: 1) identify backup water supply source for cattle watering in case well runs dry; 2) truck water into supply pond if supply runs short; 3) use alternative methods (water trucks, etc.) for temporary or emergency dust suppression in pen areas if water is unavailable for overhead sprinklers or if the sprinkler system malfunctions or fails temporarily (repairs will be made as quickly as practicable).
- Intense heavy rain: 1) in advance of severe storm conditions, reduce storage pond elevations to create additional freeboard to store stormwater runoff; 2) clean out storm drains and alleyways to remove debris and prevent localized flooding; 3) repair all stormwater drainage ways; and 4) stockpile sand for sandbagging, if required.
- Floods: 1) in advance of severe storm conditions, reduce storage pond elevations to create additional freeboard to store stormwater runoff; 2) clean out storm drains and alleyways to remove debris and prevent localized flooding; 3) repair all stormwater drainage ways; and 4) stockpile sand for sandbagging, if required.
- Heat waves: 1) the stress of a heat event can be minimized if, 3-4 days in advance of an expected period of intense heat, the feed intake (and therefore, metabolic heat production) is reduced in cattle; 2) cease any unnecessary animal movements, handling and any other practices that may increase cattle stress; 3) judicious use of sprinklers, if humidity is low; and 4) use of additional portable water troughs for vulnerable pens of cattle.

Although it is not possible to anticipate every type of potential extreme condition that may be possible, Easterday Ranches maintains active surveillance of the weather and long term climate conditions and is prepared to respond to most foreseeable events.

MANURE MARSHALING AREA BMPs

Excess manure (manure not needed for normal pen maintenance) will be removed and may be taken either directly offsite for beneficial reuse or it may be taken to the manure marshaling area to dry and await removal and transport offsite for beneficial reuse at a later date. Normally, manure is only stored in the marshaling area during the period from October 1 through April 30 to allow it sufficient time to dry until it can be removed for beneficial reuse. During the spring and fall periods, when agricultural fields are being plowed and readied for the next season's planting, any accumulated manure is removed relatively quickly for beneficial reuse. The only time that manure is placed into the marshaling area is when manure must be removed from the pen areas, which is typically limited to 2 or 3 times each year to reduce the chances of increased odor problems.

Figure 4A
Manure Stockpile Aeration and Drying Operation

Aeration Control

As noted previously, the production of hydrogen sulfide is an anaerobic (without oxygen) process. Therefore, maintaining proper aerobic conditions in the pen area surfaces is highly effective in preventing the formation and emission of hydrogen sulfide gas. To maintain aerobic conditions, manure being kept in the manure marshaling area is periodically turned using a mechanical aeration machine (Fig. 4A). Currently, Easterday contracts with a local vendor to come onsite with aeration equipment which is used to turn and aerate the manure stockpile area. The equipment is also equipped with a water tank that allows the operator to spray the drying manure as its being turned, to moisten the top layer to >25% moisture content, which helps control dust. This equipment allows Easterday to maintain aerobic conditions in the manure management area, and increases that rate at which the manure dries out in preparation for transport and beneficial reuse off-site (Fig. 4A).

Moisture Control

As noted previously, the emission of ammonia, hydrogen sulfide and other odorous gases and compounds from cattle feedlots is closely associated with moisture content and warm temperatures. The manure in the marshaling area is typically placed into long windrows, where it is allowed to dry to a design moisture content of <25%. Once it is sufficiently dry, it is loaded into covered trucks and taken to agricultural fields for land application and beneficial reuse. Easterday constantly adjusts the holding time in both the pen areas and the marshaling areas in an effort to minimize the number of times the material must be

handled and moved. Reducing manure handling activities, particularly during the early phases of drying, are believed to help in minimizing the potential for releasing odorous compounds.

pH control

As noted previously, the generation and emission of ammonia, hydrogen sulfide and several other odorous compounds from the feedlot is also closely linked to the pH of the manure pack. During normal operations, the pH in the marshaling areas stays around 6.0 – 8.0, however Easterday Ranches monitors and adjusts pH periodically to ensure that the pH in the pens stays in this range for optimal performance and to prevent the loss of ammonia nitrogen, a valuable nutrient. The manure turner is equipped with a spray bar which can used a dilute acid or base solution to adjust the pH whenever the manure is turned and operating conditions require it. Normally however, natural buffer capacity of the manure pack will tend to cause the pH to remain between 6 – 8, so adjustment is only required if pH is significantly outside this range for substantial periods of time (more than 2 – 4 weeks).

Seasonal Effects On BMPs

As noted previously, there are two primary regional seasons: 1) a warm, dry season (summer), and 2) a cold, wet season (winter). The spring and fall transition periods typically occur very fast, usually within a window of approximately 4-6 weeks. Normal climatic variation causes some years to have a very short transition period (e.g., 2-3 weeks), while in other years, the transition is more gradual due to prolonged unsettled atmospheric conditions. The two seasons, as well as the transition periods, may cause changes in how BMPs are implemented.

Summer Warm/Dry Season

As noted previously, the summer season typically lasts from late April or early May through September or even October. During the warm/dry season, manure management activities at the marshaling area focuses on: 1) achieving the proper level of dryness needed to properly store, on a temporary basis, the manure until it's needed for land application, 2) suppression of dust, 3) control of odors, and 4) avoiding any type of liquid discharge or run-off from the area. These are all simultaneously done by proper aeration, as described previously, and the use of a spray bar to control dust during turning.

Moisture management and control is, perhaps, the most challenging. As noted previously, excessively low (below 25%) moisture conditions, while helpful for reducing the rate of generation or odor compounds, can lead to excessive dust generation. To ensure optimum environmental performance, Easterday Ranches monitors the moisture content of both the surface layer to ensure that it is above the 25% minimum target, while ensuring that the manure inside the rows are drying to at least 20% moisture levels. The turning equipment is fitted with spray bars that can effectively control the surface moisture content, reducing dust and odor issues.

Easterday Ranches also monitors the pH level in the drying manure. The design target is to maintain pH in the 6 – 8 range. A high pH (>8.0) can lead to excessive volatilization of ammonia and other odor-causing compounds. Too low a pH can interfere with the metabolism of aerobic organic degrading microorganisms, so Easterday Ranches tries to maintain the pH in the range of 6 - 8. If pH adjustment is required, then a dilute acid or base (as appropriate) will be used. Adjustments are only made when pH is outside the target range for prolonged periods (longer than 2 – 4 weeks).

Fall Transition Season

During the fall transition period, the temperatures cool, reducing evaporation losses and requiring less frequent use of the dust suppression spray bar on the manure turning equipment for dust control and to maintain proper moisture levels in the top layer of the manure. As noted previously, periodic rainfall is usually expected to begin during this period, but the intensity and duration of these events is generally short and seldom requires significant activity other than turning the piles. Easterday Ranches works to ensure that most of the material in the marshaling area has been remove by the end of the fall transition period, except for a small amount held in reserve for use to groom pens and patch low areas. Because of the reduced temperatures, microbial metabolic activity will begin to reduce and the potential for generating odors will also be reduced. During the fall transition season, Easterday Ranches continues to monitors both the pH and moisture levels of the manure material, and adjusts them as needed, but generally on a less frequent basis than during the summer season.

Winter Cold/Wet Season

During the winter season, routine active turning of the stockpiles in the marshaling area stops when field conditions become too wet to allow equipment to move without becoming stuck in mud. Materials held in the marshaling area may be removed with a front-end loader and used, as needed, to maintain pen conditioning, or to replace wet manure that needs time to dewater and dry when it becomes saturated. If required, the piles/rows of drying manure in the marshaling area may be turned, weather and site conditions permitting, to facilitate drying and to prevent odors from developing.

Spring Transition Season

When the temperatures begin to warm and the ground begins to dry out (the spring transition period), the focus of activity in the marshaling area becomes receiving manure from the pen areas again, and the final preparation of dried manure for transport to the fields for land application. During the spring season, once the rainfall has decreased, Easterday Ranch personnel begin to undertake significant reshaping and aeration of the manure removed from the pens during grooming activities. Because of the higher temperatures, microbial metabolic activity will begin to increase and careful attention to moisture control becomes a focus. Proper moisture control facilitates both dust and odor control. During the spring transition season, Easterday Ranches will monitor both the pH and moisture levels of the manure in the marshaling area, and adjust them as needed.

