Technical Support Document

for

Dairy Air Quality Task Force Report

Foreword

This Technical Support Document (TSD) provides a record of the Oregon Dairy Air Quality Task Force discussion and inquiry. It highlights:

- The dairy industry in Oregon
- The federal and state regulatory framework affecting the dairy industry
- The type of air emissions produced by dairy operations
- The public health and environmental issues
- The state-of-the science for estimating dairy emissions
- Current research, and
- Options for reducing emissions from dairy operations.

It was created to provide a contextual background so the Task Force members could have a common understanding of the complicated and evolving issues facing them. It includes a broad overview of the regulatory and scientific issues related to quantifying, managing, and reducing air emissions from dairy operations.

The information contained in this report was found by the Oregon Department of Agriculture, the Oregon Department of Environmental Quality, and the Oregon Department of Health Services, as well as by Task Force members. Throughout the process, Task Force members were encouraged to gather, summarize, and present the information they deemed necessary to create a comprehensive and balanced report. That information is contained in this TSD. Over the course of the process, the Task Force explored and discussed some, but not all, of the information collected.

This document is not an exhaustive treatment of the issues, given the volume of information and differing views on these subjects. Some of the material is peer reviewed and other materials are not. Some of the material deals with dairies and other materials do not. The inclusion of materials in this TSD is not a Task Force endorsement of the content, but instead, a summary of the cited materials, which may or may not have been reviewed and discussed by the Task Force. The Dairy Air Advisory Committee should review the TSD material and decide what they will consider and how they will weight it when they make their recommendations.

Please note that several sections refer to the Appendices where the bulk of the background information is provided for the interested reader to review independently the source documents. Each Appendix is part of this TSD and is incorporated herein by this reference. Each Appendix is hyperlinked to the Web site from the Table of Contents.

To view, click on the title and you will be directed to the Web site. Appendix A provides a glossary of terms and a list of acronyms used throughout the document. The Meeting Notes are in Appendix T, the Presentations to the Task Force are in Appendix U, and the Public Comments are in Appendix V.

Ultimately, the Task Force discussions lead to the Findings and Recommendations in the Dairy Air Quality Task Force Final Report. The contents of that Report, control over the contents of this document, where inconsistent.

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I. BACKGROUND

I.A. What does SB 235 require?

Until 2007, Oregon law exempted agricultural operations from air quality regulations with the exception of field burning in the Willamette Valley. In the fall of 2005, several environmental and public interest groups argued that Oregon's statute could not exempt agriculture from regulation if those regulations were necessary to comply with the Clean Air Act.

Senate Bill 235 addressed the inconsistency between state and federal law by allowing the Oregon Environmental Quality Commission to regulate agricultural operations to the extent needed under the Clean Air Act. The bill directs the Oregon Department of Environmental Quality (DEQ) and the Oregon Department of Agriculture to enter into a Memorandum of Understanding about implementing federal Clean Air Act requirements for agriculture.

In addition, Senate Bill 235 establishes a Task Force on Dairy Air Quality, which is charged with presenting findings and recommendations to the DEQ and ODA for reducing dairy air pollutant emissions. The findings and recommendations of the Task Force may include, but need not be limited to findings and recommendations for technical studies, voluntary actions, regulation, and proposed legislation. These recommendations are not limited to current requirements of the federal Clean Air Act.

Senate Bill 235 directs the Task Force to provide its Findings and Recommendations to DEQ and ODA by July 1, 2008. ODA and DEQ are directed to jointly report on dairy air quality to an interim committee related to agriculture or natural resources no later than October 1, 2008. The report will include any recommendations of the departments for proposed legislation to reduce the emission of air contaminants by dairies.

Currently, the State of Oregon does not regulate emissions from dairy operations. According to state statutes, the Environmental Quality Commission, DEQ's policymaking Board, does not have the authority to regulate agricultural operations beyond what the Clean Air Act allows. The Task force can make recommendations to the EQC to adopt a rule that is not otherwise compliant with the Clean Air Act.

I.B. Task Force Charge

Pursuant to SB 235, the Task Force is charged with making findings and recommendations concerning the following topics:

Study the air emissions from dairy operations, including but not limited to, emissions regulated under the Clean Air Act.

Study the available data on air emissions, including but not limited to, the United States Environmental Protection Agency national air study of animal feeding operations.

Evaluate alternatives for reducing air emissions, taking into consideration:

1) The diverse nature and economic viability of dairies and the economic contribution dairies make to the state economy;
2) The impact that federal Clean Air Act regulations have, and that actions to address air emissions would have, on Oregon's dairies in Pacific Northwest markets;
3) The protection of human health, the environment, and scenic and cultural resources;
4) The impact of available alternatives on other environmental media, energy and the cost of producing dairy products; and
5) The feasibility of implementation, given the above factors.

Explore voluntary measures, including education, demonstration projects, and incentive options, together with regulatory and/or legislative options for emission reduction.

I.C. Oregon Dairy Farm Overview

Recently, much attention has been given to the potential effects of air emissions from dairies and how these emissions relate to federal Clean Air Act (CAA) regulations. This section provides background information on dairy farming in Oregon.

There are currently more than 60,000 dairy farms in the United States. Seventy seven per cent of these dairies have herds of less than 100 mature cows. The remaining dairies with herds of more than 100 cows provide 77% of all milk sold in the United States. To place Oregon in context, as of October 31, 2007, there were 370 permitted

dairy operations. Of those 370 permitted dairy operations, 331 of them were milking operations with 116,335 milking cows contained in the milking operations. Of the 331 permitted dairy operations, 39 were registered as large federal concentrated animal feeding operations (CAFOs), meaning that they had 700 or more dairy milking cows. All dairies in Oregon that provide milk for public consumption (grade A licensed) are permitted by the ODA Confined Animal Feeding Operation (CAFO) Program. Milk products were the fifth most valuable agricultural commodity in Oregon in 2006 with a farm gate value of $329,574,000.

During the last decade, the increased cost of fuel, feed, and transportation has had a direct effect on the cost of operating a dairy and, therefore, net dairy income. Farm milk prices are influenced by a combination of market forces and national dairy policy. Milk price volatility has become greater in recent years. This increased volatility is from multiple reasons including globalization; changes in federal milk marketing orders, continued changes in the farm bill, and other economic factors on the supply side. This increased volatility adds challenges for farm business planning, debt repayment, and, in some cases, achieving or maintaining solvency. It should be noted that prices for dairy products are largely out of the dairy operator's control due to two fundamental U.S. policy concepts — (1) price and income support and (2) orderly marketing (refer to Section I.D for further discussion).

Generally, the number of dairy operations in Oregon has remained unchanged in the last several years. Following a national trend, the Oregon industry has seen smaller farms ceasing milking operations or consolidating and the newer operations coming into production tending to be larger than the ones going out of business. The total number of cows in the state has remained fairly steady.

A large geographic movement or relocation of facilities does not seem to be occurring. The three brand new dairy facilities registered to the CAFO Permit in the last 5 years are located on the east side of the Cascades which may signal that this region is where most expansion may occur. However, niche marketing of artisan cheeses and organic production has provided opportunities for dairies to remain in their current locations at approximately current sizes.

The probable trend is for declining numbers of dairies and increasing herd sizes on the remaining farms. It should be noted that Oregon law requires new facilities be located

on lands zoned for agricultural use. The number of dairies registered to the Oregon CAFO Permit and the number of cows in Oregon (Figure 1) shows that the changes vary about 5% over the 5 years sampled.

A NOTE ABOUT STATISTICS USED IN THIS REPORT:

Statistics gathered for this report regarding the number of cows and the number of dairy facilities in Oregon may come from one of two sources. ODA has kept records of such numbers for the last decade. The USDA has also kept records that extend back to early in the 20th century. These two sources use different techniques to come to their final numbers. ODA has a database of CAFO facilities in Oregon that contains these numbers. For dairies, this means that only permitted grade A facilities that supply milk for public consumption are part of ODA's record. USDA collects information from each facility through surveys and marks every facility that milks cows as a "dairy." The result is that USDA statistics will report much higher numbers of dairies than ODA's statistics, yet the number of dairy animals will vary by less than 1% between the two sources.

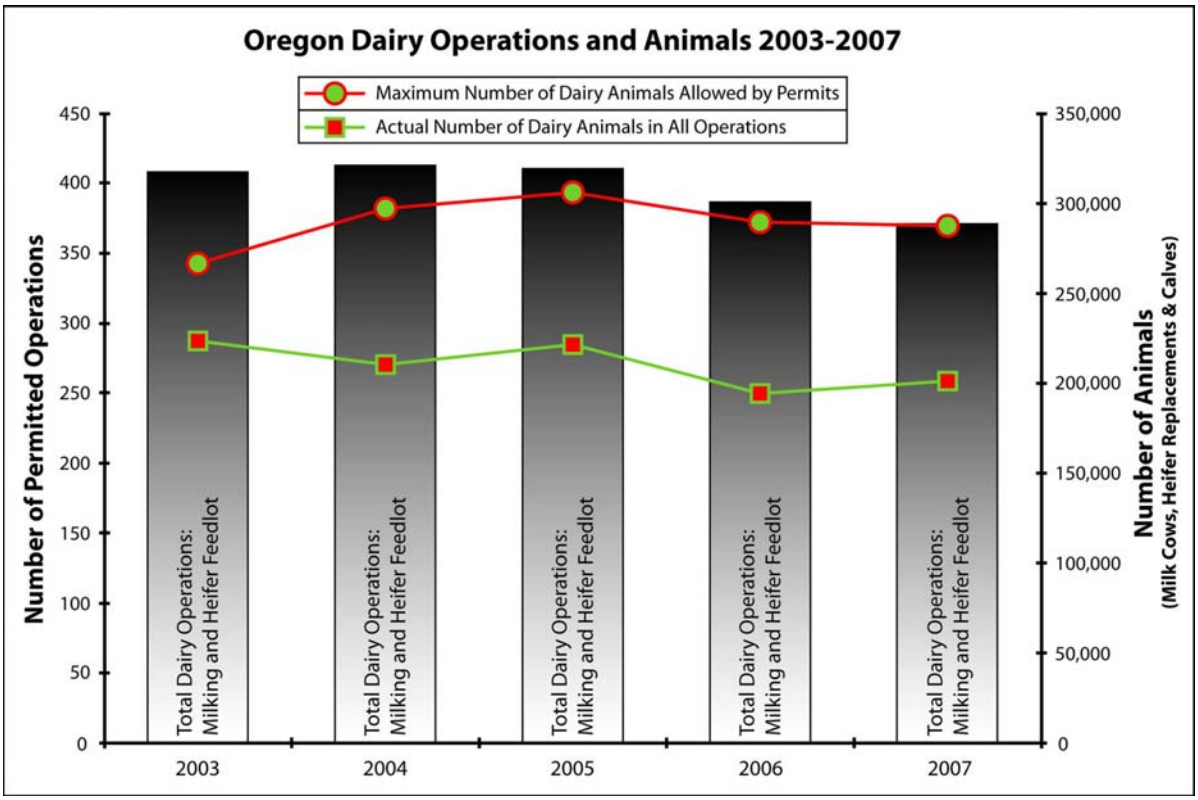


Figure 1. Oregon CAFO Program permitted dairy operation numbers plotted against the amount of all dairy animals in Oregon for the years 2003-2007. Also plotted is the maximum number of dairy animals allowed on all operations based on permit conditions. On average, the amount of animals at any given operation is approximately 30% less than the maximum number allowed based on permit conditions.

Please note that the total number of dairy operations on this graph includes both milking facilities and heifer replacement feedlots. Statistics in this graph are drawn from the ODA CAFO database and were current as of 10/31/2007. (Note: Five years versus ten years of data is reported because of a change in the statute and resulting permit five years ago.)

Table 1. Summary of dairy operation numbers and dairy animal amounts by type for the years 2003-2007

Oregon Statewide Dairy Facility & Animal Totals 2003-2007

Year	Number of Permitted Dairy Facilities of All Types	Number of Milk Cows on Dairies	Number of Dairy Replacement Heifers	Number of Dairy Calves	Number of Dairy Animals in All Operations	Maximum Number of Animals Allowed by Permits	Percent Capacity
2003	409	134,824	62,183	27,210	224,217	267,078	84%
2004	414	141,100	52,183	17,755	211,038	297,870	71%
2005	411	136,611	68,920	16,586	222,117	306,713	72%
2006	388	115,072	63,049	16,729	194,850	290,242	67%
2007	370	116,335	67,928	17,477	201,740	288,075	70%

"Percent Capacity" refers to the ratio of the number of dairy animals in all operations to the maximum number of animals allowed by permits for each year. Please note that the number of permitted facilities of all types includes both milking facilities and heifer replacement feedlots. Statistics in this graph are drawn from the ODA CAFO database and were current as of 10/31/2007. (Note: Five years versus ten years of data is reported because of a change in the statute and resulting permit five years ago.)

I.D What is the dairy industry's contribution to Oregon's economy and what factors affect the economic viability of dairies in Oregon?

Oregon dairies are a significant component of the state's economy. Value of milk production for 2006 was approximately $330 million As mentioned in section I.C, prices for dairy products are largely out of the dairy producer's control due to two fundamental U.S. dairy policy concepts — (1) price and income support and (2) orderly marketing. These concepts are further discussed below.

I.D.1. Milk Price Support Purchase Program

Under the Agricultural Act of 1949, the Secretary of Agriculture supports the price of milk through the Commodity Credit Corporation (CCC) by purchasing dairy products at predetermined prices, called the support price. These predetermined support prices are calculated to enable dairies to pay that price given the costs of producing milk at an average level of efficiency. There are many factors which impact and cause fluctuations

in the support price. Dairies can receive (and have received) less than the support price, depending on supply and demand conditions, milk composition, and market competitiveness.

I.D.2. Orderly Marketing

Federal milk marketing orders (FMMOs) are regulations issued by the Secretary of Agriculture under the authority of the Agricultural Marketing Agreement Act of 1937. The objective of FMMOs is to promote an orderly system of milk marketing to ensure that adequate supplies of milk and dairy products meet consumers' demands at reasonable prices.

FMMOs potentially impact the consumption of dairy products through their price effects. For instance, when FMMOs raise the minimum price of milk used in beverage and perishable manufactured dairy products (i.e. cream products, cottage cheese, ice cream, and related products) above levels acceptable to the consumer, then the quantities demanded of these products will drop. In theory, the milk diverted away from these perishable products then lowers the price of milk used in the hard manufactured products (i.e. cheese, butter, and dried milk products), which, in turn, increases their consumption.

In the 1996 Farm Act, Congress required that the number of FMMOs be reduced and that several pricing issues be reexamined. The reform of the FMMO system, effective January 1, 2000, reduced the number of FMMOs to better reflect the modern distribution and consumption of milk products. It also made changes to pricing provisions to provide incentives for greater structural efficiencies in the assembly and shipment of milk for fluid milk products.

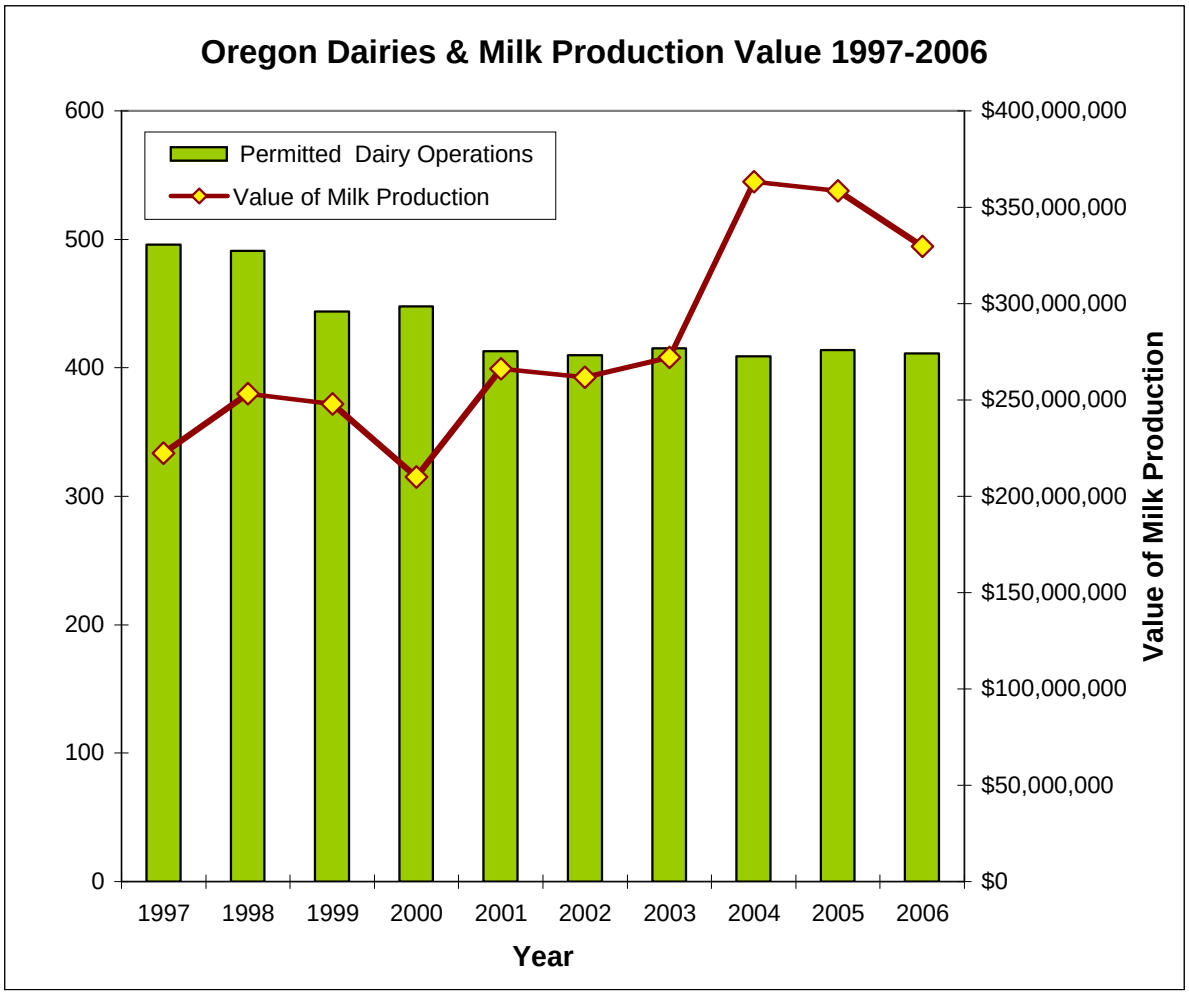


Figure 2. Number of CAFO program permitted dairies in Oregon compared to the value of milk production for the years 1997-2006. Numbers for permitted dairy operations are drawn from the ODA CAFO database. Numbers for milk production value are drawn from the USDA statistics database. Data is representative of what was available and accurate as of 10/31/2007.

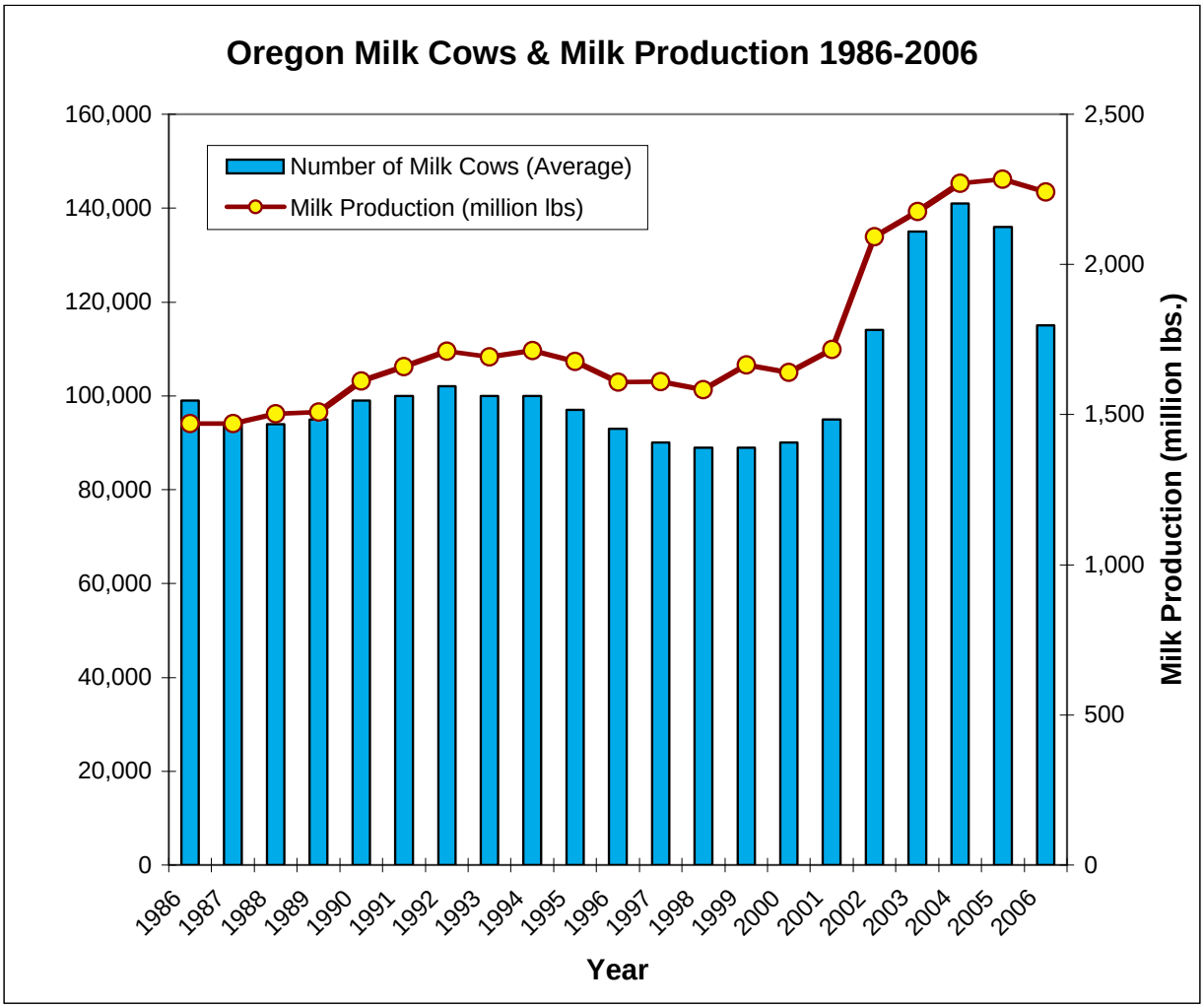


Figure 3. Number of Oregon milk cows and amount of milk produced for the years 1986-2006. The number of milk cows for the years 1997-2006 is drawn from the ODA CAFO database; all other years are from the USDA statistics database. Amount of milk production for all years is drawn from the USDA statistics database. Data is representative of what was available and accurate as of 10/31/2007.

I.E. What diversity exists amongst dairies and within the dairy industry in Oregon?

There are 370 permitted dairies in Oregon, which includes farms that are family-owned and operated to large-scale dairy operations that are corporately owned. Oregon dairies range in size from 25 to 16,000 cows and produce both conventional and organic milk.