Extreme Weather Events

Extreme weather events that pose the most common challenges to operations in the marshaling area are intensive or severe precipitation, especially rainfall and flooding. As noted previously, there is an increasing trend for more high intensity rainfall events (greater than 2 inches/day) in the CRB region. To mitigate these concerns, Easterday Ranch has located the marshaling area in naturally low spot on the property and has graded this area to ensure that no run-off can leave or flow off-site. In addition, the site grading precludes any run-off from entering the marshaling area. The site grading has also been contoured to ensure that, in the event of a severe weather event there is sufficient capacity to store the run-off from a 100-year storm event. Easterday Ranch personnel also monitor both short-term and long-term weather forecasts and plan operations accordingly. Although it is not possible to anticipate every type of potential extreme condition that may be possible, Easterday Ranches maintains active surveillance of the weather and long term climate conditions and is prepared to respond to most foreseeable events.

RUNOFF MANAGEMENT AND LAGOON AREA BMPs

Feedlot runoff can have high organic matter content, therefore a high pollution potential. All runoff from the feedlot area is directed into the storage ponds where it is stored until it can be applied to crop lands adjacent to the feedlot. All of the ponds are lined, to minimize water seepage and protect the ground and surface waters of the state from receiving any pollutants that may be in the runoff from the feedlot. The ponds also serve to collect all of the organic matter content in the runoff.

In some areas (along roadsides, etc.), diversion banks or other structures have been incorporated to prevent runoff from areas outside the feedlot from entering controlled drainage areas such as the pens, cattle alleys, and feeding alleys. This decreases the amount of liquid to be handled by the ponds and internal runoff control systems. Diversions can be done as easily as making sure that the plow furrow directions on fields near the feedlot are contoured to prevent any runoff from entering the feedlot area. Up slope runoff is also controlled so that it cannot enter the manure marshaling area, and the marshaling area is in a natural low point and is further graded to ensure that no runoff can leave this area. Pens and other areas are groomed and maintained consistent with these general requirements:

- Feed troughs are located at the top of the pen slope and running parallel to the contour to minimize pen to pen drainage.
- Water trough aprons are located and shaped to shed rainfall and divert runoff around the watering area.
- Fence lines are built and maintained so that any manure accumulating under the fence can be easily removed.
- Pens are constructed with a stable pen base to create and maintain a smooth uniform surface.
- Pen slopes are carefully maintained, typically at between 2% to 6% (as appropriate for the area).
- Feedlot mounds are built for animal comfort and are generally constructed parallel to the drainage direction, avoid blocking the drainage path.
- Feedlots are constructed to drain directly into catch basins.
- Catch and sediment basins provide a lined detention ponds which are used to store feedlot runoff until it can be utilized on adjacent crop land. The ponds are designed to allow periodic removal of solids and sediment. Because such sediment removal activities may cause a temporary increase in odor emissions, Easterday Ranches will notify the Department of Ecology and will post notifications on the website at least 24 hours in advance, whenever practicable.

Lagoon/Pond Area BMPs

The runoff management system depends on the proper operation of the sealed storage ponds or lagoons. As noted previously, all of the ponds utilize a 60-mil HDPE liner, as well as proper grading to prevent seepage. Seepage, as required by law, must be less than 0.031 inch per day as the pond stores manure solids in addition to storm water runoff. These ponds have sufficient capacity to store the run-off from one entire wet season's runoff plus a 24-hour, 25-year storm event. To ensure maximum safety, the detention ponds are all located more than 500' from the nearest well. Easterday Ranches Inc. has tested and demonstrated the efficacy of using a commercial enzyme product called BiOWiSH™ and uses this product as needed and as weather and temperature conditions dictate in all basins to control regulated emissions and odors from the six detention ponds.

Seasonal Effects On BMPs

As noted previously, there are two primary regional seasons: 1) a warm, dry season (summer), and 2) a cold, wet season (winter). The spring and fall transition periods typically occur very fast, usually within a window of approximately 4-6 weeks. Normal climatic variation causes some years to have a very short transition period (e.g., 2-3 weeks), while in other years, the transition is more gradual due to prolonged

unsettled atmospheric conditions. The two seasons, as well as the transition periods, may cause changes in how BMPs in the lagoon areas are implemented.

Summer Warm/Dry Season

During the warm/dry season, the focus will be to maintain the lagoon/pond areas in as nearly an odor-free condition as practicable. This is done by applying the BiOWiSH™ Odor product in the manner and dosages recommended by the manufacturer in all basins. In the event weather conditions lead to a temporary odor issue in one or more of the lagoon/ponds, Easterday will apply a "shock treatment", consisting of a large dose of the BiOWiSH™ product, followed by normal application consistent with the manufacturer's directions. This method has been found to be effective in eliminating any temporary upsets caused by unusual weather or other conditions. The shock process may cause a temporary elevation of odors, but not of regulated gases, and if required, Easterday will post notifications on the website.

Fall Transition Season

During the fall transition period, the temperatures cool, the likelihood of periodic rainfall increase. During this period, Easterday Ranch personnel will inspect the feedlot areas, drains, manure stockpile areas and pond areas to ensure that any debris has been removed, grading problems identified and corrected and any repairs have been made. In particular, signs of embankment erosion or piping that are identified will be corrected so that they do not become worse or lead to a failure of the run-off control system. Any repairs will be completed and documented. In addition, the pond levels will be reduced to the extent possible given the weather conditions to ensure adequate storage for stormwater run-off is available.

Winter Cold/Wet Season

During the winter season, routine inspection of the run-off control system is done every week and after storm events to ensure that any debris that accumulates is quickly removed, that grading problems are identified and corrected and any repairs are identified and quickly completed. In particular, signs of embankment erosion or piping that are identified will be corrected so that they do not become worse or lead to a failure of the run-off control system. Any repairs will be completed and documented. During the winter season, the ponds may become frozen over, in which case, addition of the BiOWiSH™ product may not be possible. In this case, the BOD/COD levels of the ponds may increase, raising the potential for increased odor production as well as the possibility of increased production of regulated gases (hydrogen sulfide and ammonia). Due to the formation of ice during the winter, the rate of oxygen diffusion may be limited (<2 ppm), leading to anaerobic conditions which favor the formation of hydrogen sulfide, ammonia and potentially odors. This condition will be treated accordingly in the Spring, once the weather warms and the ponds are no longer frozen over.

Spring Transition Season

During the spring transition season, temperatures begin to warm and the ground begins to dry out, the focus of activity related to the run-off control systems will be to identify and repair on a more permanent basis any maintenance issues identified during the winter wet season. In particular, any debris that has collected in the feedlot areas, drains, manure stockpile or marshaling areas and ponds will be removed, any grading problems identified and corrected and long term repairs will be designed and made. As noted previously, particular care will be exercised to identify any signs of long-term embankment erosion or weakening and to design permanent repairs to prevent these problems from recurring. Any repairs will be documented and described in the operating log of the feedlot. Due to the typically cold weather during the winter, one critical activity will be to begin to transition the ponds back to normal operation. During the

spring transition season, it may be necessary to "shock" the ponds with a large dose of the BiOWiSH™ product, followed by normal application consistent with the manufacturer's directions in all basins. The shock treatment may cause a temporary elevation of odors, but not of regulated gases, and Easterday will post notifications on the website.

Extreme Weather Events

Extreme weather events may pose a potential challenge to operations of the run-off control system. As noted elsewhere, Easterday Ranch personnel will inspect, on a weekly basis, all of the feedlot areas and pond areas to ensure that any debris has been removed, grading problems identified and corrected and any repairs have been made. In particular, erosion or other damage to the run-off control areas are identified and corrected so that they do not become worse or lead to a failure of the system. During summers and other seasons where sudden, intense storms may occur, the pond levels may be reduced to the extent possible given the weather conditions to ensure adequate storage for stormwater run-off is available.

FEEDLOT DUST CONTROL BMPs

Particulate matter (PM), or dust, can threaten not only the health of cattle and people, but can also compromise the feedlot's ability to operate. Easterday Ranches recognizes that the feedlot is a potential source of dust and that most of that dust comes from the pen areas. However, dust also can come from roads, service areas and feed processing. Dust is produced when dry manure is crushed into smaller particles from the action of livestock walking on it. When the animals move around through the pen areas, the manure dust is suspended in the air.

The US EPA and the Washington Department of Ecology regulate air quality using the PM-10 standard. The PM10 standard focuses on smaller particles that are likely responsible for adverse health effects because of their ability to reach the lower regions of the respiratory tract. The PM-10 standard includes particles with a diameter of 10 micrometers (μm) or less (0.0004 inches). The EPA's health-based national air quality standard for PM-10 is 150 μg/m3 (measured as a daily average concentration).

Dust control strategies generally fall into two categories. The first is reducing the generation rate and preventing dust emissions, and include varying stocking density (Auvermann, 2003; Auvermann and Romanillos, 2000a,b), modifying cattle behavior relative to feeding schedule (Miller and Berry, 2005), water sprinkler systems (Razote et al., 2006; Sweeten et al., 1988; Sweeten et al., 1998), manure harvesting methods (Auvermann and Romanillos, 2000a,b), and pen surface control using water or other dust suppression treatments (Razote et al., 2006). The second involves edge-of-feedlot, or downwind control techniques, including shelterbelts (artificial or natural) to remove and disperse particles (Adrizal et al., 2008).

Generally, the peak season for dust begins in late spring and continues throughout the summer (after rainfall ends) and the peak time for dust occurs around sunset, when the temperature starts to cool and cattle become more active. Dust accumulation is worse at this time because afternoon heat, wind, and solar radiation remove much of the moisture leaving it dryer than any other time of the day. As the temperatures cool in the evening, cattle become more active. They will move to the feed bunk and start social activities. The atmosphere also becomes more stable between dusk and midnight than during the afternoon so many manure particles suspended in the air by cattle activity tend to remain near the ground.

The four general approaches Easterday Ranches utilizes to dust control include:

- Remove dry, loose manure from the corral surface;
- Manipulate the moisture levels within the pen areas to achieve optimum moisture content;

- Enclosing feed equipment and conveyor systems; and
- Reducing peak cattle activity during the critical late afternoon hours.

Easterday Ranches controls dust using a variety of BMPs, which may include, but are not limited to the activities and actions shown in Table 1. In addition to the other BMPs listed, good pen design can be an effective tool in helping to control dust. An additional integral element of this effort is proper maintenance, grading and grooming of the pen surfaces to control moisture levels. Routine cleaning of pen surfaces also helps to minimize dust problems. Easterday Ranches tries to keep the loose manure layer no more than 1" - 2" inches deep. In addition, the desired pen moisture level is kept between 25 and 40 percent, particularly during dry months. Too much moisture will increase odors and fly problems; too little moisture will promote difficulties with dust. Because of the deep pen size, all of the pens are equipped with fence line sprinkling systems which are used to suppress dust as needed. Soil moisture readings are taken as frequently as needed to maintain the desire moisture content. To the degree practicable, Easterday Ranches uses feed preparation equipment that is enclosed, covers conveyor systems and equips other feed equipment with dust skirts or dust socks to suppress dust. To discourage end-of-day spike in livestock activity, Easterday Ranches may delay the time of the last daily feeding (typically, the third of three) into the afternoon. Some data has indicated that delaying the final feeding may drastically reduce cattle activity in the late afternoon and early evening, however, this is still being evaluated.

Source Category	Control Measure	PM-10 Control Efficiency
Agricultural Tilling	Reduce tilling during high winds	1 – 5%
	Roughen surface	15 – 64%
	Modify equipment	50%
	Employ sequential cropping	50%
	Increase soil moisture	90%
	Use other conservation management practices	25 - 100%
Agricultural Harvesting	Limited activity during high winds	5-70%
	Modify equipment	50%
	Night farming	10%
Construction/Demolition	Water unpaved surfaces	10 – 74%
	Limit on-site vehicle speed to 15 mph	57%
	Apply dust suppressant to unpaved areas	84%
	Prohibit activities during high winds	98%
Materials Handling	Implement wet suppression	50 – 90%
	Erect 3-sided enclosure around storage piles	75%
	Cover storage piles with a tarp during high winds	90%
Unpaved Roads	Limit vehicle speed to 25 mph	44%
	Apply water	10 – 74%
	Apply dust suppressant	84%
	Pave the surface	>90%
Livestock Feedlots		
Manure management	Remove manure frequently (every 6 months) with equipment that leaves a compacted layer of manure on top of the pen.	>10%
	Add wood chips or mulch to working pens	>10%
	Insert the manure directly beneath the soil.	>90%
Dust entrainment by animal	Daily water sprinkling, and timing of watering around 6PM or before sunset.	>50%
	Adjust stocking density as needed to reduce dust.	>10%
	Remove loose material on surface and maintain a compacted manure pack.	>20%
	Add fibrous material such as wood chips to working pens.	>10%
	Delay last daily feeding to reduce end-of-day livestock activity.	>10%
Other	Adding moisture to hay	>40%
	Using a totally enclosed delivery system and covered feeders, and using palletized feed.	>50%
	Planting rows of vegetation around a building to create a barrier for air exiting from the building.	>20%
Wind Erosion (agricultural, open area, and storage piles)	Plant trees or shrubs as a windbreak	25%
	Create cross-wind ridges	24 – 93%
	Erect artificial wind barriers	4 – 88%
	Apply dust suppressant or gravel	84%
	Revegetate; apply cover crop	90%
	Water exposed area before high winds	90%

Source: Western Governors' Association WRAP Fugitive Dust Handbook

Table A1
Fugitive Dust Control BMPs

Overhead Sprinklers

During dry months (when temperatures are above freezing), which is typically during the summer, the primary dust control BMP for the feedlot area is the application of water, which is routinely accomplished using overhead sprinklers. The water is applied as needed to maintain proper moisture levels and prevent excessively dry (<25% moisture content) conditions which can lead to the development of uncompacted or loose manure and soil on the feedlot surface. Maintaining proper pen moisture content is the surficial layer in the pen areas is essential to preventing excessive dust (particulate matter) emissions from the feedlot. Because the peak concentration of dust is often observed in the evening when cattle activity spikes, Easterday works to ensure that the pens are sprinkled immediately prior to this period. Also, drier manure pack and relatively stable atmospheric conditions after sunset can promote nuisance dust events downwind of the feedlot and serve as a major source of nuisance, especially on the prevailing windward side of high-traffic roadways. In addition, odorous compounds can be absorbed and transported by particulate matter from the feedlot to surrounding areas. In addition to sprinkling the feedlot, Easterday also designed the feedlot (slope, length, mound, feed bunk and watering systems) in such a manner to facilitate the separation of liquid (rain, snowmelt and process water) from manure and other organic material such as waste feed through good drainage of pens which results in reduced odor generation. Easterday works to maintain pen surface moisture content (typically between 25% - 40%) so that feedlot dust is controlled to the maximum extent practicable. As an emergency back-up plan should the overhead sprinkler system fail or become temporarily inoperable, the water truck can be used to apply water to the feedlot pen areas to control dust until the sprinkler system returns to operation.

Seasonal Effects On BMPs

As noted previously, there are two primary regional seasons: 1) a warm, dry season (summer), and 2) a cold, wet season (winter). The spring and fall transition periods typically occur very fast, usually within a window of approximately 4-6 weeks. Normal climatic variation causes some years to have a very short transition period (e.g., 2-3 weeks), while in other years, the transition is more gradual due to prolonged unsettled atmospheric conditions. The two seasons, as well as the transition periods, may cause changes in how dust control BMPs at the feedlot are implemented.

Summer Warm/Dry Season

As noted previously, the summer season typically lasts from late April or early May through September or even October. During the warm/dry season, dust control activities at the feedlot focus on: 1) maintaining proper moisture control to limit dust creation, 2) suppression of dust by application of water using either overhead sprinklers or the water truck, 3) control of odors, and 4) avoiding any type of liquid discharge or run-off from the area. Easterday carefully monitors the weather during this season, and may use the water truck and spray bar to apply water during periods when wind conditions make the overhead sprinklers less effective.

Fall Transition Season

During the fall transition period, the temperatures cool, and periods of increased wind are likely. During this period, overhead sprinklers may have limited effectiveness. During such periods, Easterday will use a towed watering wagon with spray bar. This will ensure that water can still be applied to the pen floors, as well as to the roadways and other unpaved surfaces at the feedlot and maintain excellent dust suppression.

Winter Cold/Wet Season

During the winter season, temperatures are generally quite cold and often wet. This means that active dust suppression isn't normally required. However, if dust suppression is required and temperatures are above freezing, Easterday will use a towed watering wagon with spray bar. This will allow water to be applied to the pen floors, as well as to the roadways and other unpaved surfaces at the feedlot and maintain excellent dust suppression.

Spring Transition Season

During the spring transition period, the temperatures begin to warm and are accompanies by periods of relatively strong winds. During this period, overhead sprinklers may have limited effectiveness, so Easterday will use a water truck with spray bar. This will ensure that water can still be applied to the pen floors, as well as to the roadways and other unpaved surfaces at the feedlot and maintain excellent dust suppression. Easterday carefully monitors the weather during this season, and will use this method of dust suppression during periods when wind conditions make the overhead sprinklers less effective.