Dairy production in Oregon spans across the state with at least one permitted dairy

operation in 27 of Oregon's 36 counties. Because of this, there are significant regional differences in the conditions under which Oregon dairies must operate. These include variations in climate (i.e. temperature, humidity, rainfall) and site characteristics (soil types for growing crops, availability of grassland for feed, etc.). The variation in these conditions affects what types of approaches and challenges operators must evaluate when considering changing the production system to address existing and future environmental regulations.

Currently, dairy production systems in Oregon include pasture-based production systems, partial confinement in free stall barns, total confinement in free stall barns, and dry lot operations.

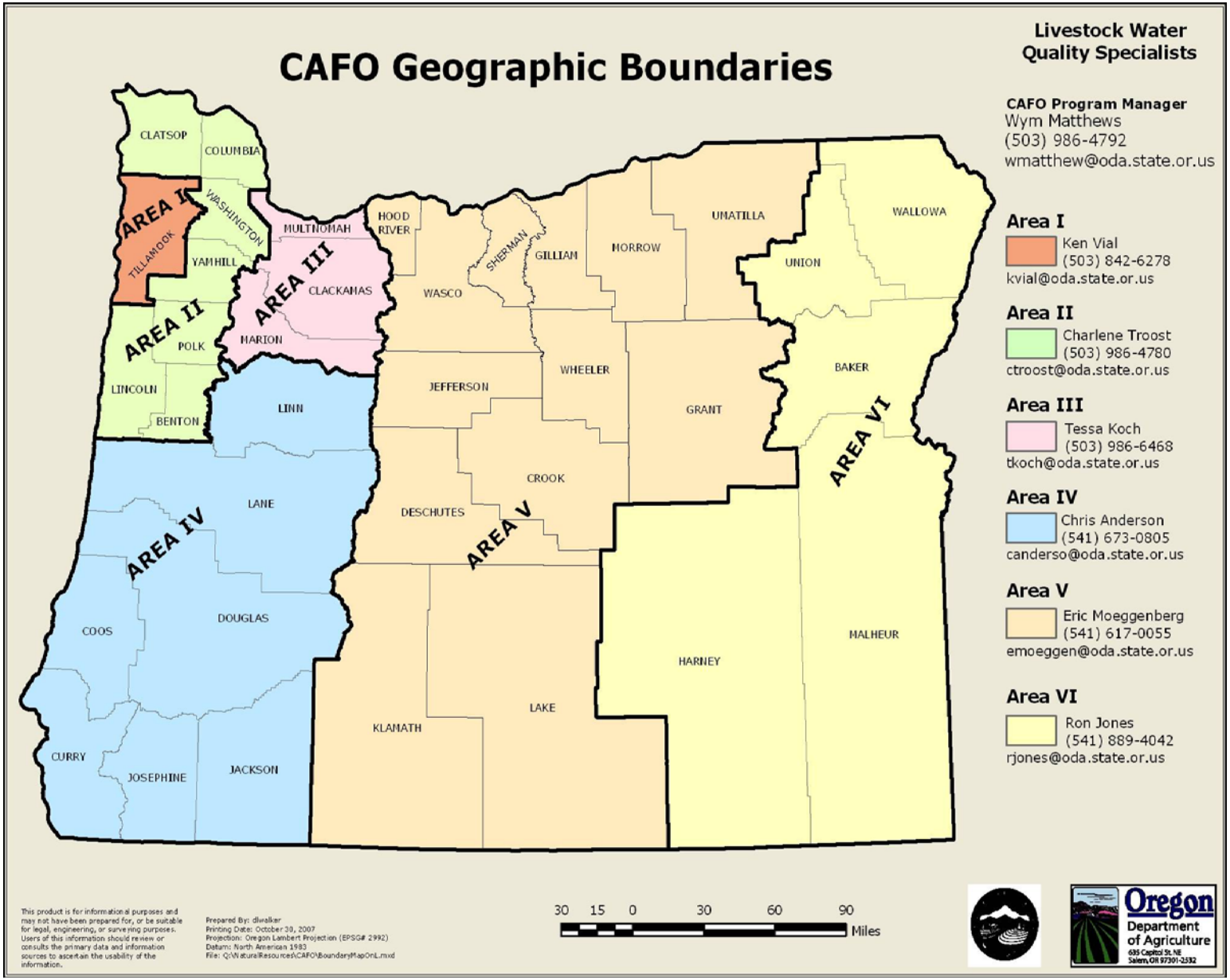


Figure 4. Map of the Oregon Department of Agriculture (ODA) CAFO Program's geographic area boundaries. Each area is covered by one Livestock Water Quality Specialist whose primary duties involve conducting inspections and providing technical

I.E.1. Pacific Coast

Coos, Curry, Lincoln, Tillamook and Clatsop Counties
(All of CAFO Area I, and portions of Areas II and IV; see Figure 4 for area boundaries)

Dairy operations located in this region have a moderate, wet climate that is ideal for both milk production and forage production. There is little variation in temperature from summer to winter and average annual rainfall is 70-80 inches. Heavy winter rains may pose management challenges. Summers are dry and pastures must be irrigated.

This region currently has 155 dairies ranging in size from 25 to 1560 cows. These dairies are generally family-owned and operated. Limitations due to heavy winter rains and amount of available storage for waste may limit herd size. Barns are necessary to shelter animals, farmers and feed from the weather. During the winter months, cows are kept in free stall barns. In the summer, most of the cows are on pasture.

The majority of these dairies harvest a significant amount of the cows' total diet from locally grown forage. Pasture can provide up to 200 days or more of feed during the spring and summer months. Excess pasture grass is ensiled and stored for winter-feeding. In the north, hot weather crops such as corn for ensilage do not do well in the cool climate, but in the south, sorne silage is harvested. Forage harvest is accomplished by having the cows graze the forage from the fields or by mechanically harvesting the forage and delivering it to the cows at the barn. All of the grains and mineral supplements fed to the cows are imported into this region.

The majority of the manure and process wastewater is collected, handled, stored on-site and land applied in a liquid form. Animal Waste Holding Ponds (AWHP) and concrete or glass-lined steel tanks are utilized to store manure and process waste water until it can be applied to fields without discharge to surface or ground waters. The vast majority of manure and process wastewater is utilized as fertilizer to grow the forage that becomes cow feed. There is one community manure digester in the north extracting methane. Some manure solid composting occurs region-wide.

I.E.2. Valley Region, including Southern Oregon

Benton, Columbia, Polk, Washington, Yamhill, Clackamas, Multnomah, Marion, Lane, Linn, Josephine, and Jackson Counties
(All of CAFO Area III, and portions of Areas II and IV; see Figure 4 for area boundaries)

This region has a moderate climate similar to the coast region, but with lower annual rainfall and greater temperature swings. Freezing does occur as well as temperatures over 100 °F. In the Willamette Valley, rainfall averages 38 inches and in southern Oregon, average rainfall is 20 inches. In the Willamette Valley, heavy winter rains may pose management challenges and dry summers require pastures to be irrigated. Southern Oregon is generally dry, so crops require irrigation.

This region currently has 122 dairies ranging in size from 40 to 2000 cows. Most of these dairies are confinement facilities, but some dairies may use irrigated pasture part of the year. Barns are necessary to shelter animals, farmers and feed from the weather. Free stall barns are the predominant type of shelter.

In the Willamette Valley, there are numerous sources of feed. Some irrigated pasture is available and corn and grass silage are common. Local feeds are supplemented with alfalfa hay from eastern Oregon or Klamath County.

The majority of the manure and process wastewater is collected, handled, stored on-site and land applied in a liquid form but manure may also be scraped to underground collection tanks. Water is used in a flush-type system to clean the alleys of the barns. Process wastewater is held in a storage pond. Many operations make use of a solids separator, in which the manure water is run over a screen to remove manure solids. The remaining liquid is utilized as fertilizer to grow the forage that becomes cow feed. The dry, washed solids are often used as bedding, in compost, or exported to other agricultural operations

I.E.3. East of the Cascades

Deschutes, Klamath, Morrow, Umatilla, Baker, and Malheur Counties
(All of CAFO Areas V and VI; see Figure 4 for area boundaries)

This region is characterized by extremes in temperature with a very low average annual rainfall. Summer highs routinely reach over 100 °F and winter lows average 19 °F with some days below 0 °F. Extended periods of freezing do occur and on average, there are 154 frost-free days. All crops must be irrigated due to the annual average rainfall of 10 inches.

This region currently has 54 dairies ranging in size from 43 to 16,000 cows. There are

some large herds in the region due to conducive weather conditions and feed supply. Some of the dairies in the region are fairly small and are often part of a larger diverse farming operation. Barns are not necessary to shelter animals, farmers and feed from the weather. When barns are present, free stall barns are the predominant type of shelter. Open lots or corrals are common only in eastern Oregon. Care must be taken to protect water lines due to the freezing weather.

There are abundant supplies of alfalfa hay and corn for silage. Grain, barley, beet pulp, and other byproducts are available for feed as well. Dairies may use irrigated pasture on the bench lands; however, beef feed lots may compete for feed at times. This area has a limited availability of high-protein grain supplements.

The dry climate is conducive to the management of process wastes. All dairies in this region apply some portion of their manure waste as a dry component to fields for fertilizer.

Table 2: Summary of dairy facility numbers by CAFO geographic area for the years 2003-2006.

Dairy Facilities by Oregon CAFO Area 2003-2006

	2003	2004	2005	2006
Area I	165	165	165	154
Area II	105	91	75	61
Area III	35	52	56	51
Area IV	37	38	47	61
Area V	30	30	29	26
Area VI	37	38	39	35
Total	**409**	**414**	**411**	**388**

Note: all numbers in this table are drawn from the CAFO database and were accurate as of the last day of the year in which they were collected; during the year, numbers can fluctuate by a small amount up or down on a weekly basis.

Prior to the year 2007, due to database limitations, is it not possible to separate milking facility numbers from heifer replacement feedlot numbers. This separation is reflected in Table 3 for the year 2007. Refer to Figure 4 for geographic area boundaries.

Table 3. Summary of dairy milking operation numbers and dairy heifer replacement feedlot numbers by geographic area for the year 2007.

Dairy Milking Operations and Heifer Replacement Feedlots by Area for 2007

	Dairy Milking Operations	Dairy Heifer Feedlots	Total Dairy Facilities
Area I	133	11	144
Area II	45	12	57
Area III	48	2	50
Area IV	51	11	62
Area V	23	2	25
Area VI	31	1	32
Total	**331**	**39**	**370**

Note: all numbers in this table are drawn from the CAFO database and are accurate as of 10/31/2007; numbers can fluctuate by a small amount up or down on a weekly basis. Prior to 2007, database limitations precluded any ability to separate heifer replacement feedlots from milking facilities. As of 2007, these database limitations have been addressed and fixed to the extent possible. Refer to Figure 4 for geographic area boundaries.

I.F. What dairy production systems are common in Oregon?

The two primary types of production systems utilized in all areas of the state are a pasture-based production system and a confined production system. There is variability within production systems due to geography, climate, available land area, and available capital. Each type of production system can be accomplished in a myriad of ways, based on the management style of the operator. Currently, both types of systems can be either conventional or organic.

I.F.1. Pasture-Based Production Systems

These types of operations utilize cows to harvest forage from available pastures. Typically, the cows are confined in wet and/or winter months. Cows in these operations are typically milked two times per day while confined in a milking parlor. All of these dairies have some type of manure storage facility (an above ground liquid tank, a below ground liquid tank, a lagoon, or solid manure dry storage). The percent of manure naturally deposited in pastures by cows varies from 20-80% based on the time of year and climate. The remainder of the manure is collected and placed into storage facilities.

The manure is used as fertilizer to grow forage crops/grain to feed to the dairy animals. A large portion of animal feed is raised on the farm and the rest is purchased and brought in to the operation.

I.F.2. Confined Production Systems

On a confined operation, animals are kept in lots or barns 100% of the time. All feed is delivered to the animals from feed storage facilities. All manure and process waste is collected and stored in various types of facilities (above ground liquid tanks, below ground liquid tanks, lagoons, or solid manure dry storage). Animals in these operations are typically milked two to three times per day and generally have higher milk production. These dairies typically have a larger amount of infrastructure and manure processing equipment when compared to pasture-based production systems. The manure is used as fertilizer to grow forage crops/grain to feed to the dairy animals. Depending on available land, the forage crops required for the herd can be partially to wholly grown on site.

I.G. How are dairies currently regulated by ODA in Oregon?

Today's environmental requirements for dairies are primarily driven by the federal Clean Water Act (CWA). It is possible that certain dairy operations could, in the future, become subject to requirements under the federal Clean Air Act (CAA) once emission estimation methodologies are improved and a more complete and accurate picture of dairy emissions can be developed.

The sections below provide a brief overview of current ODA/DEQ permitting responsibilities as they relate to provisions of the Clean Water Act. Potential applicability of the Clean Air Act is discussed in Section I.M.

I.G.1. State Implementation of the Clean Water Act: The Oregon Confined Animal Feeding Operation (CAFO) Program

The Oregon CAFO program began in the early 1980s to prevent CAFO wastes from contaminating groundwater and surface water. When the program began, the Oregon Department of Environmental Quality (DEQ) was the permit issuing and enforcement authority, and ODA acted as program administrator and investigating authority. This relationship has been modified and changed over time so that currently ODA operates the program under Memoranda of Agreement (MOA) with DEQ and EPA.

Highlights of the current CAFO Permit Program in Oregon:

- National Pollutant Discharge Elimination System (NPDES) Oregon CAFO General Permit (Permit) issued jointly by ODA and DEQ (EQC) in August 2003. EPA approved that the Permit meets NPDES and all Clean Water Act (CWA) requirements
- Permit regulates CAFOs for both surface and ground water standards. EPA only requires surface water regulations.
- Permit requires all federally defined CAFOs and all CAFOs defined in Oregon Rule (603-074-0010(3)(sections 5.1 and 5.2) to register with ODA. Oregon defined CAFOs are much smaller than federally defined CAFOs.
- Most CAFOs are registered to one General Permit. Some CAFOs are registered to Individual NPDES Permits written specifically for that one facility (see discussion below).
- All Permit registrants must prepare an Animal Waste Management Plan (Plan). This plan is incorporated into the Permit as a condition. The Plan must contain EPA minimum required elements. The Plan is site specific and only valid for the individual registrant's operation.
- All proposed new and substantially expanding large federally defined CAFOs are noticed to the public.
- ODA conducts all inspections, permit registrations, and compliance activities in coordination with DEQ and EPA according to MOAs.
- Registrants receive a routine inspection once per year. ODA also conducts complaint inspections, educational reviews and follow-up inspections.
- Every dairy in Oregon with a Grade-A milk shipping license is registered to the CAFO General or Individual Permit(s)

I.G.2. Types of CAFO Permits in Oregon

Federal CAFO Permits

Federal definitions define a dairy concentrated animal feeding operation (CAFO) as the following:

- 700+ dairy cows or 1000 dairy heifers – Large Federal CAFO
- 200-699 dairy cows or 300 heifers with a manure system – Medium Federal CAFO
- 200 mature dairy cows or less than 300 heifers – Small Federal CAFO

Federally defined CAFOs are required to meet the conditions of the National Pollution Discharge Elimination System (NPDES) program.

Oregon CAFO General Permits

Oregon law requires all CAFOs that fall under either of the federal or the state definition (Appendix B), to be permitted by the Oregon CAFO program. One significant difference between the federal and state definitions is that in Oregon if a facility has more than one animal confined for more the four months then it is considered a CAFO. Current CAFO permits require operations to meet the conditions of the National Pollutant Discharge Elimination System (NPDES) program. Most CAFO facilities that require a permit operate under the CAFO General Permit. Facilities that operate in highly environmentally sensitive areas, use experimental technology, or have compliance issues that will take longer than two years to rectify may need to apply for the Individual Permit.

Oregon CAFO Individual Permits

CAFOs that do not currently meet the definition of a CAFO in Oregon can opt for coverage under the CAFO general permit in preparation for future growth if so desired. If such operations elect coverage, they become subject to all terms and conditions of the permit.

Any person not wishing to be covered by a general permit may make application for an individual permit in accordance with OAR 340-045-0030 or 340-071-0162, whichever is applicable. In addition, ODA may refuse to authorize or renew coverage or may revoke existing coverage under a general permit as it applies to any person and require such person to apply for and obtain an individual NPDES or WPCF permit. The procedures for denial of a permit in OAR 340-045-0050 and for permit revocation in OAR 340-045-0060 apply.

The grounds for requiring an individual permit include the following (OAR 340-045-0033(10)(c):

> (A) The discharge or activity is a significant contributor of pollution or creates other environmental problems;
>
> (B) The permittee failed to comply or is not currently in compliance with the terms and conditions of the general permit, submitted false information, or the permittee is in violation of any applicable law;
>
> (C) A change occurs in the availability of demonstrated technology or practices

for the control or abatement of pollutants being discharged;

(D) For NPDES general permits, effluent limitation guidelines are promulgated for point sources covered by a general permit and the guidelines are not already in the general permit;

(E) Circumstances have changed so that the discharge or activity is no longer appropriately controlled under a general permit, or either a temporary or permanent reduction or elimination of the authorized discharge is necessary; or

(F) Any other relevant factors.

Guidelines and terms for issuance, renewal, transfer, and denial of an NPDES permit can be found in OAR 340-045-0035, 340-045-0040, 340-045-0045, and 340-045-0050.

As of January 2008, there were three CAFO individual permits in the state, one of them having no animals at this time.

I.G.3. What is a General Permit?

Section 301(a) of the federal Clean Water Act (CWA) provides that discharge of pollutants to waters of the state is unlawful except in accordance with a National Pollution Discharge Elimination System (NPDES) permit. Although such permits have been issued to individual operators, EPA's regulations authorize the issuance of "general permits" to categories of discharges when the point sources responsible for the discharge are located within the same geographic area and warrant similar pollution control measures; involve the same or substantially similar types of operations; discharge the same type of waste; require the same effluent limitations or operating conditions; require the same or similar monitoring requirements, and in the opinion of the permitting authority are more appropriately controlled under a general permit than under individual permits.

The use of a general permit for regulating Oregon CAFOs is appropriate because the waste characteristics from different CAFOs are substantially similar. In addition, the effluent limitation guidelines are determined for each facility by the animal waste management plan (AWMP), best management practices, and other requirements for CAFOs covered by this general permit. In 2007, there were 370 CAFOs with a general permit (Table 1). Figure 5 provides a map of their locations.

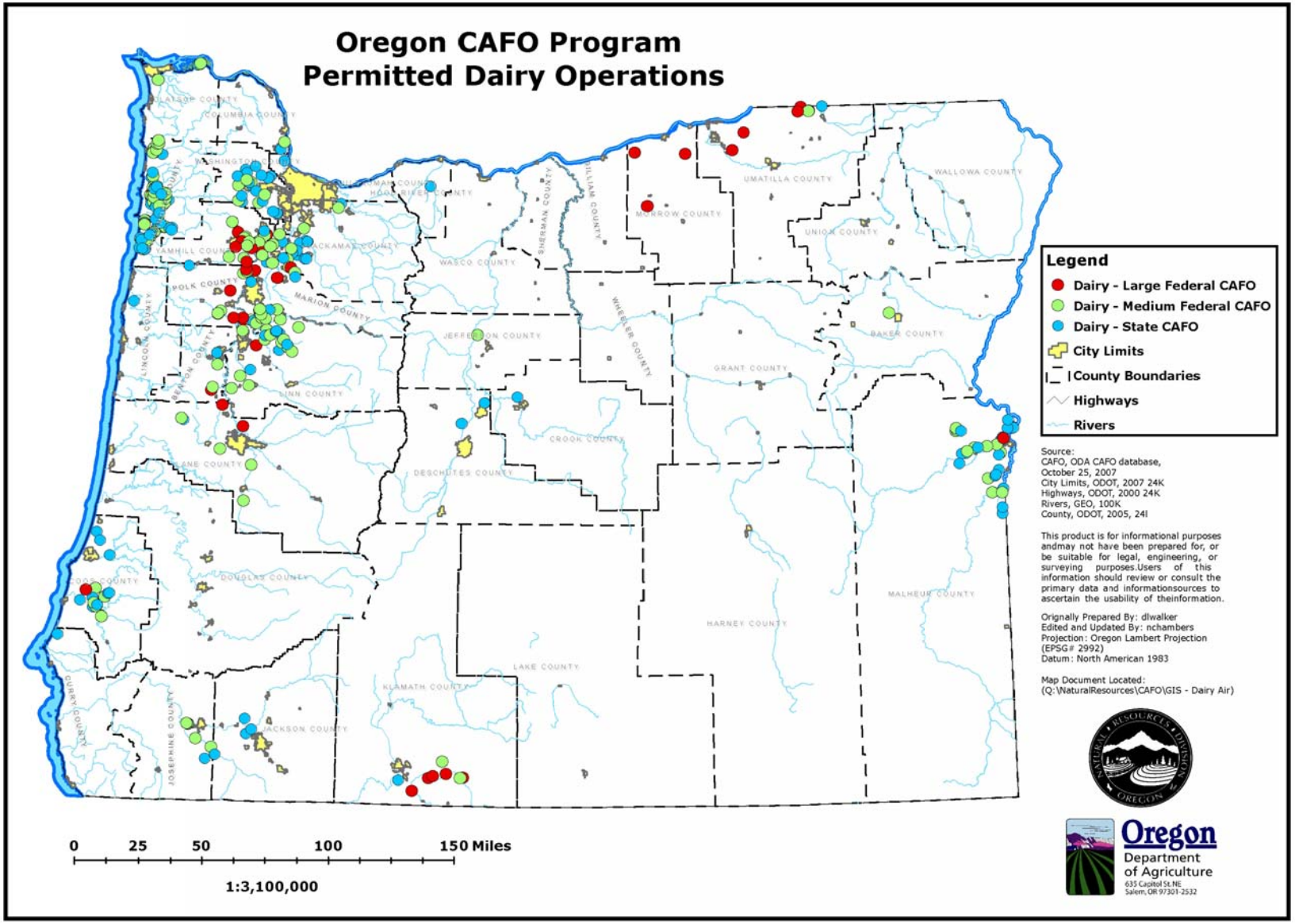


Figure 5. Map of the current distribution of permitted dairy operations in Oregon. Please note that a dairy operation may be either a milking facility, replacement heifer feedlot or a combination of both.

I.G.4. Animal Waste Management Plans

All CAFOs that require a permit must prepare an animal waste management plan. This plan is a detailed description of facilities and operations with respect to containment, treatment, storage, and disposal of waste including wastewater. The plan also describes how compliance with permit conditions and water quality laws will be achieved and maintained. The level and amount of information required will depend upon the size, complexity, and other specifics of each facility.

Permittees must prepare their waste management plan in accordance with the terms and conditions of the permit and guidelines contained in OAR Chapter 340, Division 51 and Chapter 603, Division 74. In addition, plans must conform to the Natural Resource Conservation Service (NRCS) Conservation Practice Standard Guidance 590 for Oregon, dated May 2001, and entitled Nutrient Management. ODA will accept plans from NRCS-certified Comprehensive Nutrient Management Plan (CNMP) writers and may approve such plans without review. For more information on NRCS technical guidance materials, visit:
http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=OR.

Basic elements of a plan include:

- An inventory of animals, facilities, and lands, including lands owned or leased and lands available for land application, whether on- or off-site;
- Drawings and maps showing all facilities and lands;
- Calculations of required and necessary storage capacity;
- Calculations of volumes and nutrient contents of generated wastes and wastewater;
- Guidelines for land application of wastes and wastewater;
- Operation and maintenance guidelines;
- Monitoring and record-keeping guidelines;
- Plans and specifications for proposed new or modified waste handling facilities.

To the extent applicable, the waste management plan must also:

- Ensure adequate collection, handling, and storage of manure, litter and process wastewater;
- Include procedures to ensure proper operation and maintenance of the storage facilities;
- Ensure proper management of animal mortalities to ensure that they are not

disposed of in a liquid manure, storm water, or process wastewater storage or treatment system that is not specifically designed to treat animal mortalities;

- Ensure that clean water is diverted, as appropriate, from the production area;
- Prevent direct contact of confined animals with waters of the United States;
- Ensure that chemicals and other contaminants handled on-site are not disposed of in any manure, litter, process wastewater, or storm water storage or treatment system unless specifically designed to treat such chemicals and other contaminants;
- Identify appropriate site specific conservation practices to be implemented, including as appropriate buffers or equivalent practices, to control runoff of pollutants to surface water and groundwater;
- Establish protocols to land apply manure, litter or process waste water in accordance with site specific nutrient management practices that ensure appropriate agricultural utilization of the nutrients in the manure, litter or process waste water. For Large Federal CAFOs, these protocols must be based on actual testing data. For other CAFOs, data or "book values" from established reference sources (e.g., Oregon Animal Waste Management program) may be used instead of actual testing;
- For Large Federal CAFOs, identify protocols for appropriate testing of manure, litter, process wastewater, and soil. For other CAFOs, identify the references used instead of actual testing data or test protocols if testing; and
- Identify specific records that will be maintained to document the implementation and management of the minimum elements described above.

The need for additional or alternative plan information will be established on a case-by-case basis for plans required as part of a corrective order, or to account for extraordinary circumstances. The level of detail of information required in the various plan sections will depend on the size, complexity, and other specifics of each CAFO.

Waste management plans must show, when applicable, how the CAFO will achieve an agronomic balance of nutrients land-applied with nutrients removed in harvested crops. In other words, applied nutrients must match the rate at which any crop growing on the land is capable of taking them up. This practice minimizes leaching of applied nutrients past the root zone. ODA will typically require an agronomic balance for nitrogen, but in some cases for phosphorus as well. Phosphorus balance will be required when the CAFO is within a watershed that has been designated by the state as water quality

limited for phosphorus, and when the NRCS phosphorus index for the land application soils is exceeded.

Once the plan has been submitted to and approved by ODA, the facility must be managed in compliance with the plan at all times. The application of process wastewater more frequently than specified in the waste management plan or at a concentration in excess of plan specifications or at times not specified in the waste management plan will constitute a violation of the permit.

Appendix C provides an example of an actual Animal Waste Management permit, submitted as part of the AWMP process.

I.G.5. Inspection Requirements

Permitted operations receive regular, routine inspections on a scheduled frequency determined by overall program resources. The goal is for each permitted operation to receive one routine inspection per year by an ODA Livestock Water Quality Specialist. These CAFO inspectors are also available throughout the year to help producers stay in compliance with permit conditions and regulations. Inspectors are ready to assist operators with animal waste management plan review and can provide ideas for improving management practices. They are an excellent source for information about technical and financial assistance. A list of inspection types and brief descriptions are provided below.

I.G.5.a. Inspections by Type and Description

Annual Inspection

As indicated above, it is the goal of the Oregon CAFO program to conduct one routine inspection each year. Routine inspections are scheduled over a 10-month period, so that subsequent annual routine inspections move up two months to provide a varied seasonal view over several years. In 2007, the department conducted a routine inspection of all operations that operated for the full year.

Educational Review

An operator may request that their local inspector conduct an educational review, which allows the inspector to point out potential water quality issues and to suggest best waste management practices. Generally, these reviews are informational only. However, if violations are found, operators may be subject to enforcement action.

An educational review may be especially useful for those who do not know if they need a permit.

Follow-up Inspections

Follow-up inspections are made to determine compliance related to prior-issued enforcement orders.

Complaint Investigations

Investigations are conducted for water quality concerns on any permitted or non-permitted livestock operation in response to a complaint.

First Time Inspections

New facilities and new additions to existing facilities must undergo a first-time inspection. This inspection is much the same as an annual inspection.

I.G.5.b. Compliance and Enforcement

ODA inspectors have primary responsibility for compliance monitoring and enforcement. At the time of inspection, or upon further review, ODA inspectors may issue a number of different compliance notifications:

Facility in Compliance (FIC)

Facility was found to be in compliance with CAFO permit requirements.

Water Quality Advisory (WQA)

Identifies potential problems and makes recommendations to producers for technical and financial assistance.

Notice of Noncompliance (NON)

Issued for violations, including discharges or operating without a required permit. Corrective actions described in a NON must be completed within 30 days if there is not a separate Plan of Correction.

Plan of Correction (POC)

If corrective actions will take longer than 30 days to complete, inspectors may issue a POC along with the NON. The POC provides corrective measures, with deadlines for completion not to exceed two years and directs producers to sources of technical

and financial assistance.

I.H. What are the types of dairy air emissions?

A number of study reports have been published in the past few years on the subject of air emissions from animal feeding operations. These reports, as well as journal review articles, cite numerous primary research reports related to AFO air emissions. The Task Force has relied in many cases on these secondary publications. An inquisitive reader is encouraged to seek out the primary references through these publications. Where the primary literature was cited here, a reference is provided to that literature in this report.

In 2001, the National Research Council (NRC) of the National Academy of Sciences (NAS) was asked by EPA and the US Department of Agriculture (USDA) to perform an evaluation of the state of knowledge concerning air quality impacts from Animal Feeding Operations (AFOs). A 16-person ad hoc committee was appointed, the Committee on Air Emissions from Animal Feeding Operations.

The NAS published its final report in 2003. In it, the NRC reported that air emissions from animal feeding operations have impacts on several spatial and temporal scales, and that the importance of those impacts varied. For example, greenhouse gases, such as nitrous oxide and methane, which stay in the atmosphere a long time and are transported for long distances, have global rather than local or regional effects. Primary particulate matter and odors are of concern mostly to individuals near the emissions sources. Their importance is based, not on annual totals, but on ambient concentrations over short periods of time (typically 1 to 24 hours). The following table summarizes their findings.

Relative importance of these emissions at these spatial scales was based on the NAS Committees' informed judgment on known or potential impacts. Animal Feeding Operations (AFOs) may not play an important role for some of these. For example VOCs and NOx are important in the formation of tropospheric ozone, however the role of AFOs as an emissions source is likely insignificant compared to other sources.

Table 4. NAS Committee's Listing of the Potentially Important AFO Emissions

Emissions	Global, National, Regional	Local, Property Line, Nearest Dwelling	Primary Effects of Concern
NH_3	Major[a]	Minor	Atmospheric deposition
N_2O	Significant	Insignificant	Global climate change
NO_x	Significant	Minor	Haze
CH_4	Significant	Insignificant	Global climate change
VOCs[b]	Insignificant	Minor	Quality of human life
H_2S	Insignificant	Significant	Quality of human life
PM[c]10	Insignificant	Significant	Haze
PM2.5	Insignificant	Significant	Health, haze

***National Research Council, Air Emissions from Animal Feeding Operations: Current Knowledge and Future Needs* (2003).**

There is a difference between the amount of emissions released from operations within a facility and the concentration of those emissions in the ambient air outside the facility. As emissions travel from a facility and mix with the ambient air, the concentration changes. It is the concentration of a chemical that people actually breathe, or that impacts the environment, that is important. Changes in concentration are affected by factors such as distance from the facility, chemical reactions in the air, and the meteorological conditions at the time, including such things as wind speed and direction, atmospheric stability, and precipitation.

The NAS report, as well as the Iowa State report[1] and the recent Pew Commission report[2], described the types of emissions that could be expected from all kinds of animal feeding operations, including swine, poultry, and beef, as well as dairies. Some data on the types of emissions specifically from dairy operations is also available.[3,4] These reports indicate that the types of emissions from dairies might also be of concern for health and the environment, although the amount of each type of emissions will be different and thus the magnitude of the impact.

I.H.1. General Description of Air Emissions from Dairies

I.H.1.a. Ammonia

Ammonia (NH_3) is released to the atmosphere by natural processes, including the decay of organic matter and animal excreta. It can also be released to the atmosphere by human activities such as fertilizer use; spillage or leakage from storage or production facilities; or loss from wastewater effluents. In the context of dairy operations, ammonia is produced by decomposing manure.

For the general population, the most likely source of exposure to elevated levels of ammonia is from the use of household cleaners containing ammonia or ammonium salts. People who live near farms, who visit farms during the application of fertilizer, or who live near cattle feedlots, poultry confinement buildings, or other areas where animal populations are concentrated can also be exposed to ammonia.

I.H.1.b. Hydrogen Sulfide

Hydrogen sulfide (H_2S) is a colorless, flammable gas with a strong odor of rotten eggs. It naturally occurs in the gases from volcanoes, swamps, and stagnant bodies of water and in crude petroleum and natural gas. Additionally, bacteria and fungi release hydrogen sulfide during the decomposition of sulfur-containing proteins and by the direct reduction of sulfate. It is emitted from dairies as manure decomposes anaerobicly, as cows digest feed, and as microbes reduce sulfate in feed and water.

Hydrogen sulfide tends to be a problem – primarily related to odor - in communities located near certain types of industrial operations, including pulp and paper mills, natural gas production, and near agricultural operations such as swine containment and manure handling.[5]

I.H.1.c Methane

Methane (CH_4) is an odorless, colorless, flammable gas. It is used primarily as fuel to make heat and light. It is also used to manufacture organic chemicals. Methane is emitted as a natural byproduct during microbial degradation of organic matter under anaerobic conditions. It can be formed by the decay of natural materials and is common in landfills, marshes, septic systems, and sewers.

In dairy operations, perhaps the most important consideration pertains to manure handling, storage, and treatment systems. Methane is produced at all stages of manure handling, but liquid systems produce more than dry systems due to the anaerobic conditions that are created.[6] In addition, cows and other ruminants have a chamber in their stomachs in which bacteria break down food and generate methane as a by-product. The emission rate can vary among animal species and amongst individuals within the same species since it is affected by several factors, including quantity and quality of feed, weight of the animal, age, and the amount of exercise an animal receives. [7]

I.H.1.d. Volatile Organic Compounds

Organic chemicals are the basic carbon containing chemicals found in all living things, and in products that are derived from living things, such as gasoline. Naturally, occurring organic compounds also provide the building blocks for the wide variety of synthetic chemicals that people use everyday, such as cleaners, paints, plastics, pharmaceuticals, and pesticides. Volatile organic compounds (VOCs) are chemicals that vaporize easily at room temperature.[8] At dairies a wide variety of classes of organic compounds are released from the animals, their feed, and their waste products. As examples, these include: alcohols, primarily methanol and ethanol; esters; ketones; fatty acids; and simple hydrocarbons such as methane.[9]

I.H.1.e. Nitrogen Oxides

(NOx) is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. Many of the nitrogen oxides are colorless and odorless, however, one common pollutant, nitrogen dioxide (NO_2) along with particles in the air, can often be seen as a reddish-brown layer over many urban areas. NOx are produced from most combustion processes, ranging from volcanoes to motor vehicles and home heating. NOx are also released during the aerobic decomposition of livestock wastes by a process known as nitrification.[10]

I.H.1.f. Particulate Matter

The term particulate matter (also referred to as particle pollution) refers to the mixture of solid particles and liquid droplets in the air. Some particles, known as *"primary particles*" are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks or fires. Other particles form in complicated reactions in the atmosphere of primary gas emissions such as sulfur dioxides and nitrogen oxides. These *"secondary particles"* constitute most of the fine particle pollution in the United States.

Animal feeding operations can contribute directly to particulate matter emissions via mechanical generation from equipment operation, entrainment of mineral and organic material from the soil and manure. Emissions of nitrogen oxides and ammonia can be converted to fine particle aerosols through reactions in the atmosphere.[11]

I.H.1.g. Odor

As defined in Oregon Administrative Rule, “odor” means that property of an air contaminant that affects the sense of smell.[12] Challenges arise in attempting to address public concerns related to odors generated from dairy operations, due to the various potential mixtures of chemicals (including H_2S, NH_3, and VOCs) involved, and the subjective nature of human response to odors. There are different methodologies used to measure odor intensity, yet odor measurement is predominantly gauged by human panels.[13] As an example, the smell of H_2S is faint, but easily perceptible at 0.77 parts per million (ppm), offensive from 3 to 5 ppm up to about 30 ppm, when it smells of rotten eggs. At about 30 ppm the smell is described as sweet or sickening sweet and at about 150 ppm hydrogen sulfide causes olfactory nerve paralysis and the smell is no longer perceptible. For this reason, the sense of smell is not a reliable warning of its presence, especially at high concentrations.[14]

I.I. What are the public health implications?

Concerns about community health effects from AFOs have been raised repeatedly over the past several years because of the known impacts on workers. It is important to note that these concerns are associated with this practice in general, and not specifically with dairies. Researchers have highlighted the need to investigate the emissions from concentrated animal feeding operations and their potential health effects, to identify vulnerable worker and neighborhood groups, and if warranted, to identify and implement options for mitigation. In 2005, Dr. Mitloehner, U.C. Davis, pointed out the need for research on AFO emissions as a necessary precursor to reasonable regulation. As recently as 2007, Mitloehner and Schenker, in a Commentary in the journal *Epidemiology,* noted that adverse health effects of exposures from concentrated animal feeding operations have not been addressed by traditional ambient air quality studies or regulations. Summaries and abstracts of these papers, and others, can be found in Appendix D. A majority of the abstracts and summaries are compiled in the Western Dairy Air Quality Symposium (2006 and 2007) materials. A link to the Western Dairy Air Quality Symposiums 2006 and 2007 can be found in Appendix E and F, respectively.

Brief descriptions of the health effects of emissions that come from dairies and other AFOs are given below.

The American Lung Association issued a piece on Confined Animal Feeding Operations in October 2006. As additional background information, the piece has been included as Appendix G to this document.

Ammonia

Ammonia has a strong, sharp, characteristic odor of drying urine that disperses rapidly in the air. At low concentrations, ammonia is a severe irritant of the eyes, respiratory tract, and skin. At 5 ppm, ammonia can be detectable by smell. Six to twenty ppm and above, ammonia may cause coughing, burning, and tearing of the eyes; runny nose; and chest pain.[15] Symptoms may be delayed in onset. Forty to two hundred ppm ammonia can cause headache, nausea, reduced appetite, irritation to airways, nose, and throat[16]. At very high concentrations, exposure to ammonia may cause cessation of respiration and possibly death. Exposure of the eyes to high gas concentrations may produce temporary blindness and severe eye damage. Exposure of the skin to high gas concentrations may cause burning and blistering. Repeated exposure to ammonia gas may cause chronic irritation of the eyes and upper respiratory tract problems. There is no scientific data suggesting that ammonia can cause cancer, though it may enhance the ability of other chemicals to cause cancer.

Hydrogen Sulfide

Acute inhalation exposures to low concentrations of hydrogen sulfide have been associated with eye and respiratory irritation. Higher concentration exposures can result in unconsciousness and death. There is some evidence that chronic exposure to hydrogen sulfide at low concentrations, either alone or in combination with other chemical substances, may be associated with disorders of the nervous, cardiovascular, and gastrointestinal systems. Repeated exposure to hydrogen sulfide results in increased susceptibility, so that eye irritation, cough, and systemic effects may result from concentrations previously tolerated without effect.[17]

Acute airborne exposures to low concentrations of hydrogen sulfide have been associated with eye and respiratory and cardiovascular irritation as well as headaches. Exposure to 20 ppm H_2S for 20 minutes may result in the irritation to the eyes, nose and throat.[18] At 50-100 ppm exposure may result in vomiting, nausea, and diarrhea. At 500 ppm of H_2S, exposure for 30 minutes can result in nausea, excitement, and unconsciousness. Exposure of H_2S at 600 ppm will kill an individual after taking only one or two breaths.[19]

Methane

Methane is a “simple asphyxiant”, meaning it causes health effects by displacing oxygen.

Volatile Organic Compounds

VOCs can be precursors to ozone and to fine particulate matter, and can be a source of odors. Since VOC emissions include many classes of compounds, they can cause a variety of health problems, depending on the specific compound and the exposure. Some VOCs are carcinogenic, some can cause fetal development problems, and some can cause central nervous system disorders such as drowsiness and stupor.[20]

Nitrogen Oxides

Ground-level ozone (smog) is formed when NOx and VOCs react in the presence of sunlight. Ozone can damage lung tissue, reduce lung function, damage vegetation, and reduce crop yields. NOx also reacts with ammonia, moisture, and other compounds to form nitric acid and particles. These very small particles penetrate deeply into sensitive parts of the lungs and can cause or worsen respiratory disease such as emphysema and bronchitis, and aggravate existing heart disease. Long-term exposure to high levels of nitrogen dioxide can cause chronic lung disease. It may also affect sensory perception, for example, by reducing a person's ability to smell an odor.[21] High NOx exposures produce methemoglobinemia a blood disorder that impairs the ability of the blood to carry oxygen throughout the body.[22] There is also evidence that NOx reacts readily with some organic chemicals to form toxicants associated with biological mutations.

Particulate Matter

Over the years, EPA has recognized that the smallest particles pose the largest risk to public health, and has over time reduced the size of the particles for which National Ambient Air Quality Health Standards have been set. EPA has also learned over time that acceptable thresholds for particulate (i.e. the federal particulate standard) must be lowered and made more stringent in order to protect public health.

Particles in these small size ranges in high concentrations are of great concern because they can be inhaled deeply into the lungs where they can remain for years. $PM_{2.5}$ can deposit in the smallest airways of the lung, whereas larger particles tend to be deposited in the upper airways of the respiratory tract. The health effects of particulate

matter vary with the size, concentration, and chemical composition of the particles.[23]

In addition to the currently regulated classes, particles smaller than 2.5 micrometers in diameter are known as ultra-fine particles and particles between 2.5 and 10 micrometers in diameter are called coarse particles. These additional size classes may be regulated by EPA in the future.

Odor

There have been some studies that have suggested that repeated exposure to odors can result in physical and psychological harm.[24]

There are two main ways these emissions are typically involved in health issues: National Ambient Air Quality Standards (NAAQS) set by the U. S. Environmental Protection Agency (EPA) to protect sensitive people; and safety standards set by the U. S. Occupational Safety and Health Association to protect workers.

I.I.1 National Ambient Air Quality Standards (NAAQS)

EPA has established National Ambient Air Quality Standards (NAAQS) based on the latest medical evidence of harm to public health from air pollution for:

Carbon Monoxide
Ozone (smog)
Particulate Matter
Nitrogen Dioxide (NO_2)
Sulfur Dioxide (SO_2)
Lead

These air pollutants are known as “criteria pollutants” because EPA has used health criteria to establish enforceable ambient standards. EPA currently regulates two size classes of particulate matter. Particles equal to or smaller than 10 micrometers in aerodynamic diameter are known as PM_{10}, while particles that have a diameter equal to or less than 2.5 micrometers are known as $PM_{2.5}$ or fine particles.[25]

If people are exposed to concentrations of these pollutants at levels above the standard then it is presumed that adverse health affects will occur. It is possible, depending on the circumstances, that dairy emissions could play a role in a violation of some of these federal air quality standards; however, it is unlikely that dairy emissions would be a

significant contributor to these violations. Historically, NAAQS violations have been driven by urban sources of pollution such as major industry, gasoline distribution, multiple combustion sources, transportation sources, and home wood heating. NAAQS issues related to dairy emissions are discussed more in Section I.M.

I.I.2. Occupational Health Standards

The Clean Air Act does not establish air quality standards to protect worker safety on the job-site. The U. S. Occupational Safety and Health Association (OSHA) sets acceptable air quality levels related to worker exposure and safety. Oregon OSHA operates under a state-plan agreement with the federal OSHA to enforce the state's workplace safety and health rules under the Oregon Safe Employment Act.

In addition to standards set by U.S. OSHA, other known Occupational Exposure Limits (OELs) are sometimes used for determining potential harm to workers. These are set by non-regulatory agencies and organizations with an interest in providing recommended exposure limits for hazardous airborne chemicals and some biological agents. Many of the recommended OELs go through rigorous toxicological peer review before being printed. Non-regulatory organizations and their recommended OELs that are used in the U.S. are noted below:

- American Conference of Governmental Industrial Hygiene (ACGIH) - Threshold Limit Values (TLVs)
- National Institute for Occupational Safety and Health (NIOSH) - Recommended Exposure Limits (RELs)
- American Industrial Hygiene Association (AIHA) - Worker Health Exposure Effect Levels (WHEELS)

I.J. What are the implications for the environment?

See also Sections I.K., I.L., and I.P. below.

Ammonia

Ammonia is removed from the air via dry or wet deposition (falls onto land and water) or through its reaction with other chemical compounds. In some cases it can result in acidification of ecosystems, while in others it can act as a fertilizer accelerating vegetative growth.

Hydrogen Sulfide

Hydrogen sulfide may have local effects of concern – especially odor – and may contribute to the atmospheric sulfur burden of regions with a high density of AFOs but few other sources.[26]

Methane

Methane is one of the primary greenhouse gases and contributes to global warming. As a greenhouse gas, methane is second only to carbon dioxide in its overall impact on climate change. While much more CO2 is emitted globally than methane, methane is twenty one times better at trapping heat in the atmosphere than CO2. An estimated one-half of global methane comes from manmade sources, of which agriculture is the largest source, with livestock production being a major component. By EPA's estimation, 25% of the nation's methane emissions come from livestock. [27]

Volatile Organic Compounds

As previously mentioned, VOCs can be precursors to ozone formation. In addition to causing health problems, ozone can cause significant damage to vegetation, both natural ecosystems and agriculturally important crops. EPA recently finalized a secondary ambient air quality welfare standard for ozone to prevent such damage.

Nitrogen Oxides

NOx family members include nitrogen dioxide, nitric oxide, nitrous oxide, nitric acid, and nitrates. These pollutants impact health and environmental impacts in a variety of ways. According to the EPA, in the United States, animal waste accounts for roughly 6% of NOx emissions.[28]

Nitrous oxide, N_2O, is a significant greenhouse gas. Nitrogen dioxide by itself is harmful to vegetation, and NOx in general is another ozone precursor that can also contribute to vegetation damage.[29]

NOx and sulfur dioxide react with other substances in the air to form acid rain, fog, and snow, potentially harming ecosystems, and important cultural artifacts. The affects of acidic precipitation could include accelerating damage to Native American rock images, increasing the risk of damage to forests, and causing lakes and streams to become more acidic. Increased nitrogen loading in water bodies can harm sensitive ecosystems like coastal estuaries by accelerating vegetative growth, leading to oxygen depletion

and reduced fish and shellfish populations.

I.K. What are the implications for visibility?

Particles and gases in the atmosphere, whether natural or man-made, can scatter light and degrade a person's ability to see and enjoy a valuable scenic vista. This is known as Haze Pollution or Visibility Impairment. Haze pollution is caused by a vast number of emissions sources that originate locally, regionally, and internationally. In Oregon, the DEQ is involved in addressing haze problems both through the federal Regional Haze Program, and through important bi-state initiatives such as the Columbia River Gorge Air Quality Project. These two efforts are discussed in sections I.M.3 and I.P.1.respectively.