Extreme Weather Events

Extreme weather events, such as extremely high winds, are unusual but are not expected to significantly alter dust control BMPs. When required (subject to wind speeds which may make operating equipment unsafe), Easterday will use a towed watering wagon with spray bar. This will ensure that water can still be applied to the pen floors, as well as to the roadways and other unpaved surfaces at the feedlot and maintain excellent dust suppression.

Table A2
Draft Fugitive Dust Emissions Factors for the Easterday North Feedlot
1. Primary CAFO Operations Area Estimated Dust Emissions

Total Annual Average Herd Size (Head)	PM_{10} Emissions Factor (lb/1000 head/day)	Annual PM_{10} Emissions (lbs)	24-HR Emissions Rate (lbs/hr)	24-HR Emissions Rate (g/s)	Sprinkler Dust Suppression BMP Used?	Effective Reduction in Dust Emissions (%)	Annual PM_{10} Emissions w/BMP Implemented (lbs)	24-HR Emissions Rate w/BMP (lbs/hr)	24-HR Emissions Rate w/BMP (g/s)
26,000	8.74	82,943	9.47	1.19	Yes	50%	41,471.30	4.73	0.5965

2. Vehicle Operations Estimated Dust Emissions

Vehicle Type	Mean Vehicle Weight (tons)[1]	Uncontr. PM10 EF (lbs/VMT)[2]	Adjusted PM10 EF (lbs/VMT)[3]	Peak Daily Average Vehicle Count[4]	Round Trip Distance (mi)[5]	Daily Average VMT (all units)	Water Suppression BMP Efficiency	Annual PM10 Emissions w/BMP Implemented (lbs)	24-HR Emissions Rate w/BMP (lbs/hr)	24-HR Emissions Rate w/BMP (g/s)
Employee & Visitor Automobiles	2	0.98	0.79	26	1.42	37.56	50%	1,086	0.12	0.0156
Water Truck	25	3.33	2.69	6	1.50	8.71	50%	856	0.10	0.0123
Heavy Duty Trucks (Cattle Haulers)	30	3.33	2.69	40	1.50	59.52	50%	5,847	0.67	0.0841

Emissions Calculations

Emissions Factors - Vehicle Type[6]	CO (lb/mi)	$NOx = NO + NO_2$ (lb/mi)	NO (lb/mi)	NO_2 (lb/mi)	CO_2 (lb/mi)	SOx (lb/mi)	VOC/ROG (lb/mi)
Employee & Visitor Automobiles	0.0070923	0.0007116	0.0006226	0.0000889	1.1008743	0.0000107	0.0007457
Water Truck	0.0093179	0.0274293	0.0024001	0.0250293	4.2151856	0.0000409	0.0022631
Heavy Duty Trucks (Cattle Haulers)	0.0093179	0.0274293	0.0024001	0.0250293	4.2151856	0.0000409	0.0022631
Employee & Visitor Automobiles							
lbs/yr	97.23	9.76	8.54	1.22	15092.85	0.15	10.22
24-HR (lb/hr)	0.0111	0.0011	0.0010	0.0001	1.7229	0.0000	0.0012
24-HR (g/s)	0.0014	0.0001	0.0001	0.0000	0.2171	0.0000	0.0001
Water Truck							
lbs/yr	29.62	87.20	7.63	79.57	13400.21	0.13	7.19
24-HR (lb/hr)	0.0034	0.0100	0.0009	0.0091	1.5297	0.0000	0.0008
24-HR (g/s)	0.0004	0.0013	0.0001	0.0011	0.1927	0.0000	0.0001
Heavy Duty Trucks (Cattle Haulers)							
lbs/yr	202.42	595.66	52.14	543.72	91568.11	0.89	49.16
24-HR (lb/hr)	0.0231	0.0680	0.0060	0.0621	10.4530	0.0001	0.0056
24-HR (g/s)	0.0029	0.0086	0.0007	0.0078	1.3171	0.0000	0.0007

Month	Truck Count (Round Trip)[7]	Employee Car & Visitor Vehicle Count (Round Trip)[8]	Water Truck Monthly Trip Count (Round Trips)
January	541	620	0
February	541	620	0
March	541	620	20
April	541	620	40
May	541	620	60
June	826	620	160
July	829	620	160
August	829	620	160
September	1030	740	160
October	1230	820	160
November	714	640	15
December	541	640	0
Peak Daily Average	*40*	*26*	*6*

1. Mean Weight as Estimated by Equipment Usage as given by Easterday Ranches
2. AP-42, Section 13.2.2, Equation 1a.
3. AP-42, Section 13.2.2, Equation 2. Estimated 70 days with precipitation > 0.01 inch, according to historical precipitation data collected at Eltopia, WA, Western Regional Climate Center.
4. Peak daily average vehicle count is determined using peak traffic month divided by number of days in that month.
5. Distances measured from plot plan from highway along access road to center of construction area and parking lot.
6. Emissions Factors based on South Coast AQMD CEQA Handbook Using Scenario Year 2013 (http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html).
7. Includes both trucks to haul finished cattle plus dry manure
8. Average number of employee and visitor trips assumes 10 employees and an average of 1.25 persons per vehicle, plus anticipated number of visitor cars.

3. Manure Marshaling Area Estimated Dust Emissions

Dust Emissions from Moisture Control and Aeration Activity (Turning Piles)

Constraints

Mean Wind Speed (mph) = U =	6.8	1996 - 2006 Annual Average wind speed measured at the Pasco, WA airport (http://www.wrcc.dri.edu/htmlfiles/westwind.final.html)
Manure Moisture Content (%) = M =	30	Estimate based on a final moisture content estimate of 5%
k =	0.35	
NT =	4	Number of times the manure marshaling area is turned annually

Manure in Marshaling Area (tons/year)	PM_{10} Emissions Factor (lbs/ton manure)/Turning Operation[1]	Annual PM_{10} Emissions (lbs/yr)	24-HR Emissions Rate (lbs/hr)	24-HR Emissions Rate (g/s)	Sprinkler Dust Suppression BMP Used?	Effective Reduction in Dust Emissions (%)	Annual PM_{10} Emissions w/BMP Implemented (lbs)	24-HR Emissions Rate w/BMP (lbs/hr)	24-HR Emissions Rate w/BMP (g/s)
88,400	0.00033926	119.96	0.01369	1.73E-03	Yes	50%	59.98	0.0068	0.000863

1. Calculated using US EPA Method AP-42, Section 13.2.4, Equation 2 and adapted to include number of times per year the piles are turned. Thus, the Emissions Factor, or $EF = k\ (0.0032)\ [(U/5)^{1.3} / (M/2)^{1.4}]\ NT$

Dust Emissions from Wind Erosion of Manure Stored in Marshaling Area

Estimated dust emissions from the manure stored in the Marshaling area were calculated using the US EPA Alternative Method discussed on pg. 9.8, WRAP Fugitive Dust Handbook (2006), as follows:

$EF_{PM10} = [0.85 \times (s/1.5) \times (f/15)]$ lb/day/acre

$EF_{PM2.5} = [0.13 \times (s/1.5) \times (f/15)]$ lb/day/acre

f = percentage of time the unobstructed wind speed is greater than 12 mph at the mean pile height (assumed to be 50%)

s = silt content of the material (assumed to be similar to soils in area, 50% on a weight basis)

Manure Marshaling Area Size (Acres)	PM_{10} Emissions Factor (lbs/day/acre)	Daily PM_{10} Emissions (lbs/day)	Annual PM_{10} Emissions (lbs/yr)	24-HR Emissions Rate (lbs/hr)	24-HR Emissions Rate (g/s)
8.00	0.009444	0.075556	27.58	0.003148	0.000397

4. Feed Mill/Hay Grinder Estimated Dust Emissions

Constraints

Grains/lb. = 7,000

Emissions Control Technology: Cyclone baghouse

Location/Name	Emission Rate (gr/cu ft)	Fan Size CFM (cu ft/min)	Hours of Operation per Week	Annual PM_{10} Emissions (lbs/year)	24-HR Emissions Rate (lbs/hr)	24-HR Emissions Rate (g/s)
Air Discharge, Hay Processor	0.005000	8,200	20	365.49	0.04172	0.005257

	Annual Feed Throughput (tons)	Emission Factor[4] (lb PM_{10}/ton feed)	Control Equipment	Control Factor	Annual PM_{10} Emissions (lbs/year)	24-HR Emissions Rate (lbs/hr)	24-HR Emissions Rate (g/s)
Grain Receiving Area	45,000	0.00250	b, c	0.790	23.6	0.00270	0.000340
Grain Storage Area (grain moved twice before use)	90,000	0.00630	d	0.995	2.8	0.00032	0.000041
Feed Loading Area	273,750	0.00080	c	-	219.0	0.02500	0.003150

a) Emission Factors: AP-42; 9.9.1.2; Supplement D 5th Edition; 3-03 Particulate Emission Factors for Grain Processing Facilities - Animal Feed Mills

b) Mechanical baffle system in the receiving pit. University of Oklahoma study, 1994; AP 42, 9.9.1, Section Development 4.1.27 Reference 58 (1994). Study saw a 21% reduction in dust emission. Control Factor = 0.79.

c) Shrouding or enclosure around pit area and load-out area, enclosed conveyor systems; and equipment designed to quickly achieve "choke flow" unloading are frequently mentioned as standard components in the definition of "modern feed mills" and as such are already considered in the emission factor

d) Exhaust gas volume through the passive bin vent filters equals the volume displaced by the grain filling the bin and is a function of the annual throughput. This can be described as: Tons per year x 44.643 (ft^3/ton) x .005 gr./scf x 1 lb/7,000 grains = lbs PM per year/2000 = tons PM per year.

5. Feed Mill Boiler Combustion Estimated Dust Emissions

Boiler System Constraints

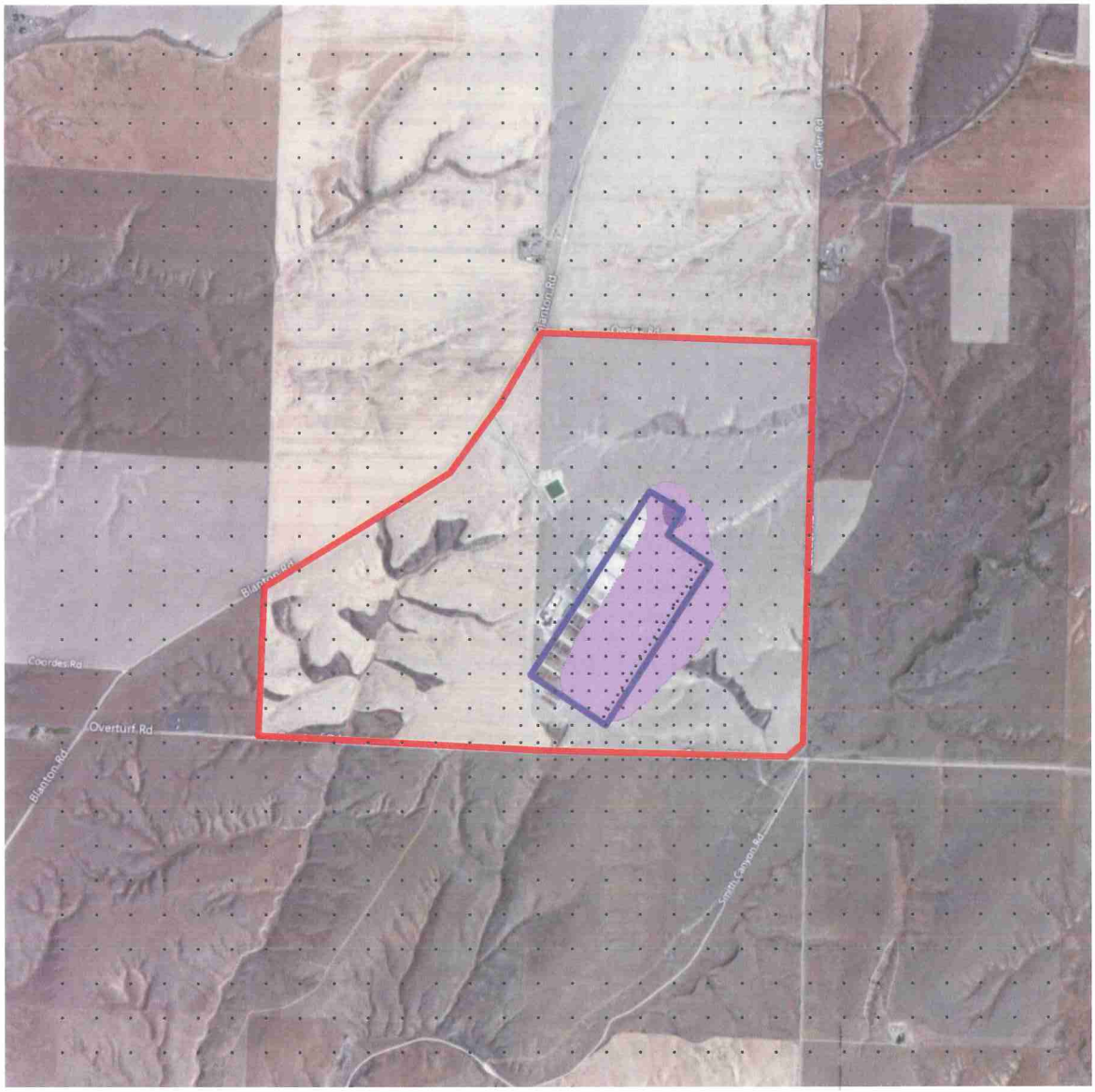
Boiler Model: Cleaver-Brooks Packaged Boiler Model # CB(LE)-700-200-150, Serial # T1580-1-1

Altitude (ft):	1,000	Firing Rate:	100.00	Percent (%)
Operating Pressure (psig):	100	CO:	0.03820	lb/mmbtu
Furnace Volume (cuft):	46.88	NOx:	0.01600	lb/mmbtu
Furnace Heat Release (btu/hr/cuft):	169,241	NO:	0.01400	lb/mmbtu
Input (btu/hr):	7,934,000	NO_2:	0.00200	lb/mmbtu
Horsepower (HP):	200	SOx:	0.00170	lb/mmbtu
NOx System:	9	VOCs:	0.00440	lb/mmbtu
		$PM10_{filterable}$:	0.01000	lb/mmbtu
		$PM10_{condensable}$:	0.00250	lb/mmbtu
		$PM2.5_{filterable}$:	0.01000	lb/mmbtu
		$PM2.5_{condensable}$:	0.00250	lb/mmbtu

Boiler Unit Operations Data	Boiler Operations (hr/wk)	Feed Mill Operations (wk/yr)	Heat Generated (mmBTU/yr) Using Propane
	48.00	52.00	19803.26

Emissions Calculations

	CO	NOx	NO	NO_2	SOx	VOCs	$PM10_{filterable}$	$PM10_{cond.}$	$PM2.5_{filterable}$	$PM2.5_{cond.}$
lbs/yr	756.48	316.85	277.25	39.61	33.67	87.13	198.03	49.51	198.03	49.51
tons/yr	0.38	0.16	0.14	0.02	0.02	0.04	0.10	0.02	0.10	0.02
24-HR (lb/hr)	0.0864	0.0362	0.0316	0.0045	0.0038	0.0099	0.0226	0.0057	0.0226	0.0057
24-HR (g/s)	0.010881	0.004557	0.003988	0.000570	0.000484	0.001253	0.002848	0.000712	0.002848	0.000712