Three key visibility-impairing gaseous pollutants involved in these reactions are Sulfur Dioxide (SO_2), Oxides of Nitrogen (NOx) and Ammonia. SO_2 and NOx are by-products of incomplete combustion and come from a wide variety of sources. These pollutants react and combine with ammonia in the air to form Sulfate and Nitrate particles that obscure and degrade visibility. Ammonia emissions from all sources play a key role in the formation of haze, and efforts to improve visibility should focus on reducing regional ammonia as well as the reduction of NOx, SO_2, and smoke.

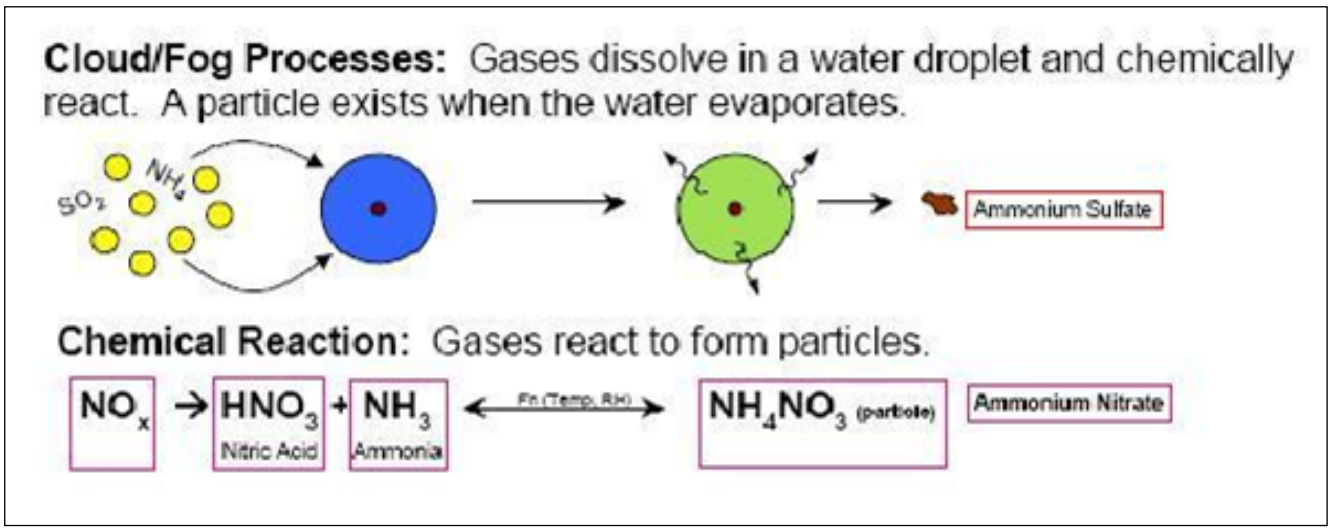


Figure 6 provides an illustration of the chemical process involved in haze formation.

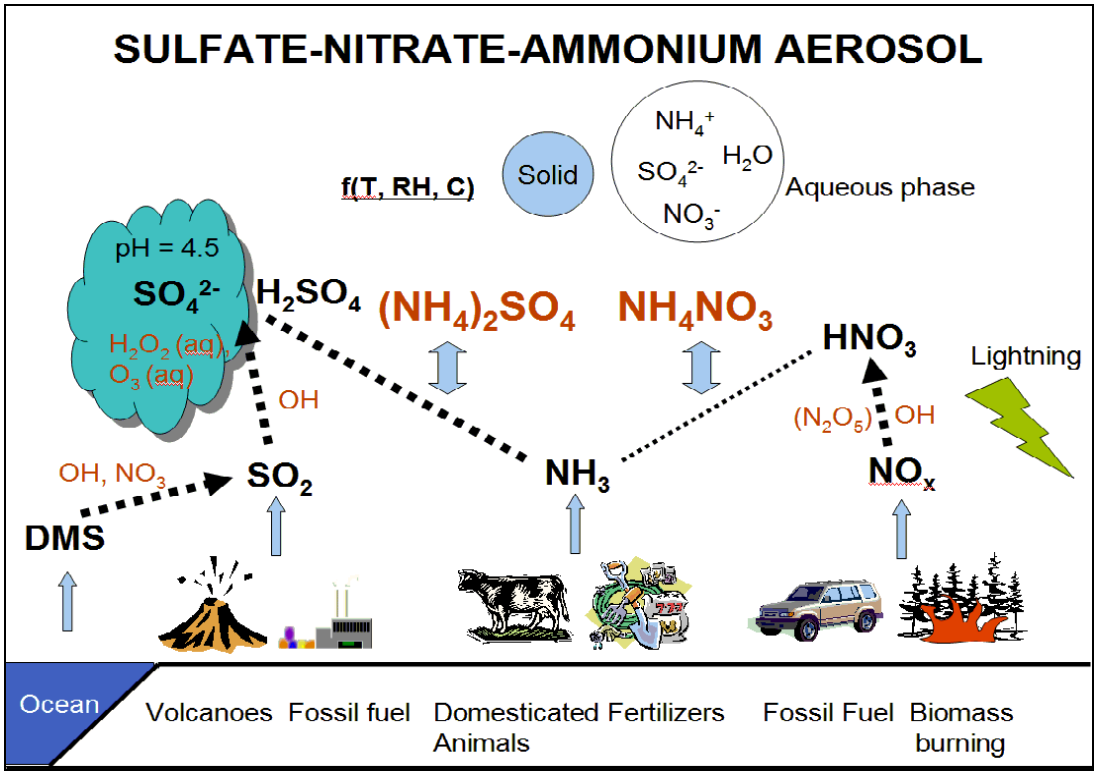


Figure 7 is a diagrammatic depiction of how some primary emissions from both man-made and natural sources are converted in the atmosphere to create visibility-reducing aerosols.

Animal feeding operations can also contribute directly to particulate matter emissions via mechanical generation from equipment operation, and entrainment of mineral and organic material from the soil and manure, most of these particles deposit near their source. Some $PM_{2.5}$ can be generated directly and can be important because it is able to remain aloft causing visibility degradation on a regional scale.[30,31]

I.L. What are the implications for cultural resources?

In addition to visibility impairment, nitrogen oxides and ammonia can play an important role in the acidic precipitation that can increase deterioration of cultural resources, such as Native American rock paintings.

I.M. How are these emissions currently regulated under the Clean Air Act?

The Clean Air Act (CAA) was originally passed by Congress in 1970 in an effort to regulate pollution from area, stationary and mobile air pollution sources and to protect public health and the environment. The Clean Air Act could potentially apply to dairy

operations in three main ways. Dairies could be affected if emissions from the dairy:

- Play an important role in violations of federal air quality health-based standards (NAAQS);
- Play an important role in the formation of haze pollution (impairing visibility in National Parks and wilderness areas); or
- Are of sufficient quantity to trigger air quality permitting requirements.

A recent report (August 2007) by the Congressional Research Service of the Library of Congress provides a good overview of the federal regulatory context in which animal agriculture must operate. In a 2005 article, Dr. Frank Mitloehner points out the importance of having good science to support regulatory action. Both these documents are summarized in Appendix D.

It should be noted that not all air emissions from dairies are regulated under the Clean Air Act (CAA) and it is important to be clear about which dairy emissions may trigger certain CAA requirements. As examples:

- All dairy emissions could potentially be regulated under the Clean Air Act if they have a role in violating NAAQS or increasing Regional Haze;
- Methanol emitted by dairies is both a criteria pollutant (because it is a VOC) and a toxic air pollutant. Therefore methanol could be affected by sections of the CAA related to NAAQS or hazardous air pollutants;
- Hydrogen Sulfide is one of several pollutants considered in determining if a source has "major source" emissions levels that trigger the need for an air quality permit;
- Ammonia **is not** considered in determining if a source has "major" emission levels that trigger air quality permitting but it can react with other chemicals in the atmosphere that create particles that contribute to NAAQS or haze problems;
- It is unclear now to what extent, or how, EPA will regulate Greenhouse Gases.

Table 5 summarizes how the key emissions from AFO would be regarded with respect to the Clean Air Act.

Table 5. CAA Classification of Substances in AFO Emissions

Substance	Criteria Pollutant	Hazardous Air Pollutant	Permit Triggering Air Pollutant
Ammonia			
Hydrogen Sulfide(1)			X
VOC			X
Methanol(2)		X	
Nitrogen Oxides	X		X
Particulate Matter	X		X

(1) Dairies that release reportable quantities of hazardous substances could also be subject to the accidental release prevention requirements of the Clean Air Act.*
(2) Criteria pollutants are those for which NAAQS have been set, plus VOC and NOx which can cause violations of the ozone NAAQS.*
* National Research Council, Air Emissions from Animal Feeding Operations, Current Knowledge, and Future Needs (2003).

I.M.1. Federal Air Quality Health-based Standards

As stated previously, EPA has established National Ambient Air Quality Standards (NAAQS) for:

Carbon Monoxide,
Ozone (smog)
Particulate Matter
Nitrogen Dioxide (NO_2)
Sulfur Dioxide (SO_2)
Lead

The Clean Air Act requires States to develop air quality improvements plans for any community that violates air quality health standards. Communities that violate NAAQS are called “non-attainment” areas, because they have failed to “attain” compliance with the NAAQS. In the past, Oregon has had non-attainment areas because of violations of the standards for ozone (smog), carbon monoxide, and/or particulate (PM_{10}). Typically, the chief contributors to these violations have been transportation sources (NOx and VOC), major industrial facilities (NOx, VOC, and particulate) or wood burning (particulate).

EPA is required to periodically review the scientific basis for the NAAQS and revise them if appropriate. In 2007, EPA lowered the PM standard while focusing on smaller particles, less than 2.5 micrometers in diameter, called $PM_{2.5}$. EPA has also finalized a new lower standard for ozone which includes both a primary health-based standard and a secondary standard to protect welfare. Based on DEQ's past experience in non-attainment communities, it is very unlikely that dairy emissions would play a significant role in violations of the federal NAAQS. However, depending on the circumstance, emissions from diaries could be evaluated as part of a comprehensive planning effort in a community where health standards are at risk.

I.M.2. Federal Hazardous Air Pollutant Program

The 1990 Clean Air Act Amendments established a list of 188 Hazardous Air Pollutants (HAPs), also called air toxics or toxic air pollutants. These are pollutants known or suspected to cause serious health effects, including cancer. EPA has identified sources of these pollutants and has adopted technology-based standards to reduce HAP emissions from these sources. These are primarily industrial and commercial operations. Oregon has adopted these same standards and DEQ is responsible for ensuring that they are being met. The only identified federally listed HAP emitted from dairy operations is methanol. EPA has not identified dairy operations as sources of HAP emissions and DEQ is not aware of any plans for EPA to develop technology-based HAP standards for dairies.

I.M.3. Regional Haze Program (Visibility Impairment)

The Clean Air Act mandates a program, called Regional Haze, with the goal of significantly improving visibility in our nation's wilderness areas and National Parks by the year 2060. This is a long-term program that requires incremental emission reduction and visibility improvement at roughly ten-year milestones. Oregon has twelve wilderness areas protected under the Regional Haze program, as well as Crater Lake National Park. The DEQ website has further information available online at: *http://www.deq.state.or.us/aq/haze/index.htm.*

Haze is a form of air pollution that can travel hundreds of miles and degrade the quality of the viewing experience in wilderness areas, National Parks, and other Scenic Areas, including the Columbia River Gorge National Scenic Area. This degradation of scenic vistas is called Visibility Impairment. Figure 8 shows the difference between days with good or impaired visibility at Crater Lake National Park.

Good Visibility (100 to 150 miles)

Impaired Visibility (10 to 25 miles)

Figure 8. Visibility at Crater Lake[32]

Key pollutants involved in the formation of haze include: sulfates, nitrates, organic carbon, elemental carbon, and soil dust. Sulfates and Nitrates are two of the most significant visibility impairing pollutants and are formed when oxides of nitrogen (NOx) and sulfur dioxide (SO_2) combine with ammonia. NOx and SO_2 are waste products of combustion, and come from a wide variety of sources such as cars and trucks, boats, trains, large and small engines, and home heating. Ammonia also comes from many sources, including dairy operations. Other key sources of visibility impairing emissions include industry, agriculture and forestry burning, residential open burning, and dust generated from roads and farming practices.

Figure 9 graphically represents the contribution of different pollutants in the Northwest to regional haze on days when visibility is the worst. In Oregon, the largest contributors to haze are organic air pollutants (indicated in green), which are comprised mostly of organic carbon from fire sources (both controlled burning and natural fire), sulfates (indicated in yellow) and nitrates (indicated in red). In Western Oregon, sulfates tend to be higher than nitrates. In Eastern Oregon, just the opposite is true. In both cases, these sulfates and nitrates are in the form of ammonium sulfate and ammonium nitrate, due to the presence of ammonia emissions in the atmosphere.

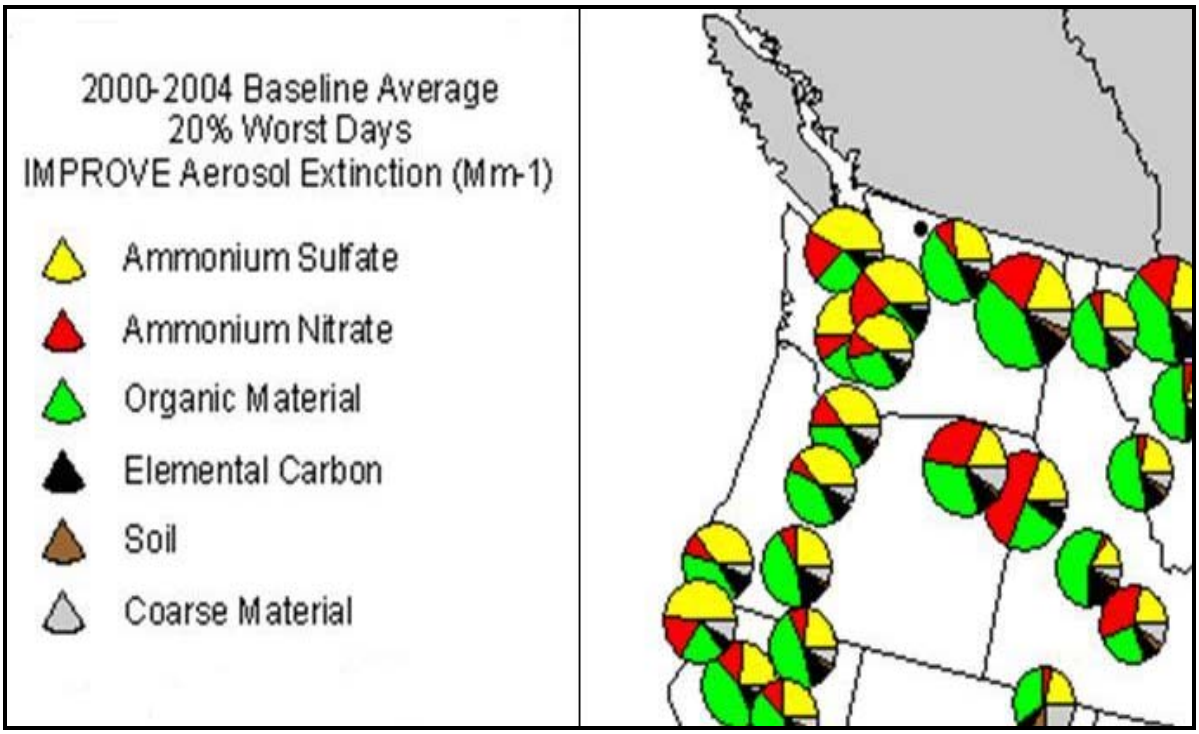


Figure 9. Pollutants that Contribute to Haze in the Northwest[33]

Provided as Appendix H of this document, for reference, is a memo from DEQ to ODA addressing the contribution of ammonia from confined animal feeding operations to regional haze in the Columbia River Gorge.

I.M.4. Oregon Air Toxics Program

Other toxic air pollutant emissions, not covered by EPA's program, are being addressed under Oregon's Air Toxics Program.

The Oregon Environmental Quality Commission (EQC) adopted rules in October 2003 that established the Oregon Air Toxics Program. In August 2006, with the advice of a technical committee, the EQC adopted rules setting ambient air benchmark concentrations for 51 air toxics in Oregon based on levels protective of human health that consider sensitive populations. Air toxics benchmarks, expressed as micrograms of a specific toxic chemical per cubic meter of air, are levels that a person could breathe for a lifetime without any non-cancer health effects, and without increasing their cancer risk by more than one in a million.

The Oregon Air Toxics Program uses three complementary approaches to reduce the release of toxics air pollutants: geographic, source category and safety net. The

geographic approach relies on community members, working with DEQ, to identify toxic air contaminants of concern in a specific urban area, determine their sources, and develop strategies that will reduce people's exposure to those chemicals.

Because the geographic approach is at the heart of the Oregon program, DEQ is now focused on developing the scientific tools needed to help communities solve their air toxics problems. In areas with high risk, local toxics reduction plans will be developed to reduce ambient concentrations to the air toxics benchmarks over a 10-year period, and may include voluntary or regulatory measures. Under the source category approach, DEQ may also develop programs to reduce toxics from entire source categories of emissions, like diesel engines, trucks, and woodstoves; and under the safety net approach, DEQ can work with major industry to reduce toxic air emissions at specific facilities as needed.

The highest risk air toxics in Oregon communities are benzene, primarily from transportation-related sources, diesel particulate matter, from both on and off-road engines, and combustion by-products, that is, smoke from all forms of vegetative, fossil fuel and other burning. The Oregon program will likely not apply to dairies because of its focus on multi-pollutant and multi-source problems in urban areas. But both hydrogen sulfide and ammonia are considered air toxics in Oregon and it is possible that in the future one or more dairy operations could be evaluated as part of a comprehensive community toxics reduction plan.

I.M.5. Other Federal Laws Governing Air Emissions: EPRCA & CERCLA

Aside from the Clean Water Act described earlier, and the Clean Air Act just reviewed, there are other areas of federal law where dairy operations may be subject to regulation.

In its Agricultural Law Research Article (2006), the National Agricultural Law Center examines EPA's consent agreement for Animal Feeding Operations and their potential regulation under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and the Emergency Planning and Community Right-to-Know Act (EPCRA) as well as the Clean Air Act. Reporting under CERCLA and EPCRA is required for both episodic and continuous releases of regulated substances by facilities that meet certain criteria. Ammonia and hydrogen sulfide are the chemicals relevant to

dairy operations that must be reported under CERCLA and EPCRA at released quantities of 100 pounds or more in any 24-hour period.[29] There is some uncertainty however, about whether CERCLA and/or EPCRA apply to dairy operations, as these laws were intended to address accidental releases of chemicals stored on-site at various facilities. There have been a number of court cases surrounding this issue but some are still pending and others were settled out of court, so the question remains unresolved.

On April 18, 2005 Threemile Canyon Farms, LLC reported their ammonia emissions as required by CERCLA and EPCRA. The operation reported that they operated with 52,300 dairy cows, and released 15,500lbs of ammonia per day, 12 months of the year, totaling 5.6 million pounds of ammonia released annually.[34] This report can be found in Appendix I.

On December 20, 2007, EPA proposed to exempt CERCLA and EPCRA Reporting Requirements Releases to the Air of Hazardous Substances from Animal Waste at Farms. It proposes to exempt "those hazardous substance releases which are emitted to the air (typically during digestion, break-down or decomposition) from animal waste at farms." The exemption covers all hazardous substances generated from manure. The National Association of Clean Air Agencies opposes the proposed exemption because it implies that releases of hazardous substances from manure are not harmful, and because animal feeding operations are a significant source of ammonia and hydrogen sulfide, which cannot be considered trivial in their contribution to ambient hazardous air emissions levels.[35] The public comment period on this proposal closed on March 27, 2008.

I.M.6. Air Quality Permitting

The Clean Air Act establishes two types of permitting programs that apply to all major sources of air pollution. These programs are delegated to, and operated by state and local air quality agencies, with oversight by EPA.

Title I of the Clean Air Act requires construction approval for all new major sources and for existing major sources that have major modifications. In nonattainment areas, the construction approval process is called New Source Review (NSR); in other areas, the construction approval process is called Prevention of Significant Deterioration (PSD). Because major new dairies are not likely to be located in nonattainment areas, the PSD

program is most relevant for dairies. With some exceptions that are not relevant to dairy operations, the Clean Air Act requires PSD construction approval for a major new source that has a potential to emit 250 tons/year or more of the air pollutants listed in Table 6. The Clean Air Act also requires construction approval for an existing major source with an increase in emissions equal to or greater than the significant emissions rate listed in Table 6.

In Oregon, both the NSR and PSD programs are implemented through the Air Contaminant Discharge Permit (ACDP) program, which also regulates construction and operation of non-major sources].

In addition to construction approval under Title I of the Clean Air Act, Title V of the Act requires all major sources to have an operating permit. Except in areas with severe air pollution, Title V applies to major sources that have a potential to emit over 100 tons/year of pollutants listed in Table 6. In addition, Title V applies to major sources that have a potential to emit 10 tons/year of a Hazardous Air Pollutant, or 25 tons/year of all Hazardous Air Pollutants combined.

Table 6. Significant Emission Rates

Total Particulate (PM):	25 tons/yr
Particulate 10 microns and less is size (PM_{10}):	15 tons/yr
Carbon Monoxide (CO):	100 tons/yr
Nitrous Oxides (NOx):	40 tons/yr
Sulfur Dioxide (SO_2):	40 tons/yr
Volatile Organic Compounds (VOCs):	40 tons/yr
Hydrogen Sulfide	10 tons/yr
Total Reduced Sulfur*	10 tons/yr
Reduced Sulfur Compounds*	10 tons/yr
Sulfuric Acid Mist*	7 tons/yr
Lead	0.6 tons/yr
Fluorides	3 tons/yr

OAR 340-200-0020 Table 2.

Note: These emissions typically relate to the permitting of landfills, wastewater treatment facilities, or chemical plants.

Fugitive (non-point) emissions are not considered in determining if a source is major for

either PSD or Title V permitting under the Clean Air Act. As previously mentioned, ammonia does not trigger permitting (PSD or Title V).

There are three scenarios that could potentially trigger the need to go through the air quality permitting process:

1. A company that proposes to build a new facility with criteria emissions above permitting thresholds.
2. An existing facility proposes a major expansion, where the proposed emissions increase is over significance thresholds.
3. An exiting facility where new information on emissions is developed that show emissions above permitting thresholds. Emission estimates must be of sufficient quality to make that determination.