LEGEND

- Site Boundary
- CAFO Boundary
- AERMOD Calculation Point

N

0 0.25 0.5

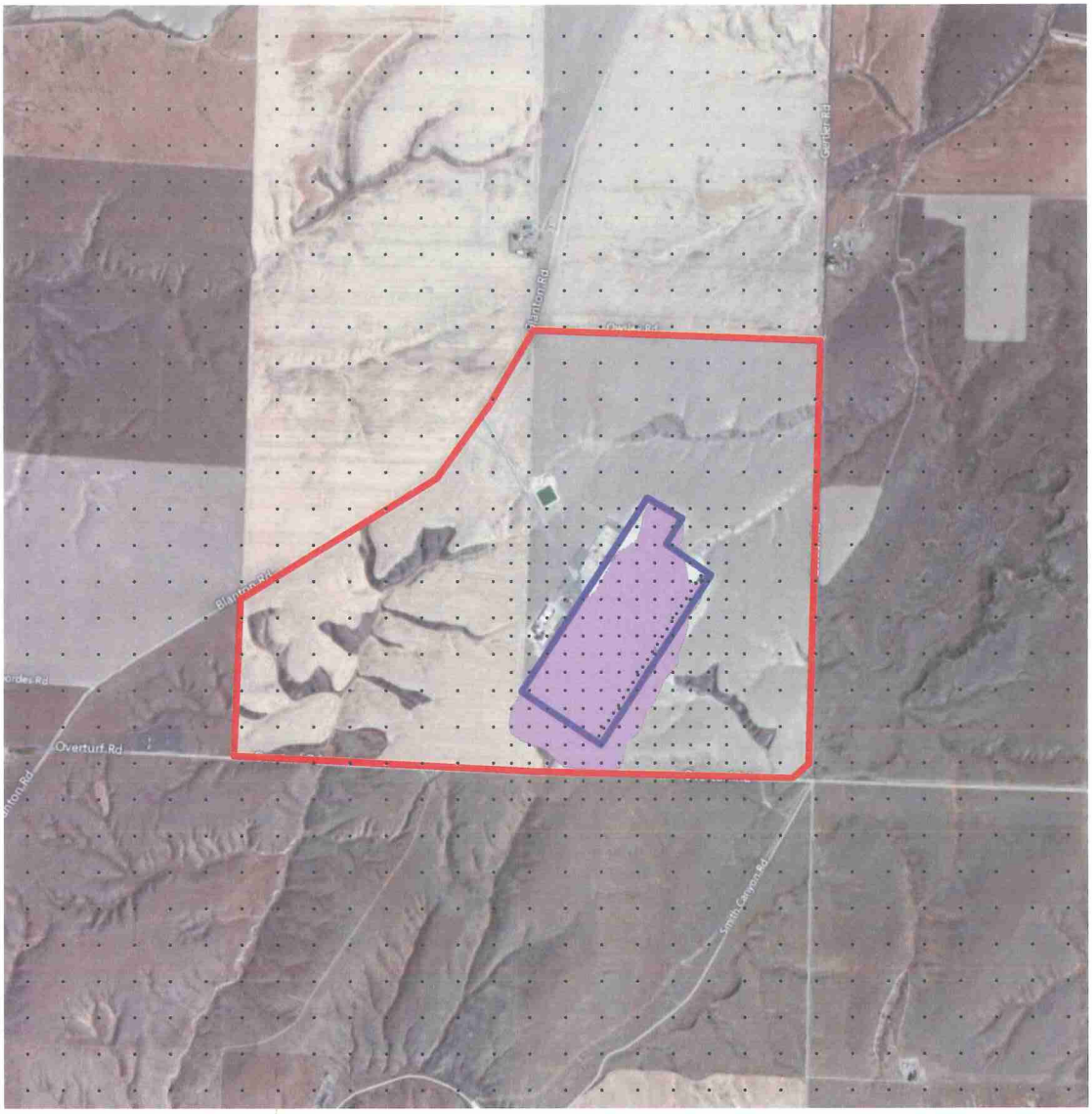
Scale: Miles

Kennedy/Jenks Consultants

Easterday Ranches Air Dispersion Modeling
Franklin County, Washington

H_2S Emissions with Existing BMPs Concentrations for Peak 24-hour Average On August 4, 2010

K/J 1264012*00
July 2013
Figure 1



LEGEND

- Site Boundary
- CAFO Boundary
- AERMOD Calculation Point

N

0 0.25 0.5

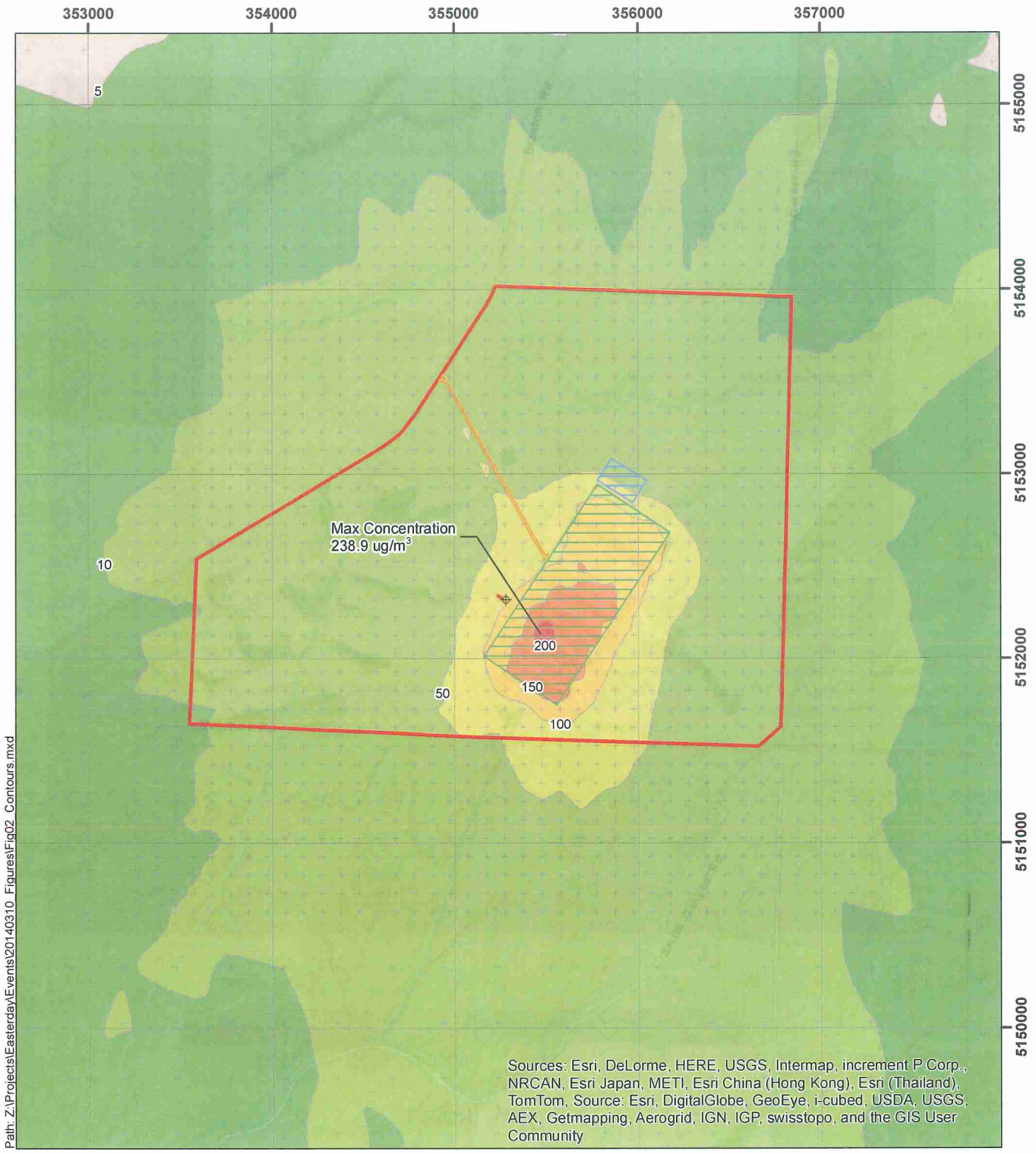
Scale: Miles

Kennedy/Jenks Consultants

Easterday Ranches Air Dispersion Modeling
Franklin County, Washington

NH_3 Emissions with Existing BMPs Concentrations for Peak 24-hour Average On August 16, 2011

K/J 1264012*00
July 2013
Figure 2



Legend

- Receptors
- Feed Mill Boiler
- Feed Mill Hay Grinder
- Vehicle Dust Area
- CAFO - Feedlot
- Manure Marshalling Area
- Site Boundary

Concentration Contours ug/m3

- >5
- >10
- >50
- >100
- >150
- >200

N

0 1,200 2,400

Scale: Feet

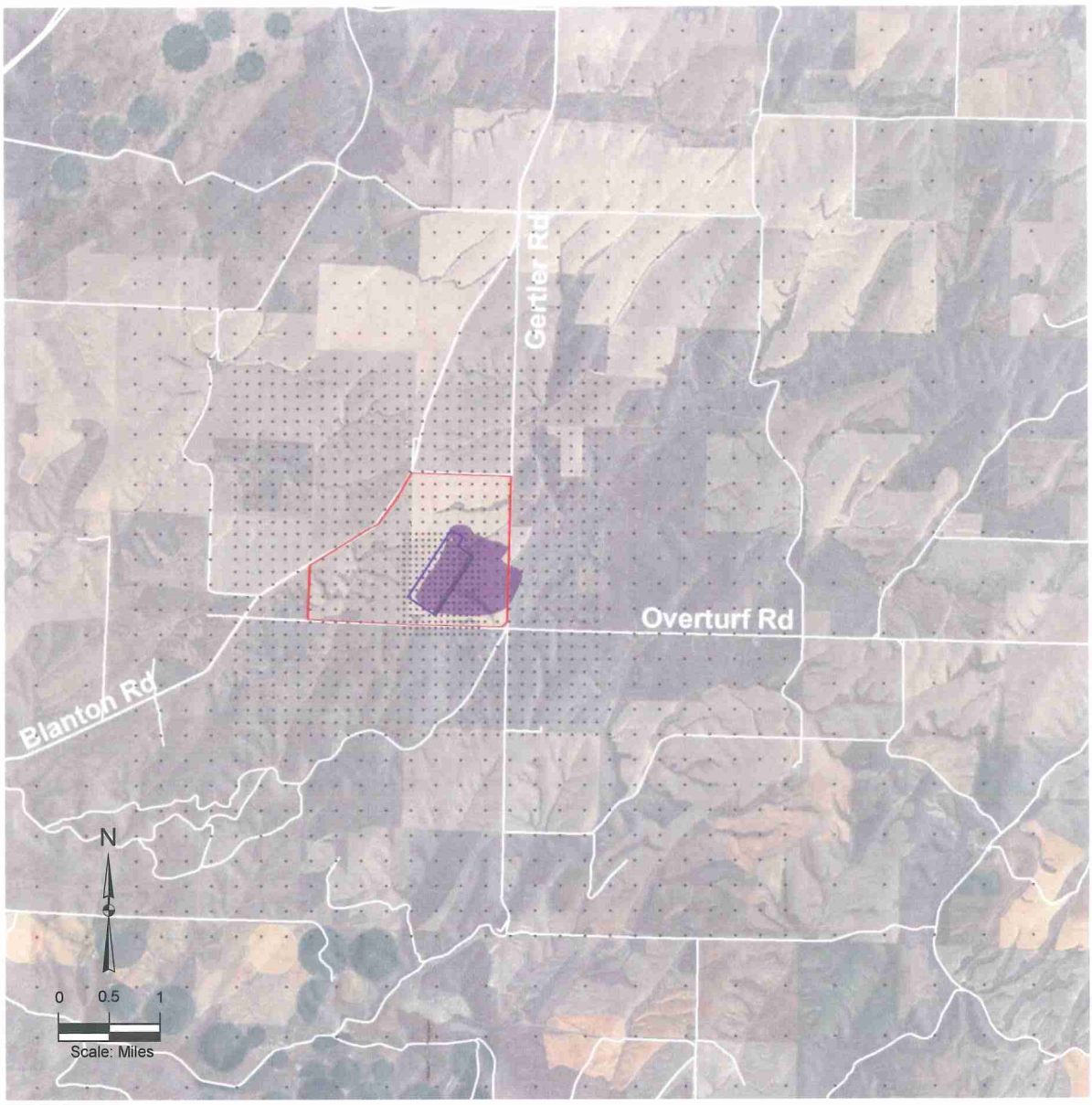
Kennedy/Jenks Consultants

Easterday Ranches Air Dispersion Modeling
Franklin County, Washington

PM10 Emissions
24-Hour Averaging Period

K/J 1264012*00
March 2014

Figure 2



LEGEND

- Site Boundary
- CAFO Boundary
- AERMOD Calculation Point

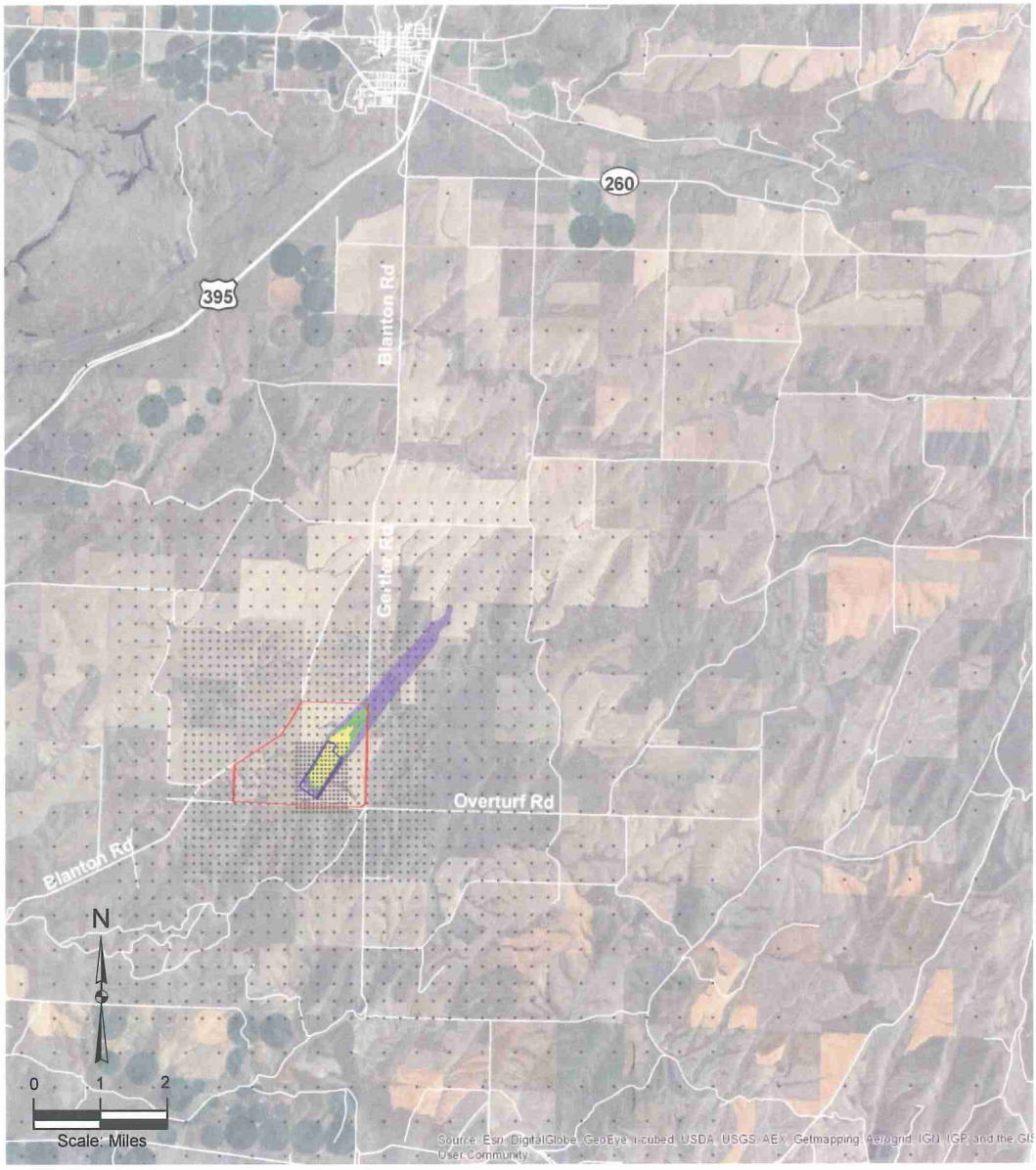
Kennedy/Jenks Consultants

Easterday Ranches Air Dispersion Modeling
Franklin County, Washington

Odor Potential Using H_2S as an Odor Proxy
Maximum 1-Hr Average Concentration
On August 4, 2010

K/J 1264012*00
November 2013

Figure 4



LEGEND

- Site Boundary
- CAFO Boundary
- AERMOD Calculation Point

Kennedy/Jenks Consultants

Easterday Ranches Air Dispersion Modeling
Franklin County, Washington

Odor Potential Using NH_3 as an Odor Proxy
Maximum 1-Hr Average Concentration
On August 27, 2007

K/J 1264012*00
December 2013

Figure 5

APPENDIX B

Feed Mill

We are proposing to have the limit changed for the maximum annual receiving of dry grain.

To reflect our anticipated needs for the foreseeable future, we ask that the limit be increased from (the current) 24,000 tons year to 45,000 tons per year.

The annual receiving of 45,000 tons of grain per year have been included in the emissions calculations in Appendix A, Table A2, (4. Feed Mill/Hay Grinder Estimated Dust Emissions).

Boiler

Boiler information:

Manufacturer: Cleaver Brooks

Model: CB(LE)-700-200-150

Serial#: T1580-1-1

Fuel Consumption: See Cleaver-Brooks Expected Emission Data in Appendix B, page 2 and 3 for fuel consumption and emissions.

We are proposing a limit of 19,980mmBTU/year for the boiler.

With a dedicated fuel source for the boiler only, we would use monthly fuel purchases and/or fuel delivery slips for verifying the fuel burned through the boiler does not exceed the 19,980mmBTU/year.