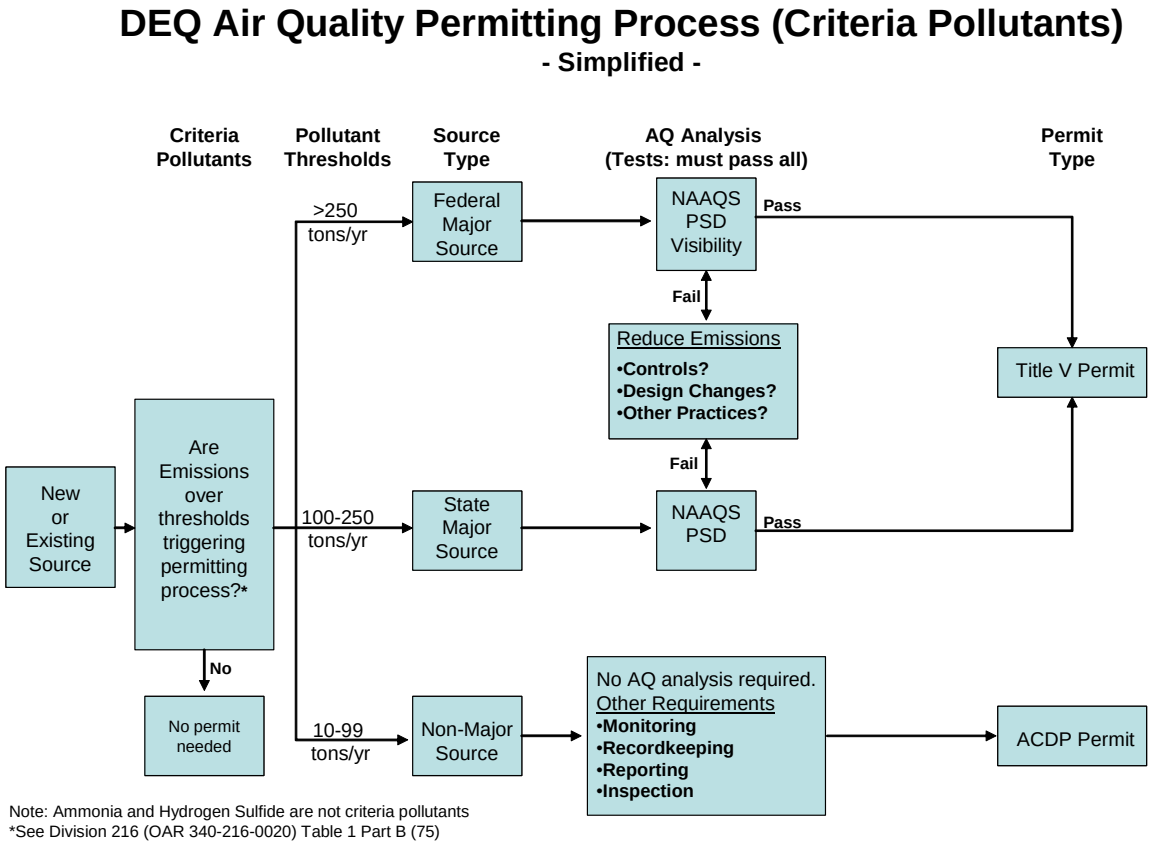


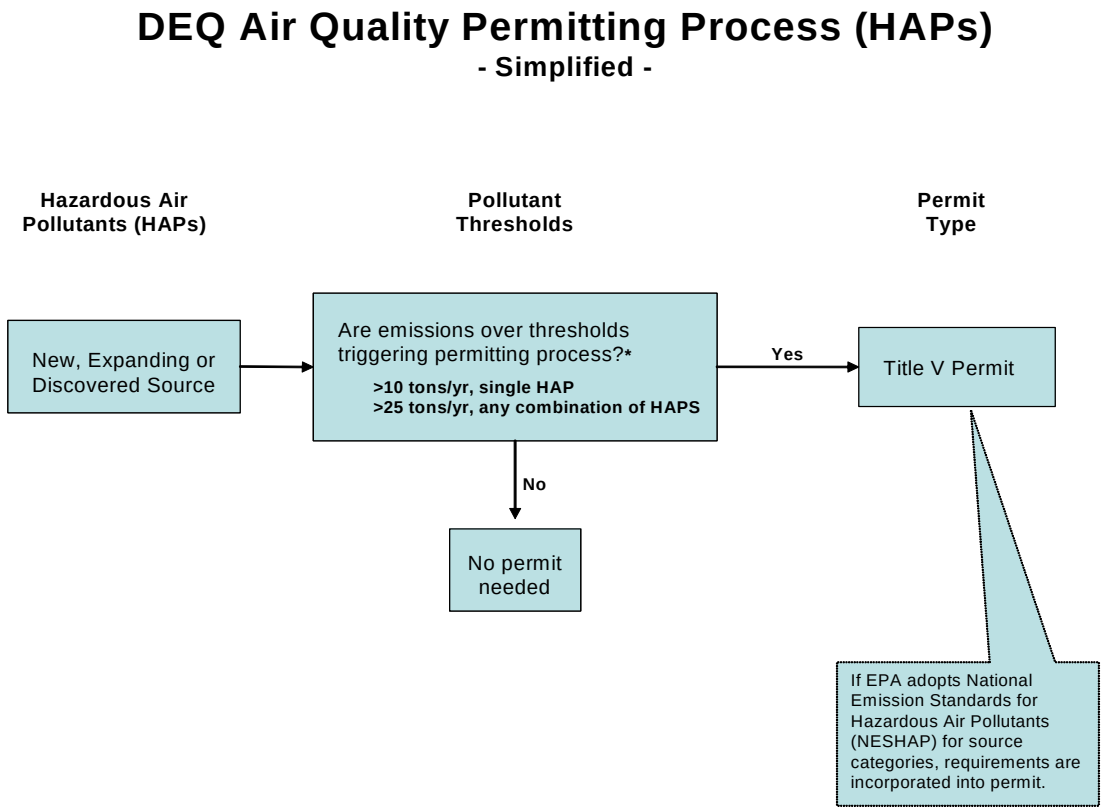
Figure 10 provides a simplified schematic of Oregon DEQ's permitting process for criteria pollutants.

Air Quality Analysis (tests) is required for some sources as part of the permitting process. The analyses include:

- NAAQS: A modeling analysis to show that emissions from the facility would not cause or contribute to a violation of National Ambient Air Quality (health) Standards.
- PSD: A modeling analysis to evaluate whether the proposed emissions significantly contribute to air quality degradation. Known as Prevention of Significant Deterioration (PSD).
- Visibility: Analysis required for the largest (federal major) sources to evaluate impacts on visibility in wilderness areas and National Parks (i.e. haze pollution).

These modeling and analysis activities are iterative. If the tests cannot be passed initially, the facility must reduce its emissions as needed to pass. Typically, this can be accomplished through emission control technology, changes in facility design or processes, or changes in other management practices.

If a facility only has Hazardous Air Pollutant emissions, the flow chart is simpler.



*See Division 200 Tables from OAR 340-200-0020

Figure 11 provides a simplified schematic of Oregon DEQ's permitting process for Hazardous Pollutants (HAPs).

As discussed in Section II.A of this report, the current uncertainties about quantifying emissions from dairy operations make it difficult to determine if a dairy is a major source subject to Clean Air Act permitting. To date, no air quality permits have been required for dairies in Oregon. In the future, dairies could be subject to air permitting requirements. However, in order to make that assessment, DEQ would need accurate emission estimates for individual dairies to compare to permitting emissions thresholds.

I.M.7. What does an air quality permit do?

The purpose of PSD is to ensure that a new or modified major source does not cause a violation of NAAQS, does not cause significant deterioration of air quality in areas that are not violating the NAAQS, and does not cause significant impairment to visibility in a Class 1 area (National Park or wilderness area). A source subject to PSD must install Best Available Control Technology (BACT). BACT is an emission limit based on the maximum degree of reduction achievable, taking into account energy, environmental, and economic impacts on a case-by-case basis. Under EPA guidance, BACT is considered the highest level of control achieved for a similar source in any state, unless the applicant demonstrates that it would result in unusually high energy, environmental or economic impacts when applied to the proposed source. A source subject to PSD must also conduct an analysis of impacts on NAAQS, degradation and visibility (which could lead to requirements for further controls or design changes).

The purpose of a Title V permit is to ensure compliance with all air quality requirements that otherwise apply to a permitted source. The Title V permitting process is also designed to provide a strong role for public involvement. A Title V permit includes a monitoring condition for each existing requirement, and permittees must certify compliance every six months. It is important to note is that a Title V permit does not, by itself, impose any additional requirements for emission reduction. If EPA or DEQ adopt specific emission reduction requirements affecting that facility or that type of operation, those requirements and associated monitoring conditions are added to the permit to ensure compliance.

I.M.8. Air Quality Permits and Hazardous Air Pollutants

As already mentioned, Hazardous Air Pollutants (HAPs) and toxic air pollutants are chemical compounds that are listed by EPA or DEQ as having serious cancer or non-cancer health affects, such as neurological damage. While EPA has established emissions standards for HAPs from various source categories, the agency has not

established federal ambient standards to protect public health from HAPs. Oregon, however, has established health-based benchmark levels for 51 toxic air pollutants. Dairy emissions for which Oregon has established air toxics benchmarks are:

Hydrogen Sulfide (non-cancer effects)
Ammonia (non-cancer effects)
Methanol (a VOC and federal HAP) (non-cancer effects)

In some instances, pollutants can fall under more than one regulatory category. For example, methanol emissions from dairies fall under the classification of a Volatile Organic Compound (VOC), as well as that of a Hazardous Air Pollutant (HAP).

EPA is required to adopt emission standards for all source categories with major sources of HAP emissions, and for categories of smaller (area) sources of HAP emissions that contribute most to risk in urban areas. These standards are called National Emission Standards for Hazardous Air Pollutants (NESHAP). For major sources, the NESHAPs are initially based on the Maximum Achievable Control Technology (MACT). In some cases, EPA may later strengthen the NESHAP as needed to address residual risk after application of MACT. Because a major source of HAP is subject to Title V permitting as discussed in Section I.M.6., the NESHAP is included in the Title V permit along with associated monitoring conditions. As DEQ understands it, EPA is not contemplating setting MACT standards for dairies at this time.

I.N. How are these emissions currently regulated in Oregon?

The Oregon Department of Environmental Quality administers the Clean Air Act in Oregon, with the exception that the Lane Regional Air Protection Agency (LRAPA) administers it in Lane County. Oregon dairy emissions are not regulated by either air agency. Both agencies administer the Oregon Air Toxics program within their respective jurisdictions. These programs are intended to protect outdoor air quality for the general population.

Workplace protection is provided by OSHA. That agency works with labor, businesses and other government agencies to provide compliance enforcement, laboratory analysis, workplace consultation, technical assistance, public education and workplace

training with regard to worker health and safety. Scheduled inspections to enforce workplace health and safety standards are determined by history of workplace injuries and illnesses, previous inspections, number of employees and overall hazard rating of the employer's industry. Inspections for compliance are also conducted on referral and in response to complaints of unsafe working conditions. Oregon OSHA works in cooperation with the federal OSHA to investigate cases of alleged violations of worker health and safety standards and is authorized to issue citations for violations of those standards.[36]

OR-OSHA is responsible for ensuring all Oregon employers are controlling potentially hazardous airborne chemical and some biological exposures at or below Permissible Exposure Limits (PELs). OR-OSHA determines the employer is in compliance with the OR-OSHA Agricultural hazardous airborne substance code (Division 4/Z: 437-004-9000) by sampling for worker airborne exposure to particular hazardous agents within the worker's "breathing zone" (BZ).

For an employer to comply with Division 4/Z, the employer must ensure that the worker's BZ chemical exposure does not exceed the respective OR-OSHA PEL. The PEL is an established legal limit based on toxicological models and review. It is not to be exceeded and is usually compared to a BZ sample concentration averaged over an eight-hour work shift within a forty-hour workweek.

I.O. How are these emissions currently regulated in other states?

Other states have recently begun regulating dairies and dairy emissions. Some states focus on the emissions and have adopted ambient air quality standards for the types of emissions coming from dairies, primarily ammonia and hydrogen sulfide since these standards are often related to odors. This Section describes state programs that focus on emissions. Other states have established regulations focused on permitting and adoption of "best management practices" by dairy operations. Section IV contains information on this type of state program. The California program is unique. The concern there is with VOC and PM because the state has significant numbers of violations of the NAAQS, especially in the San Joaquin Valley. This means that regulations focus on permitting and controls to reduce those emissions.

One Task Member noted the issue of evaluating and managing the health and

environmental impacts of emissions from animal agriculture facilities has largely been left up to states. Air quality has not been the driving force behind state government action on animal feeding operations (AFO), but has emerged out of long standing concern to protect water resources. Several states have recognized a need to regulate air emissions from agricultural operations, but many states have not yet directly adopted or enacted programs affecting AFO emissions.[37]

State programs, under statutes and regulations, both implement and supplement federal CAA requirements. That is, in some cases, state programs have been adopted to ensure state compliance with requirements of federal law and to implement State Implementation Plans or SIPs, such as facility permits that apply to construction and operation of livestock operations. In other cases, states have enacted more comprehensive laws and regulations calling for air emission testing and monitoring, manure management to abate pollutant emissions, inspections, and testing. Some states have regulatory programs or ambient air standards for odor and/or certain AFO pollutants, such as hydrogen sulfide, for which no NAAQS apply. In states with significant animal production, facility management statutes often govern construction and operation of AFOs, primarily for purposes of protecting water quality, with incidental provisions for air quality. For example, facility management statutes often contain setback requirements for confinement buildings and waste impoundments that may help to reduce air emissions by avoiding or minimizing odor nuisances.

I.O.1. Other States

- Minnesota requires feedlots and manure storage areas to acquire construction and operating permits and also requires air emission plans for large livestock facilities. The state has adopted an ambient air quality standard for hydrogen sulfide that applies to emissions from AFOs as well as other sources.
- Missouri regulations set odor emission limitations and require large AFOs to submit odor control plans. In addition, the state's CAA permit program includes operational requirement for AFOs to prevent air pollution. Missouri's CAA contains a hydrogen sulfide emission standard that does not refer to AFOs or other agricultural operations specifically, nor does it exempt AFOs. Missouri also has an ambient acceptable level (AAL) for ammonia.
- In Texas, a consolidated program governs water and air quality general permits. Its requirements control the emission of odors and other air contaminates from AFOs, although it does not have a specific air emission threshold for odors. Like Missouri,

Texas has a hydrogen sulfide emission standard that makes no specific reference to, or exception for animal agriculture.

- Illinois has implemented a facility statute that relies in part on setback distances to control odor emissions. Like Missouri, Illinois has established a numerical "objectionable odor nuisance" standard (that is when odor is detectable in ambient air adjacent to residential or similar structures after dilution with a specific volume of odor free air) and has enforced the limitation against AFOs.
- Colorado water quality rules help to control air emissions through provisions that govern the construction and operation of facilities that treat animal wastes. A separate regulation establishes an odor emissions standard for swine feeding operations and requires that anaerobic waste impoundments be covered.
- North Carolina, like Colorado has focused its regulatory efforts on odor emissions from swine operations. All AFOs must use management practices that control odors and some swine operations must submit odor management plans, although it does not require control technology (e.g. covers) unless best management practices fail.
- A study done by the Nebraska Department of Environmental Quality found that more than half of the states have ambient air standards for H_2S. States base standards on a variety of issues, including odor or nuisance, welfare effects and health effects. Consequently, standards vary considerably from as low as .7ppb for a yearly average (New York) and 5 ppb averaged over 24 hours (Pennsylvania) to standards based on nuisance, such as Minnesota's 50 ppb not to be exceeded for one half hour twice per year and measured at the AFO property line.

I.O.2 California

California recently addressed the discrepancy between state and federal law with regard to agricultural operations and air quality standards. Like Oregon, California law exempted agricultural operations from air quality regulation. In February 2003, EPA gave California until November 18, 2003, to change the state law that exempted agricultural operations from the State's required industrial permitting program or face possible sanctions under the Clean Air Act.[38] EPA took final action on June 25, 2003, to require that California remove the agricultural permitting exemption from state law for the new source review permitting program for major stationary emissions sources. These permits require appropriate pollution controls and pollution credits to offset pollution increases at new or modified stationary sources.

In response, California passed Senate Bill 700 on January 1, 2004. SB700 lifted the

agricultural air quality exemption and required, among other things, permits, conservation management practices, temporary offset exemptions, and CAFO emissions reductions. A lawsuit in San Joaquin Valley over permit timing, emission factors, and Best Available Control Technologies prompted additional rules applicable to dairy operations in California.[39]

Deferral of Permit Requirements for Some Smaller Operations (Excerpted from San Joaquin Valley Air Pollution Control District Air Pollution Control Officer's Determination of VOC Emission Factors for Dairies, August 1, 2005.)

> Under Senate Bill 700, permitting requirements were deferred for smaller agricultural operations with emissions less than half of major source thresholds. Based on dairy VOC emissions factors in use in California at that time, existing dairies with 1,954 cows were expected to have VOC emissions equal to or greater than one-half of the District major source thresholds, and were required to apply for District permits by June 30, 2004.
>
> Dairies with less than 1,954 cows were determined to have emissions less that one-half of major source threshold, so permitting was deferred for these smaller operations. Under the provisions of SB700, an Air District may permit these smaller sources by making several findings which are presented in a public process.
>
> - The District must find that a permit is necessary to impose or enforce reductions in emissions of an air pollutant that causes or contributes to a violation of a state or federal ambient air quality standard.
> - The District must find that the requirement for a source, or category of sources, to obtain a permit would not impose a burden on those sources that is significantly more burdensome than permits required for other similar sources of air pollution.
>
> For dairies with 1,954 cows or more, these findings were not necessary. Permitting is specifically required under Senate Bill 700 for these agricultural sources with emissions over one-half the major sources with

emissions over on-half the major source thresholds.

In addition to the permitting requirements described above, Section 40724.6 of the California Health and Safety Code was added to require that Districts establish VOC control requirements for existing dairies. This code section requires the California Air Resources Board to review all available scientific information and develop a definition for the source category of “Large” Confined Animal Facilities, including dairies. State law requires Large CAFOs to submit application for a permit or permit amendment to reduce emissions within six months of District adoptions of the Rule (July 1, 2005) and requires the facilities to implement the required emissions reductions within one year of District approval.

Rule 4570, also known as the Large CAFO Rule, was passed in June of 2006, and is aimed at reducing VOC and NH_3 emissions by requiring best available retrofit mitigation measures. Conservation Management Plans were introduced in August of 2004 to reduce PM_{10} emissions by requiring practices on unpaved roads, equipment yards, land prep, harvest, and AFO housing and feeding areas. In addition, other stationary source requirements were implemented, such as engine emission limitations and gas tank requirements.

In 2006, California passed Assembly Bill 32 (AB32), also known as the California Global Warming Solutions Act. The Act created a comprehensive program to reduce greenhouse gas emissions in California. Within the planning effort, consideration is given to manure management strategies of animal feeding operations and their contribution to greenhouse gas emissions.[40] AB32 is included with this document as Appendix J.

California’s Air Resources Board created manure management strategies and protocols as part of the State’s strategy for reducing greenhouse gas emissions pursuant to the comprehensive, multi-year program to reduce GHG emissions to 1990 levels by the year 2020 under AB32. Under their Manure Management Program, the Air Resources Board manages a list-serve to which individuals can subscribe to keep abreast of activities

taking place. For more information about the program, visit http://www.arb.ca.gov/ag/manuremgmt/manuremgmt.htm, or to subscribe to the list, go to http://www.arb.ca.gov/listserv/manuremgmt.htm.

The following comment was received for the Task Force to consider:

It is important to know the ambient air quality concentrations in California prior to the implementation of the air quality regulation. This will allow for comparisons to be made between the states. It is difficult to compare what was required of San Joaquin Valley dairies to Oregon dairies without knowing the concentration levels in each of the states.

In reference to Senate Bill 700, when using the California Model for regulating VOCs, approximately three dairies in Oregon would meet the criteria that would require regulation. The VOC emissions factor that determines dairy emissions today (in California) is derived from a study that is not only critically outdated but did not measure VOC at all according to Mitloehner in his 2005 paper, previously mentioned.

I.O.3. Iowa

In 2002, the Iowa Legislature directed the Iowa Department of Natural Resources (DNR) to perform a field study to determine airborne levels of ammonia, hydrogen sulfide, and odor near animal feeding operations.[41]

The DNR Best Management Practices Workgroup addressed the following issues related to BMPs:

1. What types of BMPs are there to mitigate the emissions of pollutants from AFOs?
2. What is the effectiveness of the BMPs?
3. What are the associated costs (installation, maintenance, operation) of the BMPs?
4. What is the availability of the BMPs?
5. Will the BMPs have other environmental impacts that may need to be considered?
6. How should information be provided to producers on the availability of BMPs?
7. How will future technologies be approved and ranked?[42]

In the process of answering the above questions, the workgroup identified four fact sheets and associated flow charts, published by Iowa State University, on BMPs for reducing air emissions of ammonia, hydrogen sulfide, odor and dust from Animal Feeding Operations (AFOs). The workgroup decided to adopt the fact sheets and flow charts for incorporation in their report to the legislature, and are currently being distributed to dairy operations throughout the state. These fact sheets have been included as reference with this report in Appendix K.

Iowa has also adopted a health effects-based ambient air quality standard for hydrogen sulfide that will be used in a three year AFO field study to measure levels of H_2S, ammonia and odor to determine if material adverse health effects exist.

In addition, Humboldt County, Iowa Ordinance #22 provides guidance regarding reporting and other requirements for owners and operators of large livestock confinement feeding facilities in rural areas of Humboldt County to provide details of the operation to the county for review by the general public.[43]

The Task Force did not have sufficient time to explore how dairy emissions are currently regulated in other countries, or how these emissions types are regulated in non-agricultural sectors.

I.P. What are the cross-relationships between our work and other related air inquiries?

I.P.1. Visibility in the Columbia River Gorge National Scenic Area

The Columbia River Gorge is not a federal wilderness area or National Park and is therefore not addressed under the federal Regional Haze program. The Gorge is however, our nation's first National Scenic Area, with a mix of thriving communities as well as outstanding scenic vistas, important ecosystems, and places of great cultural significance to Native American Tribes. Since 2000, the Oregon DEQ and the Southwest Washington Clean Air Agency (SWCAA) have been conducting a study of visibility in the Columbia River Gorge National Scenic Area (Gorge). This study is part of an effort to develop an air quality improvement plan for the Gorge that will help protect valued scenic and other resources in the area. This plan is not required under the Clean Air Act, but has been undertaken by the Oregon and Washington air agencies at the request of the Columbia River Gorge Commission.[44]

As part of this study, the agencies have been identifying potential sources of visibility impairment and providing a future look at visibility conditions in the Gorge. The study suggests that visibility impairment is greatest in the winter and influenced greatly by sources east of the Gorge. Air stagnation and fog are more common in the wintertime and are responsible for the rapid conversion of precursor gases (sulfur dioxide, nitrogen oxide, and ammonia) to haze in the Gorge.[45] It is premature to say exactly what role dairy emissions contribute to haze events in the Gorge, but emissions from sources such as electric utilities, motor vehicles and other transportation sources, dairies, and other man-made sources are likely tied to visibility impairment in the Gorge. DEQ is interested in identifying opportunities for emission reductions across all sectors to benefit the Gorge over time.

I.P.2. Acid Deposition in the Columbia River Gorge National Scenic Area

The U.S. Forest Service (USFS) has been conducting a study looking at nitrogen levels from acid rain deposition in the Gorge. The results from the acid rain study suggests air pollution is at levels that could potentially impact cultural and natural resources, based on soil acidification and elevated levels of nitrogen and sulfur in lichen plants. Studying lichen compositions helps provide a first glimpse of potential ecological effects from air pollution. Potential sources of nitrogen are associated with agricultural emissions from regions east of the Gorge, whereas emissions from fossil fuel combustion (such as motor vehicles and industrial processes) contribute nitrogen and sulfur at the west end of the Gorge. Excess nitrogen deposition is of concern in the Gorge because it can alter plant composition and productivity as well as soil chemistry. Acidic pollution can fall to earth through both dry and wet deposition as illustrated in Figure 12.

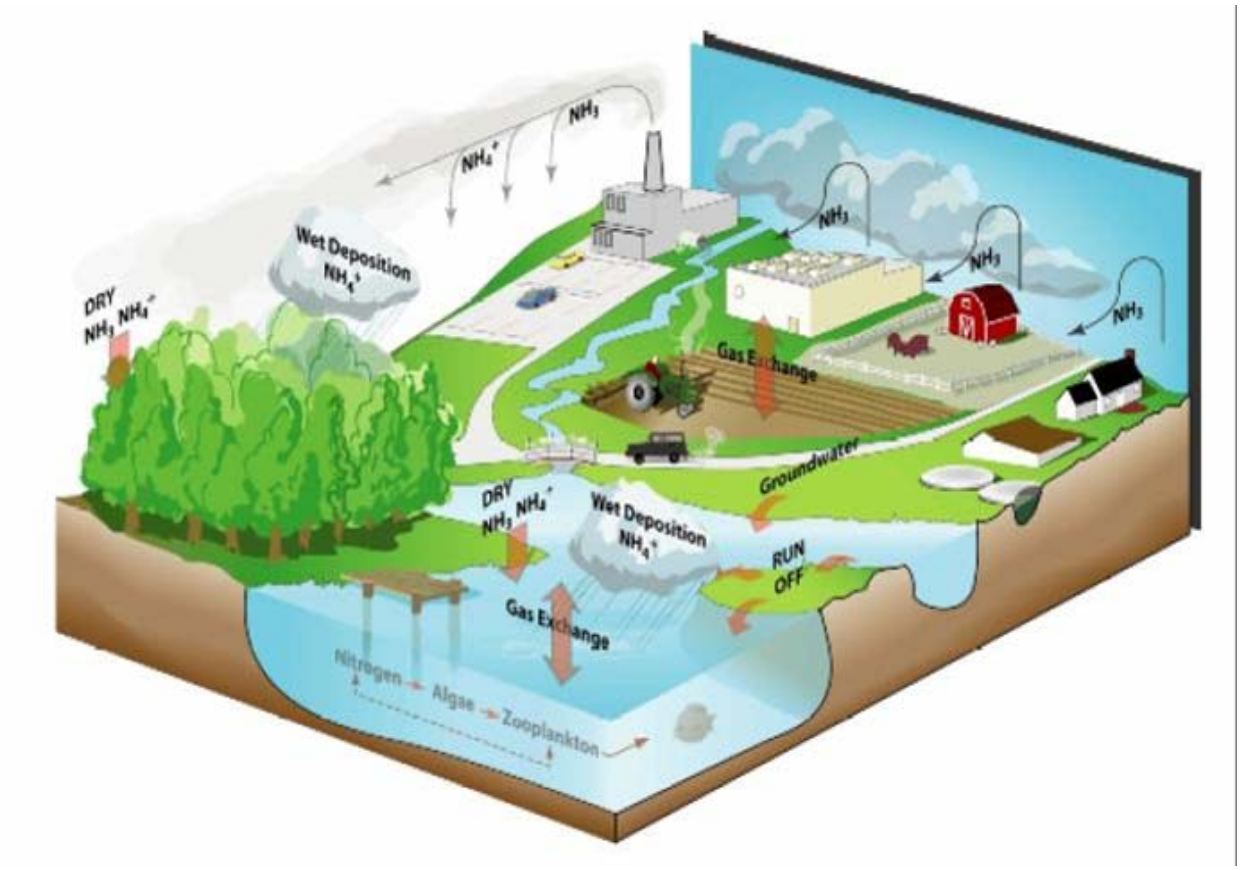


Figure 12. Wet and Dry Acidic Deposition sources and Processes

Dry deposition occurs when the wind or gravity brings acidic compounds into contact with water bodies, ecosystems, and communities. Wet deposition occurs when acidic compounds increase the acidity of rain, snow, fog, or mist. The strength of the effects depends on several factors, including the acidity of the water; the chemistry and buffering capacity of the soils and waters involved; and the types of fish, trees, and other living things that are affected.[46] There is also concern that acid deposition may cause harm to resources of high cultural importance to Native American tribes, such as culturally significant plants and ancestral rock images in the Columbia Gorge.

In addition, excess nitrogen in the atmosphere acts as fertilizer when it deposits on the land or in water bodies, and may cause unnatural nitrification of ecosystems. Excess nitrogen could come in part from agricultural application of nitrogen fertilizers.

More information on the USFS study of acid deposition in the Gorge can be found at http://www.swcleanair.org/pdf/GorgeAtmosphericDeposition.pdf.

I.P.3. Ozone Effects on Ecosystems

In a separate study by the USFS, the effects of ozone (smog) on forest ecosystems was examined. Effects of ozone injury were found at one site in the Gorge, but it is a unique site showing damage to a non-native species. Overall, the study concluded that forests in Oregon and Washington are not being injured by ozone, but it does suggest the potential for some risk in the future if emissions increase and/or summertime temperatures increase causing more ozone formation.

I.P.4. Native American Cultural Resources, Rock Images, Culturally Important Plants

The Oregon and Washington air agencies recognize the importance of addressing the preservation of Native American rock images including petroglyphs and pictographs. Knowledge of potential damage to the rock images and indicators of atmospheric pollution will be helpful in establishing practices for rock image preservation and air quality improvements. Future projects could be designed to further investigate the effects of acidic deposition on the Native American cultural resources.

I.P.5. Greenhouse Gas Emissions Reporting Program

Governor Kulongoski is committed to combating global warming and several initiatives are underway to reduce greenhouse gas emissions in Oregon. He established the Governor's Advisory Group on Global Warming in 2004 to develop a state strategy to complement the regional effort. The Advisory Group issued its recommendations to the Governor in the Oregon Strategy for Greenhouse Gas Reductions in 2004. The Oregon Strategy includes a suite of policies and measures to reduce Oregon's greenhouse gas emissions along with recommended greenhouse gas emission reduction goals.

In February 2007, the Governor joined with other western states and helped form the Western Climate Initiative, which commits partners to developing a regional target for reducing greenhouse gases, participating in a multi-state registry, and developing a market-based program to achieve greenhouse gas emission reductions.

In May 2007, Oregon became an inaugural member of The Climate Registry, which now includes over 40 states, all Canadian provinces, several tribes and the Mexican state of Sonora.

On August 7, 2007, the Governor signed into law HB 3543 that creates a permanent

Global Warming Commission, and also put into statute the state greenhouse gas reduction goals the Governor outlined in 2005. The reduction goals are to:

- arrest increasing emissions by 2010,
- reduce emissions to 10% below 1990 levels by 2020; and
- reduce emissions to 75% below 1990 levels by 2050.

Key to both the Western Climate Initiative and the new Oregon legislation is obtaining accurate greenhouse gas emissions data. To address this important need, on July 17, 2007 the Governor asked Oregon's Environmental Quality Commission (EQC) to consider adopting rules for mandatory greenhouse gas reporting as soon as possible.

DEQ will develop greenhouse gas reporting rules to address the most significant emission sources of greenhouse gases in Oregon, be consistent with other regional and state emission reporting mechanisms, and ensure good quality emissions accounting and quantification. DEQ established a Greenhouse Gas Reporting Advisory Committee (GHGRAC) to develop recommendations for this reporting system by the end of 2007. These draft rules will be proposed for EQC consideration by mid-2008.

The GHGRAC has recommended that the scope for the mandatory greenhouse gas reporting system for Oregon address agriculture and forestry. However, they did not recommend that the mandatory reporting rules that DEQ is developing for EQC consideration in 2008 include these sources unless they have an Oregon Title V or Air Contaminant Discharge Permit. The GHGRAC recommended that DEQ and the Oregon Department of Energy (ODOE) discuss agricultural reporting with the Oregon Department of Agriculture (ODA), and discuss forestry reporting with the Oregon Department of Forestry (ODF), and seek additional data that would improve the top-down statewide emissions inventory for these source categories of sources. .The Western Climate Initiative is also addressing agricultural and forestry emissions under the scope of the market-based multi-sector mechanism that they are developing to reduce greenhouse gas emissions within the region.

II. SCIENCE

The following section examines the science behind understanding the methodologies used to estimate air emissions; the potential for air pollution to affect various cultural resources and the environment; and Oregon-specific implications for the application of nationally used data and methodologies.

II.A. How does DEQ currently estimate emissions from dairies and how are they used?

II.A.1 Emissions Inventories

DEQ estimates the air emissions from hundreds of different types of source sectors across the state and makes estimates for multiple air pollutant types, such as Volatile Organic Compounds, Particulates, and Hazardous Air Pollutants. These estimates are used for a variety of purposes, from simple tracking of emissions changes over time to more focused air quality planning efforts in specific communities. For some source sectors (like major industry, cars, home heating) there is a long history of research documenting the actual emissions produced by the sector and the factors that influence those emissions. For many sectors, this history of research and methods development results in a generally high degree of confidence as to the accuracy of the estimates. This is not the case with estimating emissions from some source sectors, including dairies.

We are at a very early stage of being able to estimate dairy emissions, and there is currently a high degree of uncertainty as to the actual emissions generated by specific, individual dairies. In fact, after reviewing current practice for estimating CAFO emissions,, the National Academy of Science (NAS) Committee on Air Emissions from Animal Feeding Operations concluded that current methods for "estimating air emissions from CAFOs by multiplying the number of animal units by existing emissions factors is not appropriate for most substances."[47]

Determination of emissions from these operations has been an extremely active area of research since that report was published. Appendix D contains summaries or abstracts, of recent research work that has been planned or completed, relying primarily on presentations at the 2006 and 2007 Western Dairy Air Quality Symposia., This research covers a variety of pollutants, measurement methods, and the effects of

different livestock management options. This work is important because it focuses on dairy operations. Another helpful source of emissions information is a recent study of CAFO operations in Iowa. This study has been included as Appendix L of this document as additional background.

There has been significant progress studying dairy emissions in some states, but even so, one significant limitation for DEQ is that there is still no "official," high quality method for estimating dairy emissions. Emissions estimation methodologies are improving however, and within a few years, DEQ expects to be able to use new EPA research and technical tools to more accurately estimate dairy emissions. Key new research in this area is discussed below in Section II.F.

II.A.2. Factors that Influence Dairy Emissions

Once feces and urine leave the animal, they undergo a variety of processes that are driven by wind, temperature, moisture, and microbial metabolism. Factors such as pH and the availability of oxygen affect the communities of microorganisms that are going through their own life cycles and are responsible for transforming the nonvolatile compounds in feed, water, and manure into volatile compounds such as ammonia (NH_3), nitrous oxide (N_2O), nitric oxide (NO), methane (CH_4), volatile organic compounds (VOCs), hydrogen sulfide (H_2S) and odor-causing compounds. Most emissions are released from area sources such as feedlots, wastewater lagoons, or the land to which manure or lagoon liquid is applied, rather than from a few discrete point sources (e.g., animal house exhaust fans).

The production of methane is an ideal example. In addition to enteric fermentation, CH_4 emissions also occur during anaerobic microbial decomposition of manure.[48] The most important factor affecting the amount produced is how the manure is managed, because some types of storage and treatment systems promote an oxygen-depleted (anaerobic) environment. Metabolic processes of methanogens lead to CH_4 production at all stages of manure handling. Liquid systems tend to encourage anaerobic conditions and tend to produce significant quantities of CH_4, while more aerobic solid waste management approaches may produce little or none. Therefore, estimates of emissions generated for one set of conditions or for a single type of Oregon dairy may not translate readily into others.

II.A.3. Current DEQ Methodology

It is common for the Environmental Protection Agency (EPA) to provide states an official method for estimating emissions from various source sectors, such as industrial operations, transportation, open burning, home heating, etc. EPA develops emissions factors and guidance for quantifying emissions and these methods are used by air quality management agencies, providing consistency across the country in the determination of air emissions from similar sources. At this time however, there is no official EPA method for estimating dairy emissions. EPA offers no emissions factors or estimation methodology guidance. EPA encourages states to evaluate their own situation and determine the most appropriate method of estimating emissions.

One of the key obstacles to estimating dairy emissions is the unique nature of each dairy operation and the variation in operating parameters that can affect what that operation emits. A dairy on the Oregon coast, in a cool and wet climate, with certain operating parameters could produce very different air emissions than a dairy operating in north-central Oregon. The unique operating characteristics of each dairy operation cannot currently be taken into account. Therefore, DEQ's current emissions estimates are only sufficient for getting a general understanding of what the dairy industry as a whole could be emitting, not for estimating air emissions from individual dairy operations.

In many cases DEQ uses a simple equation to calculate air emissions for different source sectors (e.g. such as cars, woodstoves, open burning, ect.) where direct measurement of emissions is not possible. In the equations, an "activity level" (such as miles traveled, or cords of wood burned) is multiplied by an emission factor that indicates the amount of emissions released for each unit of activity. DEQ's current methodology for dairy operations is relatively crude, and based solely on the number of cows multiplied by a generic emission factor. In general, emission factors (currently expressed in units like X lbs of ammonia per cow), can be obtained from EPA or from other research conducted around the country.

DEQ currently uses the following formula to estimate dairy emissions:

(# of cows) x (Emissions Factor) = Emissions

DEQ has attempted to make some refinements to dairy emission factors to better reflect

different manure treatment systems employed by each operation. DEQ reviewed available emission factor information from around the county and selected factors it thought reasonable. The factors were a first attempt to reflect general operating differences between different types of dairy treatment systems (i.e. dry scrape vs. flush manure handing systems). However, the emission factors still do not consider all the variables that can influence emissions generation (such as temperature and other climatic factors) and do not fully describe the actual emissions from individual dairy operations.

II.B. What does the existing data say about the type, amount, durations and frequency of those dairy air emissions? What do we know and how confident are we that it is reliable?

II.B.1. DEQ Emissions Estimates

As discussed earlier, DEQ periodically develops statewide estimates of air emissions from all types of sources, including major industry, transportation, forestry, agriculture, and many others. DEQ's statewide Emission Inventory (EI) also includes estimates for dairy operations. DEQ's estimates are update periodically to track changes and trends in statewide emissions, and can also be use for special projects, such as the regional visibility study recently conducted for the Columbia River Gorge National Scenic Area. A more detailed description of DEQ's estimation methods for dairy emissions is provided below.

There is at least one dairy located in 27 of Oregon's 36 counties. The description of the dairy industry provided earlier includes a map showing the distribution of dairy operations in Oregon. Twenty-four counties contain about 20 or fewer dairy farms each. Because of the existence of one very large operation, Morrow County leads the state in number of dairy related animals, followed by Tillamook County. A map showing the distribution of dairies across Oregon was shown earlier, in Section I.E. The ODA inspects dairies on a 10-month schedule and collects information on the number of animals present. This data on number of animals was provided to DEQ to be used in the emissions equation shown earlier.

To develop DEQ's estimates of regional dairy ammonia emissions in other projects, contractors conducted a literature search and the Technical Team selected the a representative emission factor based on its best scientific judgment from university reports and the EPA using the following criteria:

- Emissions Factors used by EPA (if available)
- Emissions Factors from studies conducted in geographic areas with climates similar to Oregon
- Emissions factors utilized in other countries with climates similar to Oregon

Table 6 below illustrates the range of possible emission factors and emissions DEQ assembled based on additional research into dairy emission factors also using the above criteria. The extreme variability in the range of possible factors may reflect the fact that some research only accounted for a portion of an operation's emissions, while other research captured a more complete accounting of total emissions. The emission factors considered in this effort can be found in Appendix W.

Table 6. Range of Potential Emission Factors (kilograms per head (cow) per year)

Pollutant	kg/hd-yr
Ammonia	8.45 - 97
VOC	8.75 - 17.3
PM10	0.84 - 3.04
N2O	0.14 - 2.8
Methane (CH4)	124.6 - 164.4
H2S	0.012 - 9.9

For each air emission, DEQ selected a representative emission factor based on an assessment of available research. With the exception of ammonia, one emission factor was chosen to apply to each dairy, regardless of its location. For ammonia, DEQ applied a variety of emission factors in an attempt to approximate the use of different manure treatment systems on various diaries. Regional emissions were estimated from this data for NH_3, CH_4, VOC, H_2S, N_2O and PM_{10}.

Figure 13 below shows the location of dairies in both Oregon and Washington. It is interesting with respect to the Gorge study to note the high density of Washington dairies in the Yakama region. This could suggest an opportunity for future bi-state collaboration with Oregon and Washington to reduce ammonia emissions influencing levels in the Columbia River Gorge.

Figure 13. Northwest Regional Dairy Locations

The data provided by ODA in the Gorge study was expanded for the current work on statewide dairy emissions. Figures 14 and 15 below show the most recent information on the number and location of dairies across Oregon and the number of animals by county. A comparison of Tillamook and Morrow counties also illustrates how a large

amount of emissions can be produced by either having a large number of smaller dairies operating in one region, or a small number of very large dairies.

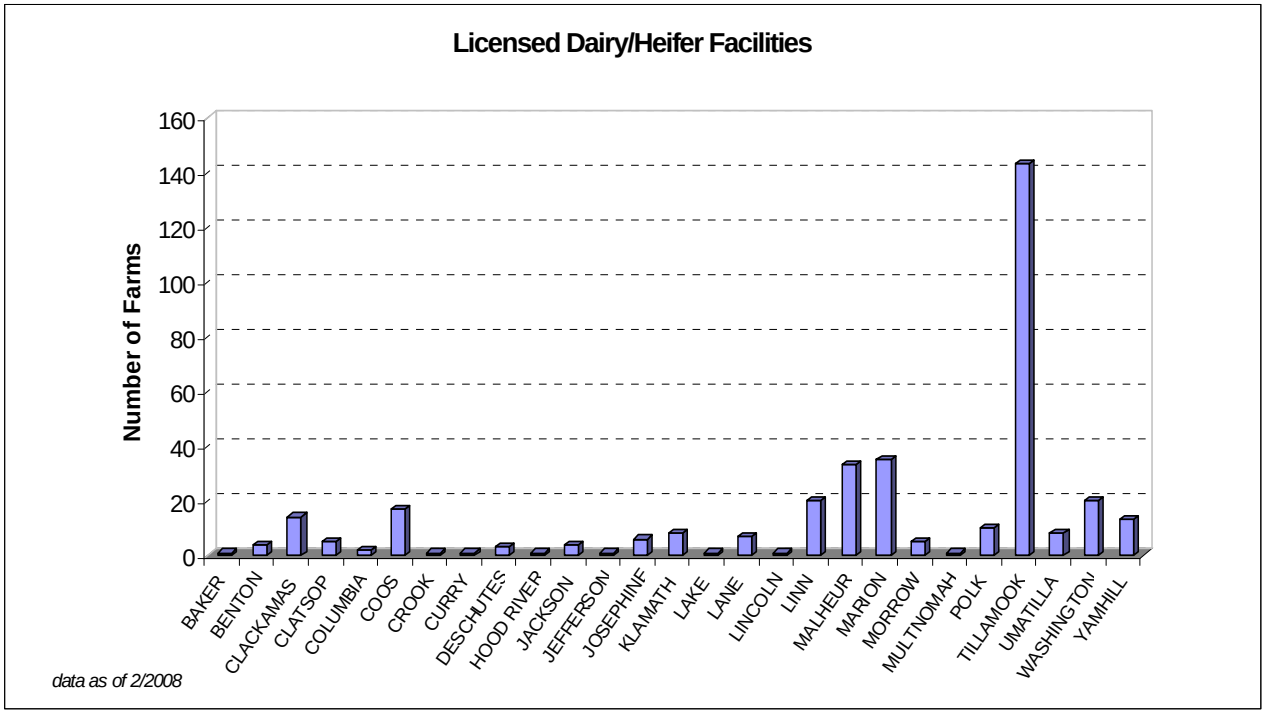


Figure 14. Number of Dairy and Heifer Facilities in Oregon by County as of February 2008.

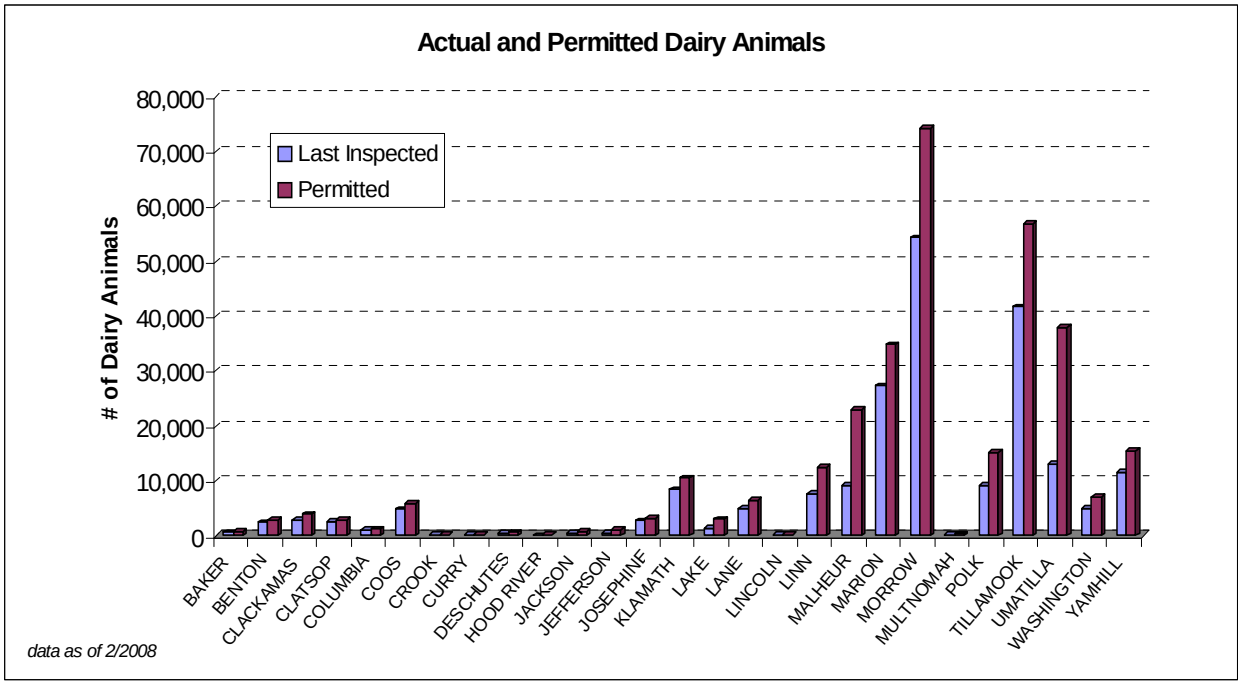


Figure 15. Number of Dairy Animals in Oregon by County as of February 2008. Includes Dairy Cows, Heifers, and Adolescents, and Juveniles

Table 7 below illustrates the range of emission estimates possible for the Oregon dairy industry based on DEQ's current information on dairy operations, current estimation methodology, and the range of available (per cow) emission factors previously found.