Cleaver-Brooks Boiler Expected Emission Data

Producing Steam Firing **Propane Air**

BACKGROUND INFORMATION

Date	10/14/13	Boiler Model	CB(LE)
Author	L.C. Banks	Altitude (feet)	1000
Customer	Easterday Farms	Operating Pressure (psig	100.00
City & State	Pasco , WA.	Furnace Volume (cuft)	46.88
		Furnace Heat Release (btu/hr/cu ft)	169,241
		Heating Surface (sqft)	1000
		Nox System	9

Propane Air		Firing Rate			
		25%	**50%**	**75%**	**100%**
Horsepower		50	100	150	200
Input , Btu/hr		1,986,000	3,958,000	5,949,000	7,934,000
CO	ppm	150	50	50	50
	lb/MMBtu	0.1145	0.0382	0.0382	0.0382
	lb/hr	0.23	0.15	0.23	0.30
	tpy	0.996	0.662	0.995	1.326
NOx	ppm	13	13	13	13
	lb/MMBtu	0.0160	0.0160	0.0160	0.0160
	lb/hr	0.03	0.06	0.10	0.13
	tpy	0.139	0.278	0.417	0.557
NO	ppm	10.9	10.9	10.9	10.9
	lb/MMBtu	0.014	0.014	0.014	0.014
	lb/hr	0.03	0.05	0.08	0.11
	tpy	0.11	0.22	0.33	0.45
NO_2	ppm	1.9	1.9	1.9	1.9
	lb/MMBtu	0.002	0.002	0.002	0.002
	lb/hr	0.00	0.01	0.01	0.02
	tpy	0.03	0.06	0.08	0.11
SOx	ppm	1.00	1.00	1.00	1.00
	lb/MMBtu	0.0017	0.0017	0.0017	0.0017
	lb/hr	0.0035	0.0069	0.0104	0.0138
	tpy	0.015	0.030	0.045	0.061
VOCs	ppm	10	10	10	10
(Non-Methane Only)	lb/MMBtu	0.0044	0.0044	0.0044	0.0044
VOCs does not include	lb/hr	0.009	0.017	0.026	0.035
any background VOC	tpy	0.038	0.076	0.114	0.152
emissions.					
PM10 (Filterable)	ppm	N/A	N/A	N/A	N/A
	lb/MMBtu	0.0100	0.0100	0.0100	0.0100
	lb/hr	0.020	0.040	0.059	0.079
	tpy	0.087	0.173	0.261	0.348
PM10 (Condensable)	lb/MMBtu	0.0025	0.0025	0.0025	0.0025
	tpy	0.011	0.04	0.011	0.09
PM2.5 (Filterable)	lb/MMBtu	0.010	0.010	0.010	0.010
	tpy	0.044	0.17	0.044	0.35
PM2.5 (Condensable)	lb/MMBtu	0.0025	0.0025	0.0025	0.0025
	tpy	0.011	0.04	0.011	0.09
Exhaust Data					
Temperature, F		335	360	375	380
Flow	ACFM	632	1,300	1,990	2,671
	SCFM (70 Degrees Fah.)	416	830	1,248	1,664
	DSCFM	381	759	1,140	1,521
	lb/hr	1,874	3,735	5,614	7,487
Velocity	ft/sec	7.55	15.52	23.77	31.90
	ft/min	453	931	1,426	1,914

Notes:

1) All ppm levels are corrected to dry at 3% oxygen.
2) Emission data based on actual boiler efficiency.
3) % H2O , by volume in exhaust gas is **13.50** % O2, by volume **3.77**
4) Water vapor in exhaust gas is **81.05** lbs/MMBtu of fuel fired
5) CO2 produced is **137.19** lbs/MMBtu of fuel fired
6) Particulate is exclusive of any particulates in combustion air or other sources of residual particulates from material. PM level indicated on this form is based on combustion air and fuel being clean and turndown up to 4:1.
7) Heat input is based on high heating value (HHV).
8.) Emission produced in tons per year (tpy) is based on 24 hours per day for 365 days = 8,760 hours per year
9.) Exhaust data is based on a clean and properly sealed boiler.
10.) Emission data is based on a burner turndown of 4 to 1 above 40 hp.
11.) Maximum flame temperature is 2800 degrees fahrenheit.

14) Fuel High Heating Value = **1371** Btu/FT^3

Cleaver-Brooks Boiler Expected Emission Data

Producing Steam Firing **Nat Gas**

BACKGROUND INFORMATION

Date	10/14/13	Boiler Model	CB(LE)
Author	L.C. Banks	Altitude (feet)	1000
Customer	Easterday Farms	Operating Pressure (psig	100.00
City & State	Pasco , WA.	Furnace Volume (cuft)	46.88
		Furnace Heat Release (btu/hr/cu ft)	173,549
		Heating Surface (sqft)	1000
		Nox System	9

Nat Gas		Firing Rate			
		25%	**50%**	**75%**	**100%**
Horsepower		50	100	150	200
Input , Btu/hr		2,036,000	4,058,000	6,100,000	8,136,000
CO	ppm	150	50	50	50
	lb/MMBtu	0.1124	0.0375	0.0375	0.0375
	lb/hr	0.23	0.15	0.23	0.30
	tpy	1.003	0.666	1.001	1.336
NOx	ppm	9	9	9	9
	lb/MMBtu	0.0111	0.0111	0.0111	0.0111
	lb/hr	0.02	0.04	0.07	0.09
	tpy	0.099	0.197	0.296	0.395
NO	ppm	7.7	7.7	7.7	7.7
	lb/MMBtu	0.009	0.009	0.009	0.009
	lb/hr	0.02	0.04	0.06	0.08
	tpy	0.08	0.16	0.24	0.32
NO_2	ppm	1.4	1.4	1.4	1.4
	lb/MMBtu	0.002	0.002	0.002	0.002
	lb/hr	0.00	0.01	0.01	0.01
	tpy	0.02	0.04	0.06	0.08
SOx	ppm	1.00	1.00	1.00	1.00
	lb/MMBtu	0.0017	0.0017	0.0017	0.0017
	lb/hr	0.0035	0.0070	0.0105	0.0140
	tpy	0.015	0.030	0.046	0.061
VOCs	ppm	10	10	10	10
(Non-Methane Only)	lb/MMBtu	0.0043	0.0043	0.0043	0.0043
VOCs does not include	lb/hr	0.009	0.017	0.026	0.035
any background VOC	tpy	0.038	0.076	0.115	0.153
emissions.					
PM10 (Filterable)	ppm	N/A	N/A	N/A	N/A
	lb/MMBtu	0.0100	0.0100	0.0100	0.0100
	lb/hr	0.020	0.041	0.061	0.081
	tpy	0.089	0.178	0.267	0.356
PM10 (Condensable)	lb/MMBtu	0.0025	0.0025	0.0025	0.0025
	tpy	0.011	0.04	0.011	0.09
PM2.5 (Filterable)	lb/MMBtu	0.010	0.010	0.010	0.010
	tpy	0.044	0.18	0.044	0.36
PM2.5 (Condensable)	lb/MMBtu	0.0025	0.0025	0.0025	0.0025
	tpy	0.011	0.04	0.011	0.09
Exhaust Data					
Temperature, F		335	360	375	380
Flow	ACFM	656	1,349	2,067	2,773
	SCFM (70 Degrees Fah.)	432	862	1,295	1,728
	DSCFM	387	772	1,161	1,548
	lb/hr	1,945	3,877	5,829	7,774
Velocity	ft/sec	7.83	16.12	24.68	33.12
	ft/min	470	967	1,481	1,987

Notes:

1) All ppm levels are corrected to dry at 3% oxygen.
2) Emission data based on actual boiler efficiency.
3) % H2O , by volume in exhaust gas is **16.05** % O2, by volume **3.81**
4) Water vapor in exhaust gas is **99.39** lbs/MMBtu of fuel fired
5) CO2 produced is **116.31** lbs/MMBtu of fuel fired
6) Particulate is exclusive of any particulates in combustion air or other sources of residual particulates from material. PM level indicated on this form is based on combustion air and fuel being clean and turndown up to 4:1.
7) Heat input is based on high heating value (HHV).
8.) Emission produced in tons per year (tpy) is based on 24 hours per day for 365 days = 8,760 hours per year
9.) Exhaust data is based on a clean and properly sealed boiler.
10.) Emission data is based on a burner turndown of 4 to 1 above 40 hp.
11.) Maximum flame temperature is 2800 degrees fahrenheit.

14) Fuel High Heating Value = **1000** Btu/FT^3