Table 7. Potential Range of Dairy Emission Estimates (2006)

County	**Estimated Potential Range of Emissions** (Tons Per Year)																	
	NH3			VOC			PM10			CH4			N2O			H2S		
Baker	10	-	16	3	-	7	0	-	1	48	-	63	0.1	-	1	0.0	-	4
Benton	39	-	61	24	-	48	2	-	8	348	-	455	0.4	-	8	0.0	-	27
Clackamas	45	-	72	31	-	61	3	-	11	442	-	579	0.5	-	10	0.0	-	35
Clatsop	43	-	68	12	-	24	1	-	4	174	-	227	0.2	-	4	0.0	-	14
Columbia	18	-	29	14	-	27	1	-	5	192	-	225	0.2	-	4	0.0	-	15
Coos	79	-	125	36	-	71	3	-	13	515	-	675	0.6	-	11	0.0	-	41
Crook	1	-	2	0	-	1	0	-	0	6	-	8	0.0	-	0	0.0	-	1
Curry	1	-	2	1	-	1	0	-	0	11	-	14	0.0	-	0	0.0	-	1
Deschutes	7	-	12	4	-	9	0	-	2	62	-	81	0.1	-	1	0.0	-	5
Harney	0	-	0	12	-	23	1	-	4	166	-	217	0.2	-	4	0.0	-	13
Hood River	7	-	12	2	-	4	0	-	1	27	-	35	0.0	-	1	0.0	-	2
Jackson	5	-	9	4	-	8	0	-	1	61	-	80	0.1	-	1	0.0	-	5
Jefferson	43	-	68	1	-	2	0	-	0	17	-	22	0.0	-	0	0.0	-	1
Josephine	136	-	216	32	-	64	3	-	11	459	-	602	0.5	-	10	0.0	-	36
Klamath	23	-	37	96	-	189	9	-	33	1,367	-	1,747	1.5	-	30	0.1	-	108
Lane	79	-	126	37	-	72	4	-	13	522	-	684	0.6	-	12	0.0	-	41
Lincoln	1	-	1	1	-	2	0	-	0	15	-	20	0.0	-	0	0.0	-	1
Linn	126	-	200	88	-	173	8	-	30	1,248	-	1,635	1.4	-	28	0.1	-	98
Malheur	147	-	234	67	-	133	6	-	23	957	-	1,253	1.1	-	21	0.1	-	75
Marion	445	-	707	229	-	452	22	-	80	3,259	-	4,269	3.6	-	73	0.3	-	257
Morrow	977	-	1,551	503	-	993	48	-	175	7,166	-	9,387	8.0	-	160	0.7	-	565
Multnomah	3	-	5	2	-	5	0	-	1	35	-	45	0.0	-	1	0.0	-	3
Polk	148	-	235	115	-	228	11	-	40	1,643	-	2,153	1.8	-	37	0.2	-	130
Tillamook	679	-	1,078	366	-	722	35	-	127	5,210	-	6,690	5.8	-	116	0.5	-	411
Umatilla	212	-	337	231	-	456	22	-	80	3,292	-	4,312	3.7	-	73	0.3	-	260
Washington	82	-	130	58	-	114	6	-	20	822	-	1,077	0.9	-	18	0.1	-	65
Yamhill	189	-	301	75	-	148	7	-	26	1,069	-	1,384	1.2	-	24	0.1	-	84
	3,547		5,632	2,046		4,038	196		711	29,133		37,942	32		650	3		2,298

Figures 16 and 16a below show the ODA CAFO regions in Oregon and total dairy emissions estimate for each. Obviously, these estimates have uncertainties spanning at least the range listed in Table 7 above. The rational for choosing an EF and the source of the EF are indicated in the notes accompanying Figure 16a below. A complete discussion will be available as part of the statewide emission inventory documentation. For further information please contact the DEQ Technical Services Section at 503.229.5506.

ODA permits CAFO facilities by six distinct areas of the state, known as CAFO Regions.

Figure 16 below shows the ODA CAFO regions in Oregon. In Figure 16a below, DEQ has created an example of what the regional distribution of dairy emissions could look like, based on total dairy animals in each CAFO region.

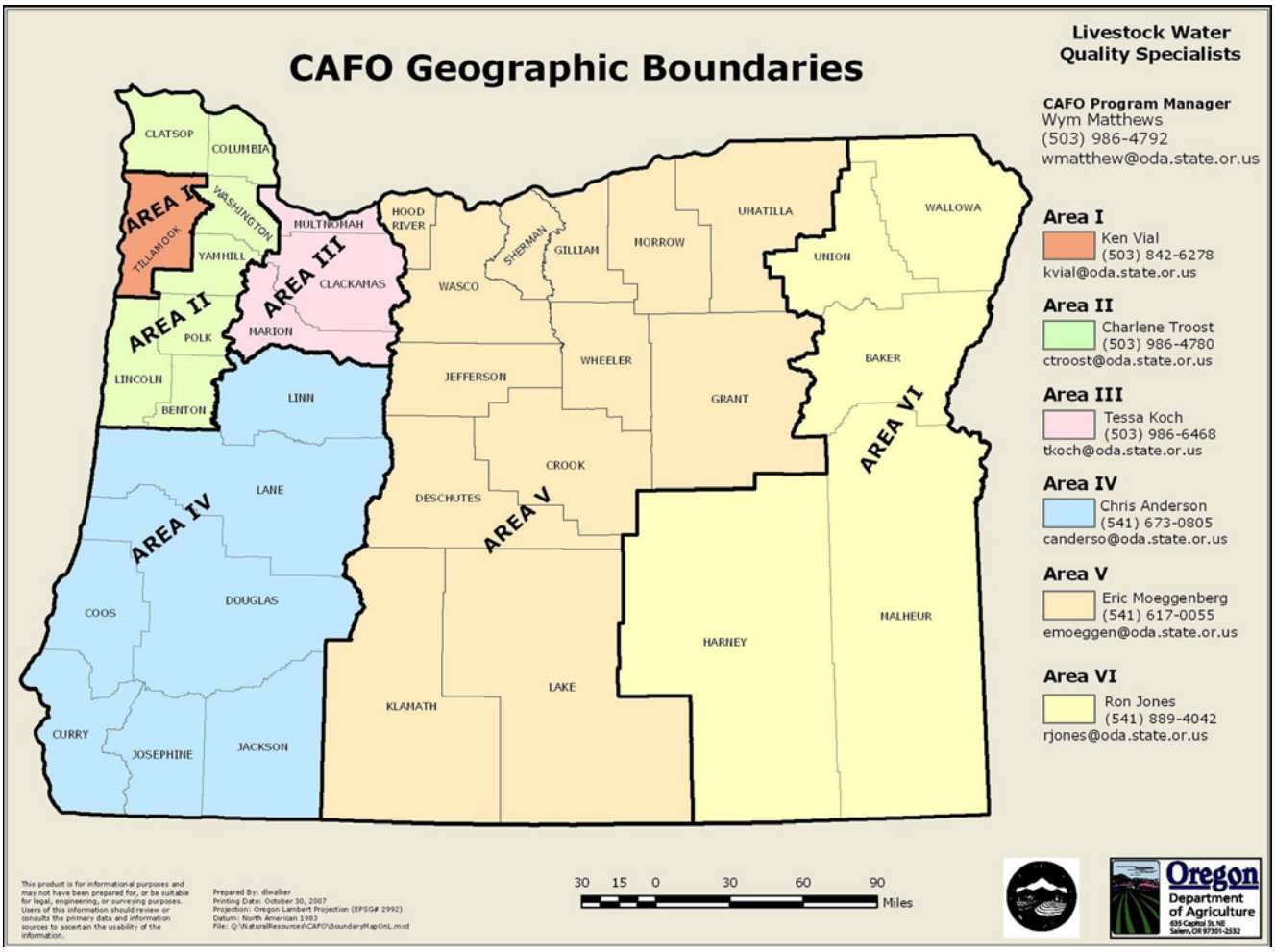


Figure 16 (repeat of Map in section I.E.) CAFO Areas in Oregon

ODA permits CAFO facilities by six distinct areas of the state shown above. Figure 16a, below, illustrates the estimated contribution of dairies by these six permitting areas.

Potential Interim Refinements Discussed by ODA Dairy Task Force Members, and DEQ Staff

Currently, DEQ's dairy emission estimates reflect the total of working dairy cows, heifers, adolescent, and juvenile animals. Emissions created by these animals are currently all given the same weight and label as a "dairy animal." ODA speculates that a somewhat more refined emission estimate might be appropriate if the average

emission factor were weighted by the type or age of the animal. This concept may be worth pursuing, and may be included as a factor in EPA's upcoming CAFO emission estimation modeling tool. DEQ staff also discussed available emission factors with Task Force members Dr. Jim Males and Dr. Jim Moore. Dr. Males and Dr. Moore advised staff to focus on peer reviewed research when evaluating possible emission factors in the future, and suggested DEQ evaluate some research done on dairy emissions in Europe[49] because climate and other factors there may have important similarities to Oregon conditions. Interim refinements such as those discussed above may improve DEQ's emission estimates somewhat in the near term; however, there is not likely to not be a major improvement of certainty until EPA releases its upcoming CAFO emission estimation model.

For illustration purposes, DEQ developed a chart (Figure 16a below) showing what the relative regional distribution of dairy emissions could look like for Oregon. For this illustration, emissions were divided by ODA CAFO Region (Figure 16), and used the European ammonia emission factor noted previously. This chart was developed simply to give the Task Force a sense of the potential geographic distribution of dairy emissions across Oregon.

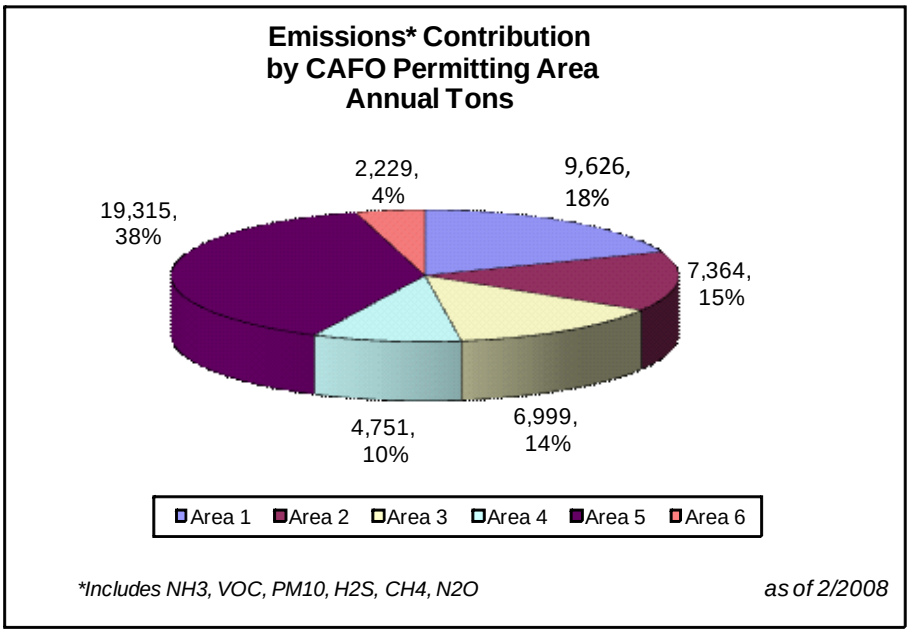


Figure 16a. Estimate of Total Dairy Emissions by CAFO Region (2006): Total includes Ammonia, VOC, Particulate (PM_{10}), Hydrogen Sulfide, Methane, and Nitrogen Dioxide

Notes:

- **NH_3**, Van der Hoek, 1998. Estimating ammonia emission factors in Europe: Summary of the work of the UNECE ammonia expert panel. Atmospheric Environment 32:315-316.

- **VOC**, "VOC and GHG from Dairy Sources," Mitolehner F.M. UC Davis Presented 4/26/07 Western Dairy AQ Symposium. VOC = EF Methanol + EF Ethanol
- **PM_{10}**, WRAP Fugitive Dust Handbook 2006 update version; http://www.wrapair.org/forums/dejf/fdh/content/Ch13-Livestock_Husbandry_Rev06.pdf
- **H_2S**, "Emissions from Animal Feeding Operations" U.S. EPA Office of Air Quality Planning and Standards, Aug 15, 2001. Used for model farms and D2A and S2B; data was transferred from anaerobic lagoons not following flush houses for swine.
- **CH_4**, Canada's 2004 GHG Inventory, Environment Canada. This is the sum of enteric fermentation and manure management sources. Chosen because of similarity to IPCC but with additional amounts from manure management (not just enteric fermentation). http://www.ec.gc.ca/pdb/ghg/inventory_report/2004_report/ann13_e.cfm#sa13_5.
- **N_2O**, "Emissions from Animal Feeding Operations" U.S. EPA Office of Air Quality Planning and Standards, Aug 15, 2001

Statewide Emissions

Until EPA's CAFO emissions estimate model becomes available, DEQ will continue to use this methodology and may make some interim refinements based on further discussion with the Dairy Air Quality Advisory Committee.

For illustration purposes, DEQ developed Table 8 below to give the Task Force a sense of dairy emissions within the full context of total statewide emissions from all sources. As discussed below, there are many data gaps still to be filled, and only a partial picture is available of the complete universe of all emission sources.

To provide some context for dairy emissions, Table 8 compares the current understanding of statewide emissions from dairies to some other groups of sources in Oregon. For some categories, this table is not complete because DEQ does not yet have a full accounting of all possible emission sources. For example, natural sources of ammonia may not be fully accounted for. Note that the sum in Table 8 is the Sum of Known Emissions, not necessarily total emissions of the full universe of all emission sources. Each pollutant and each source category will have its own unique uncertainties that would have to be examined case-by-case to understand the completeness of the emissions inventory.

To further illustrate this, hydrogen sulfide is reported in the table below for Area, Dairy and Point sources. Point sources are required to report *"sulfur dioxide*" (SO_2) emissions, while pulp and paper mills are required to report *"total reduced sulfur",* with no accounting requirements for "*hydrogen sulfide*". This illustrates that there are many ways to account for air emissions of sulfur pollution). For emission estimates of

hydrogen sulfide from dairies, only lagoon waste was quantified. There may be other sources of hydrogen sulfide on a dairy not well documented. The same may be true for N_2O, given that only emissions from lagoon waste are currently accounted for in the emission estimates.

Table 8: Statewide Emissions Estimates (in tons per year)

Sector	**Ammonia**	**Hydrogen Sulfide**	**Methane**	**Nitrous Oxide**	**PM_{10}**	**VOC**
AREA	29,734	35	60,789	2,252	345,909	200,844
DAIRY	5,632	605	37,942	32	439	3,986
BIOGENIC	(D)	(D)	(A)	(D)	(F)	1,321,354
NONROAD MOBILE	25 (B)	0 (G)	(H)	(H)	4,112	36,888
ON-ROAD MOBILE	3,257	0 (G)	(H)	(H)	2,762	93,871
POINT	0.1	94 (C)	41,145 (E)	426 (E)	10,939	16,319
	---	---	---	---	---	---
Sum of Known Sources	**38,647**	**734**	**139,876**	**2,710**	**364,186**	**1,673,288**

(A) The amount of naturally occurring methane emissions in Oregon is unknown.
(B) 2005 estimates for Oregon from the EPA National Mobile Emissions Model (NMIM)
(C) DEQ estimates only emissions of Total Reduced Sulfur from sources such as pulp and paper mills - the H_2S would be a portion of this total
(D) Naturally occurring (biogenic) ammonia, hydrogen sulfide, and nitrous oxide emissions are not known at this time.
(E) Point Source emissions from GHGRAC work and include only Oregon TV permitted emissions.
(F) Oregon DEQ has no data on the biogenic (natural) causes of PM_{10} such as windblown dust.
(G) EPA emissions generating models do not attribute any H_2S emissions to nonroad or onroad mobile sources so the emissions are assumed to be zero (0).
(H) Methane and Nitrous Oxide emissions from the onroad and nonroad sectors is unknown at this time but not assumed to be zero (0)

EPA defines area sources as a group of individual, identical sources that, instead of being estimated separately, are estimated collectively for a geographic area, typically by county. Confined Animal Feeding Operations can be grouped and estimated as an area source. For the purposes of this document, dairy emissions have been separated from the Area source category to facilitate Task Force discussion.

As a side note, emissions generated from an uncovered lagoon are considered fugitive sources if they are un-captured. However, if a lagoon were capped and the emissions vented through a collector pipe, the emissions could then be considered a point source.

II.B.2. San Joaquin Valley: VOC Emission Factors for Dairies

The following is one example of other state efforts to develop dairy emission factors and evaluate emission reduction options. It should be recognized that the air emission regulations are very stringent in the San Joaquin Valley Air Pollution Control District because their air quality does not currently meet the NAAQS. Air quality throughout Oregon currently meets NAAQS.

A 2005 report from the San Joaquin Valley Air Pollution Control District (District) presents and provides the basis for the Air Pollution Control Officer's (APCO) determination of VOC emissions factors to be used for permitting San Joaquin Valley dairies.

The report provides a summary table of the emissions factors recommended by the APCO for each source and constituent. It is noted within the reports that the proposed factors the District employed a number of conservative guiding principles aimed at ensuring that the proposed factor would likely represent a low-range estimate of dairy emissions that is supported by best available science, in recognition of the importance of the economic health of dairy farmers in the Valley.

The report also provides a table summarizing studies throughout the U.S. regarding the cross-media considerations of manure moisture content on Volatile Fatty Acid Emissions, a subgroup of Volatile Organic Compounds.

The report provides responses to general issues raised regarding the proposed emissions factor determination in addition to addressing specific comments regarding the determination. These responses include the following:

- Dairy VOC emission factors are needed to implement the requirements of State law.
- Based on any viewpoint expressed in the comments (that we) received, dairies are a significant source of VOC emission that require controls under State law.
- San Joaquin Valley Air District staff is well qualified to develop VOC emissions factors
- The VOC emissions factors for dairies proposed in this report are based on a detailed review of available science.
- In evaluating the research studies, California research was always given preference

- Before applying any data from outside California, the District performed a detailed analysis comparing the research study conditions with process conditions at California dairies.
- All comments, including those from California Scientists, were considered in the development of the proposed emission factor.
- The District strongly supports further research on California dairies to further refine and supplement these emission factors.

Lastly, the report provides recommendations for future research. The recommendations are as follows:

- Standardized methods and a target suite of compounds are needed to guide future research work regarding dairy emissions. Specific research should be undertaken to determine which gases should be included from amines, oxygenated VOC, VFAs, phenols, and other potentially important compounds identified in (the) report, as well as to develop improved sampling, analytical and quantification methods.
- Significant work is needed to better understand the role of emissions from feed versus direct emissions from cows and their waste. Direct emissions from feed appear to be important in overall VOC emissions and evidence was also presented (to DPAG) suggesting that diet may have an impact on emissions from cows and manure decomposition.
- Additional data are needed on different process emissions and effects of management practices on emissions.

In addition, the APCO strongly believes that future research also needs to focus on sources at a dairy where little or no data is available, such as land application, settling basins, manure storage piles, disturbance of manure piles, process pits, composting, and identify any other sources at a dairy that have the potential to emit VOCs.[50]

In a companion document to the report, "An Assessment of Technologies for Management and Treatment of Dairy Manure in California's San Joaquin Valley," the San Joaquin Valley Dairy Manure Technology Feasibility Assessment Panel provides conclusions and recommendations based on a 2005 evaluation of technologies that have a potential to improve the management and treatment of dairy manure. The Panel solicited information from technology vendors and received material from 44 vendors by the deadline to be evaluated. The panel grouped manure treatment technologies into

ten categories and evaluated each for its environmental and economic performance, based on the information supplied by each vendor. The panel also considered the quality of supporting data, and the development status of the technology.

Conclusions of the evaluated technologies are as follows:

- There are a great many companies selling products and process to treat manure.
- The Panel was unable to determine the environmental and economic performance of most of the technologies submitted due to insufficient scientific data.
- Technologies were untested on California dairies.
- Most technologies address only a limited portion of the environmental issues associated with manure.
- Some technologies intentionally or unintentionally transfer pollutant from one medium to another. The challenge in evaluating a single component of a system is to understand the net effect on he entire manure system.
- Treating manure is expensive (in some cases).

Recommendations of the Panel include:

- Develop standard test methods so that the environmental and economic performance of technologies can be fairly evaluated and compared.
- Conduct applied research on key data gaps.
- Establish pilot projects to assess comprehensive technology combinations for treating dairy manure in the San Joaquin Valley.[51]

II.C. What does the existing data say about the impacts of air emissions from dairies on human health? What do we know and how confident are we that it is reliable?

Air emissions from dairies, including gases and vapors, solid and liquid particulates and bioaerosols have the potential to adversely impact human health (Table 9). Acute exposures to high emission levels during accidents can lead to severe lung and eye injuries and death.[52,53] More common are chronic exposures to low emission levels, which may cause a variety of mild to moderate respiratory effects like coughing, wheezing, lung inflammation, bronchitis and asthma-like symptoms. People may be exposed chronically to dairy air emissions in the workplace or in the ambient environment at nearby locations and at regional scales if emissions persist in the atmosphere.

Table 9. Health benchmarks for dairy air emissions. Values are in units of micrograms per cubic meter of air (µg m^{-3}).

		Occupational Health		Environmental Health	
Type	Air Emission	NIOSH	OSHA	ATSDR	Oregon
Gases and vapors	Ammonia	17,500	24,500	70	200
	Hydrogen sulfide	13,900	27,800	2	2
	Methane	---	---	---	---
	VOCs	Variable[a]	Variable[a]	Variable[a]	Variable[a]
Particulates	PM_{10}	---	---	150[b]	150[b]
	$PM_{2.5}$	---	---	15[b]	15[b]
	Respirable	---	5,000	---	---
Bioaerosols	Bacteria	---	---	---	---
	Fungi	---	---	---	---
	Viruses	---	---	---	---

[a] While health benchmarks exist for a few chemicals that are classified as VOCs (e.g., acetaldehyde, methanol), the values vary according to each individual chemical.

[b] EPA National Ambient Air Quality Standards (PM_{10} value is a 24 hour maximum; $PM_{2.5}$ value is an arithmetic mean).

II.C.1. Occupational Exposures

The majority of studies investigating the impacts of dairy air emissions on human health relate to occupational exposures. Occupational health problems for those who work at CAFOs in general have been well recognized since 1977.[54] Workers are at the greatest risk for health effects from chronic exposures to dairy air emissions because concentrations are often highest inside dairy houses or on the farm property, particularly near manure storage sites.[55,56] CAFOs, because of their continuous operation within a confined environment, along with the large number of animals, produce considerably more waste than smaller traditional type farms. Dairy farm work has been associated with decreased respiratory health as measured by coughing, wheezing and chronic bronchitis.[57, 58, 59, 60]

The general CAFO worker health studies oftentimes identified locations and sources for emissions that can cause acute toxicity. Primary locations for such emissions are silos, manure pits, and modern semi-enclosed animal production buildings. To the extent that similar operations occur on dairy farms, similar worker exposures may occur. A May,

2006 study "CAFOs Chemicals Associated with Air," provides examples of the types of hazardous airborne chemical and biological agents that can be found in a CAFO working environment that are potentially detrimental to worker health, and may provide a source for community exposure.[61]

To date, it has been difficult to accurately identify which specific air emissions are directly linked to adverse respiratory effects observed in occupational health studies. Some respiratory disorders may be caused by multiple factors and some causative agents may be unknown.[62] For example, co-exposure to hydrogen sulfide and ammonia has a cumulative or additive effect on pulmonary irritation.[63] Also, volatile organic compounds (VOCs) are a complex suite of chemicals, and research is just beginning to identify what particular chemicals are important to measure in dairies.[64]

A number of researchers have noted the importance of bioaerosols, notably endotoxins, for worker health. Recently, a study was completed in Italy by Mastrangelo, et. al. (2005) that concluded that increased levels of endotoxins (or other associated environmental factors) might be proactive against lung cancer for dairy farm workers. (Appendix D, Section II.C.1)

Included with this document as Appendix M and N, respectively, are a NIOSH Health Hazard Evaluation Report, and a summary of that report, which describe an investigation of occupational exposure to dairy workers at Three Mile Canyon Farms. The investigation did not result in any actions, and are provided as background information only.

II.C.2. Environmental Exposures

People may be exposed to dairy air emissions in the ambient environment at nearby locations and at regional scales if emissions persist in the atmosphere.

Little is known about the health effects of dairy air emissions on local communities that may be exposed in environmental settings. There are no health studies specific to dairy farms and monitoring data are inadequate to assess risks.

Two recent studies measured ammonia and hydrogen sulfide concentrations downwind from emission sources on dairy farms.[65] Emissions were highly variable seasonally and daily. While emissions decreased significantly with distance, levels of ammonia (range

of 0 – 209 µg/m^3) and hydrogen sulfide (range of 0 – 163 µg/m^3) above health benchmarks were observed occasionally (i.e., on hot and windy days) at approximately 150 to 200 meters. Because emissions were highly variable, it is difficult to compare potentially pulsed exposures to established health benchmarks that are based upon more constant exposures. Also, it is unclear how applicable these two studies are to other dairy farms that may differ in animal handling and waste management practices.

Regionally, ammonia may be of concern for human health because of the large volumes emitted by dairy farms.[66] Ammonia may be deposited in nearby watersheds where it can be converted to nitrates by microorganisms and degrade drinking water supplies. Ammonia may also be converted in the atmosphere to small particulates ($PM_{2.5}$) that can cause respiratory disorders. $PM_{2.5}$ pollution is a common problem in some urban and suburban areas due the combustion of fuels such as wood and gasoline. The extent to which dairy farms can contribute to regional pollution levels is not well known, and these questions are currently an active area of scientific research.

Methane is emitted by dairy farms, but will not likely have a direct impact on human health because of its low toxicity. The primary health concern for methane is that it is a greenhouse gas that could indirectly affect human health via climate change processes at the global scale.

II.C.3. California Experience with Dairy Health Risk Assessment

Glenn Reed, of the San Joaquin Valley Air Pollution Control District, described for the Task Force a Health Risk Assessment his agency conducted on an expanding dairy operation. This modeling analysis estimated that the non-cancer risk from ammonia inhalation to people living off-site was greater than the California benchmark exposure limit. No other non-cancer effects were estimated to be a problem. The cancer risk, primarily due to hexavalent chromium presumed to be in all Valley soil, required further analysis. After further review the health risk was considered acceptable for permitting purposes. Mr. Reed acknowledged that any analysis is only as good as the emissions data available. Details of San Joaquin Valley Air Pollution Control District analysis can be found at *http://www.arb.ca.gov/ag/caf/dairypnl/dmtfaprprt.pdf.*

II.C.4 Ambient Monitoring

Other evidence of the potential impact of dairy operations on human health comes from ambient air monitoring that has been done in the Midwest. The Iowa Dept. of Natural

Resources has monitoring sites at residences near animal feeding operations. One of those sites, near a dairy but no other AFOs, has occasionally shown H_2S concentrations that exceed Iowa's Health Effects Level of 30 parts per billion for a one-hour average. However, concentrations have not exceeded the Health Effects Standard that would require additional controls. Monitoring results, along with descriptions of the monitor locations and aerial photos, can be found on the Iowa DNR website.[67]

In summary, normal activities at dairies farms can expose people to a variety of air emissions including gases and vapors, solid and liquid particulates and bioaerosols. Such exposures have been associated with adverse health effects in occupational settings. These health effects include a range of mild to moderate respiratory disorders like coughing and bronchitis. Occupationally exposed workers are at the greatest risk for health effects because of their proximity to emission sources. Less is known about environmental exposures and direct health effects at the local and regional level. Health risks are difficult to assess at this scale because there are few studies on this topic. Furthermore, emissions are highly variable, which makes it difficult to compare potential exposures to established health benchmarks.

II.D. What does the existing data say about the impacts of air emissions from dairies on animal health and welfare? What do we know and how confident are we that it is reliable?

The Task Force did not have sufficient time to explore this question.

II.E. What does the existing data say about the impacts of air emissions from dairies on the environment, including greenhouse gases? What do we know and how confident are we that it is reliable?

The several studies described in Section I.P. provide important information about the impact of livestock operations and the types of emissions associated with dairies on the environment. However, none of these studies are able to point specifically to dairy operations as the source of the pollutants responsible for environmental impact. As an example, since there is considerable uncertainty in the estimates of ammonia emissions from dairies it is not possible to estimate their role in nitrogen deposition.

The US Department of Agriculture did a Greenhouse Gas Inventory involving agriculture

and forests for the years 1990-2001. It is consistent with the work done by the EPA and can be used to identify opportunities to reduce emissions through agricultural management. See **The U.S. Agriculture and Forestry Greenhouse Gas Inventory: 1990-2001,** published by the Global Change Program Office, Office of the Chief Economist, U.S. Department of Agriculture, Technical Bulletin No. 1907, 164 pp. March 2004, summarized in Appendix D.

One Task Member noted emissions from livestock operations may have negative implications for the environment. Nitrogen pollution contributes to the formation of visibility reducing haze and ozone, a pollutant harmful to human health and vegetation.[68] In the Northwest, aerosols arising from nitrogen emissions play a significant role in visibility degradation, contributing about 6-14% of the fine particle mass at most federally protected sites on an annual basis. However, on the worst visibility days, nitrates can contribute nearly half of the fine mass and over half of the visibility reduction.[69] In addition, Nitrogen pollution carried in air currents and deposited in ecosystems can act as a fertilizer, favoring some types of plants and leaving others at a disadvantage. This creates an imbalance in natural ecosystems, and it is not known whether these changes can be reversed even if nitrogen deposition is later reduced.[70] Although Nitrogen is an essential plant nutrient, increased levels of atmospheric Nitrogen deposition stress ecosystems and have been associated with forest decline in North America.[71]

Some areas of the Northwest already exceed nitrogen deposition levels that are detrimental to some species of lichens over the long term. Long-term deposition of elevated levels of nitrogen compounds may affect soil microbiological processes, resistance to insects and pathogens, winter injury in conifers and foliar leaching. A 2005 study of the levels of atmospheric deposition in the Columbia River Gorge found the deposition to be at levels shown to have ecological impacts in western ecosystems as a result of Nitrogen enrichment. The data on changes in the chemistry and community composition of lichens in the Columbia River Gorge indicates other adverse ecosystems effects are occurring as a result of atmospheric deposition.[72]

II.F. What new research is occurring to improve our understanding of dairy air emissions?

As previously mentioned, the National Academy of Sciences (NAS) was asked in 2001 to perform an evaluation of the state of knowledge concerning CAFOs. It was charged

with reviewing, evaluating and reporting back to the Congress on the scientific basis for estimating the emissions to the atmosphere of various specified substances from confined livestock and poultry operations; reviewing the characteristics of the agricultural animal industries, methods for measuring and estimating air emissions, and potential best management practices for mitigating emissions; evaluating confined animal feeding production systems in terms of biologic systems; and identifying critical short- and long-term research needs and recommend methodological and modeling approaches for estimating and measuring air emissions and potential mitigation technologies. Their comprehensive report, which was published in 2003, added to the impetus for scientific examination of dairy air emissions.

In addition to the official Purdue/EPA study, there are a number of other studies underway that are designed to better understand the levels of emissions from dairies, the sources of those emissions, the variables that contribute to those emissions, and the options for reducing emissions. Appendix D contains summaries or abstracts of a number of these studies and is intended to allow the reader to do further research of the literature.

II.G. EPA sanctioned, national air study of animal feeding operations (National Air Emissions Monitoring Study - NAEMS)

In response to the findings of the National Academy of Science report, the National Air Emission Monitoring Study (NAEMS) was initiated. Established in 2006 by a voluntary air compliance agreement (also known as a consent decree) between the EPA and the pork, dairy, egg and broiler industries, it will address the lack of scientific data needed to accurately estimate emissions from agricultural operations, including dairies. Livestock producers have provided the financial support for the NAEMS so that emissions data can be collected at select sites to:

1) accurately assess emissions from livestock operations and compile a database for estimation of emission rates, and

2) promote a national consensus for emissions estimation methods/procedures from livestock operations. This study is being led by Purdue University and is currently collecting data at twelve dairies across the nation.

Figure 17 indicates the states in which farms were selected to participate in NAEMS. The sites selected in Washington serve to represent Pacific Northwest region dairy

operations in the nation-wide study.

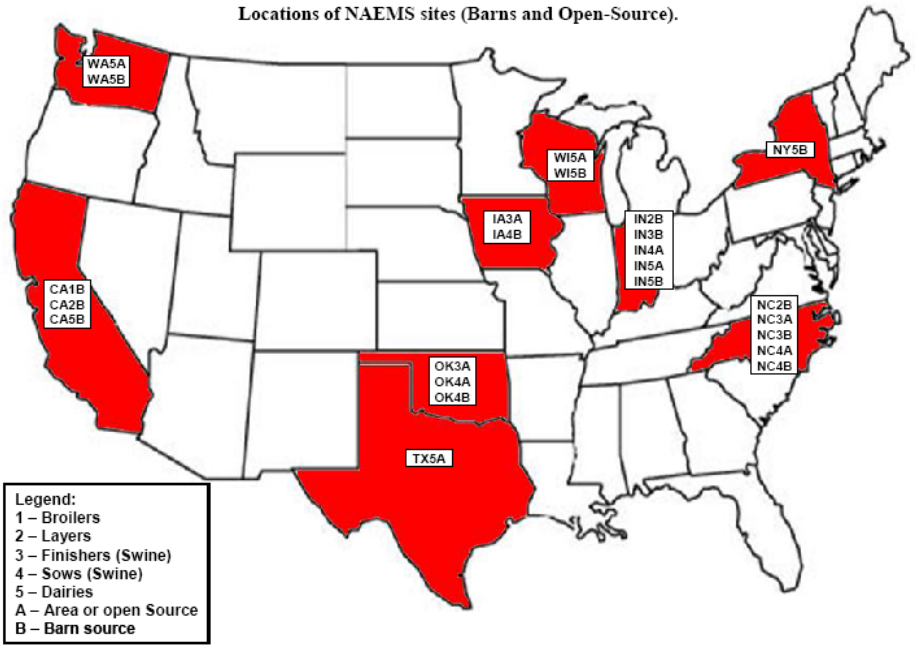


Figure 17. Sites in the National Air Emissions Monitoring Study.[73]

Note: No Oregon dairies will be monitored as part of this study.

In addition, new studies conducted by land grant colleges and universities are producing reliable data that can be used to estimate air pollutant emissions from dairy farms. This data, provided it fits the EPA protocol, may be used to supplement the data collected under NAEMS. The results of these studies will eventually be synthesized by EPA to provide guidance in the form of a “process-based modeling” approach for estimating air emissions, as recommended by the NAS report.

A description of these collaborative studies can be found in a paper given at the April 2007, Western Dairy Air Quality Symposium, sponsored the Western States Dairy Producers Trade Association. At the symposium, Dr. Herber, Professor of Agricultural and Biological Engineering at Purdue University, explains the collaborative efforts currently underway. The paper also describes the criteria and considerations used in site selection, sampling protocol and analytical methodologies

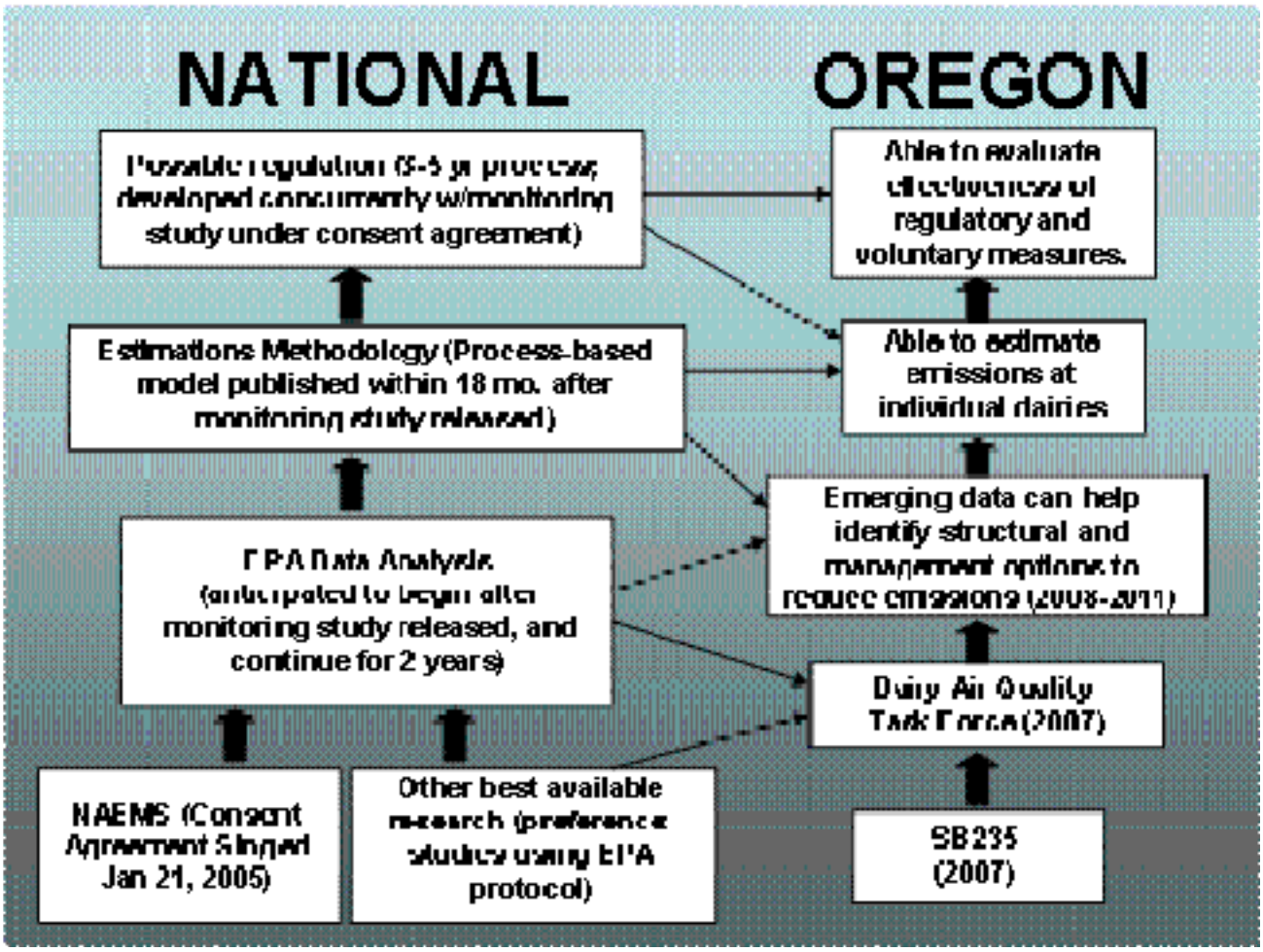


Figure 18 represents ongoing activities and estimated timelines under the NAEMS efforts and contingent actions that could be taken in Oregon.

II.H. When, realistically, will EPA have its intended process-based emission estimation model available to states? And will the results produced by this model be considered by EPA as definitive emission estimates for the purpose of applying Clean Air Act requirements?

Peter Murchie from EPA described the NAEMS for the Task Force. EPA expects to have a process-based model available for use in 2011. The intent is that this model will be used nationally to determine emissions from dairies and other animal feeding operations. Those emissions estimates would then be used to determine Clean Air Act applicability.

II.I. What are the limitations of applying existing studies to Oregon?

There remain a number of questions regarding the timing, use, and limitations of EPA's emission estimation model for dairies, which is the intended outcome of the current National Air Emission Monitoring Study. At this time, DEQ expects that emission estimates produced by EPA's process model will be of sufficient quality for states to make determinations as to the applicability of certain Clean Air Act requirements. When this occurs, an important question will be, does a specific dairy operation have emissions over the threshold that would require an air quality permit?

II.J. Will EPA's model sufficiently reflect emissions from the Oregon dairy industry? If not, why not?

ODA and DEQ understand that two dairies in Oregon elected to participate in NAEMS, however these facilities were not selected for the research trial. Although there are no Oregon dairies involved with the data collection of the study, the Oregon dairy industry did financially contribute to this national air emission study. The industry also sits on the oversight committee for this study. One Washington dairy has opted in.

In their 2006 research article, 2005 Environmental Law Update, the National Agricultural Law Center examined concerns raised by individual producers and the livestock and poultry industries as a whole with regard to the consent agreement underlying the NAEM Study. The industry voiced concerns that:

- The proposed study (and the consent agreement) addressed only emissions from production areas and waste storage areas. Land application areas are excluded.
- The proposed methodology for collecting data from livestock and poultry farms calls for few to be included in the study. Total numbers in each category are considered by most as being far too few to represent the diversity of livestock and poultry farms across the county and to provide reliable data upon which to regulate. (Only 12 percent of selected sites are dairy operations.)
- The difficulty of measuring air quality attributes in the open sided barns that are used on most dairy farms.

For the full article, see Appendix P.

As additional background, on December 4, 2007 the full ten-member DC Circuit Court

denied a citizens' group request for judicial review of the consent decree leading to the NAEM Study.

Quoting from the story, “The Court's ruling clears the way for EPA and America's farms to effectively resolve scientific and regulatory uncertainty, and serves as a template for resolving future industry-wide environmental challenges in the face of uncertain science.” Also in the article, Richard E. Schwartz, partner in the law firm of Crowell & Moring is quoted as follows: “The EPA's consent agreement is a good example of the agency partnering with industry to replace uncertainty with knowledge. The end result will be an industry better equipped to tackle its environmental challenges and a government that will be able to rely on fact rather than guesswork.” Crowell & Moring worked on behalf of the NPPC, independent farms, and agricultural associations to create the consent agreement with EPA, as well as respond to litigation. The US Newswire story can be found at the following web link: http://www.prnewswire.com/publicinterest.

It seems that despite the concerns raised by some in the industry, the industries leading legal council support EPA’s efforts to encourage the National Air Emissions Monitoring Study (NAEMS) and the use of the resulting process-based methodology for the estimation of emissions from animal feeding operations.

Additional studies could add to our knowledge about how dairies operate, and where to best focus our efforts on reducing air emissions from dairy operations. However, states and the EPA need to make a range of decisions, from generally understanding emissions from different source sectors to the application of regulatory requirements

II.K. Can additional field studies of Oregon dairies add to either the representativeness or accuracy of EPA’s process model?

If yes,

- **What studies would be most valuable and how would they really be used?**
- **Would it be valuable to study the actual emissions from specific dairy operations?**
- **Would it be useful to study and better document the factors that are used as inputs to the model (such as rainfall, feed, temperature, etc.) so that the model output is more specific to Oregon dairies?**

One Task Member noted that additional field studies to assess the effectiveness of Best Management Practices (BMP) for controlling air emissions would be invaluable for the Oregon dairy industry. The majority of the Oregon dairy farms employ several BMPs to reduce air emissions, however, research is not available to compare the effectiveness of one BMP to another. This is a very important research component that needs to be incorporated.

For example, many dairy producers monitor the amount of nitrogen excreted by the cow through a Milk Urea Nitrogen (MUN) test. Increased levels of MUN are an indicator that the cow is not efficiently utilizing the protein (nitrogen) in her diet and thus more nitrogen is being excreted in the manure. The diet of the cow can be manipulated to lower the amount of nitrogen excreted in milk (which would be monitored through MUN testing) and thus reduce the amount of nitrogen excreted in the manure.

With this research, it will allow dairy producers to make educated decisions about the implementation of BMPs on the farm to insure the "best bang for the buck." In addition, the effects of the air emission BMPs on water quality must also be studied (Cross media impact).

The Task Force did not have sufficient time to explore the following questions:

> Do we need Oregon-specific studies? What topics do we need to learn about? Why do we need to know that information and how would it be used? How do we get needed information, and when do we need it by?
>
> What testing protocols must be used in any Oregon studies? Must the NAEMS protocol be used if the data is to be acceptable to EPA? Are there other protocols that could be used, and what limits, if any, would that put on the use of Oregon results?

II.L. What are the relationships and challenges surrounding the cross-media management of dairy emissions for air, water, and land? What are the trade-offs/considerations?

The September 2005 United States Department of Agriculture Economic Research

Service (USDA ERS) report “Managing Manure to Improve Air and Water Quality” addresses the complications that can arise when a single pollution source simultaneously affects more than one environmental medium such as air, water and land. The report asserts that a “single-medium approach to pollution control can confound policymakers concerned with economic efficiency.”

Further, the report goes on to state, “an uncoordinated set of policies that independently address different pollution issues can result in unnecessary and unanticipated economic and environmental costs.” In other words, regulations that are meant to control emissions to water might inadvertently increase emissions to air, and vice versa. For instance, producers who are currently operating under a nitrogen-based plan to comply with water quality regulations may store liquid wastes in an uncovered lagoon prior to land application. A possible result of this storage is that nitrogen compounds can volatilize to the atmosphere from the lagoon potentially creating air quality concerns.

The USDA ERS report concludes, “air and water quality regulations would be most cost effective if implemented simultaneously. This would allow farmers to select the most appropriate mix of practices that satisfy environmental quality goals while maximizing net returns. If environmental policies are uncoordinated, farmers may have to make costly changes to practices more than once before both environmental goals can be met.” Policymakers must anticipate the various forms and pathways that pollutants take under an assortment of different management strategies when developing air, water and land quality policies. A systems based approach to analyzing farm operations is necessary to determine if cross-media (water, air, and land) impacts may occur from implementation of regulations.

To assist dairy farmers in understanding these trade-offs and interactions the Natural Resource Conservation Service of USDA has prepared a table of management practices that can be applied to reduce specific types of emissions at dairies and their impact on other media or other aspects of air quality. Titled “Conservation Practices Physical Effects – National Template” it contains the latest information available from USDA (http://www.nrcs.usda.gov/Technical/standards/nhcp.html). Department staff are also available to explain the practices and effects described in the table. Section III summarizes a number of these practices, some currently in use and others planned.

III. ALTERNATIVES FOR REDUCING EMISSIONS (What can be done?)

III.A. Overview

In addition to the research on emissions measurements and emissions affects, the 2006 and 2007 Western Dairy Air Quality Symposia provided forums to discuss the latest planned and completed studies of emissions reduction options and their effectiveness. This work, because it is being carried out in the West, has particular relevance for Oregon dairy operations. A number of the papers presented at these Symposia are summarized, along with a few other studies appearing in journals and other workshops, in Appendix D. This continues to be an active area of testing and research.

III.B. What are the structural and management options for reducing emissions from dairy operations?

The following section lists conservation practice standards recommended in the National Handbook of Conservation Practices and Oregon Supplement, which establish standards for conservation practices commonly used to address natural resource concerns (soil, water, air, plant, and animal). Conservation practice standards are based on research, conservation field trials, and knowledge and experience.

A more complete explanation of all listed practice standards s can be found in Appendix Q. The standards are currently selected by individual operators based on need and are included in any given facility's Animal Waste Management Plan (see Appendix O). Standards listed in the last subsection titled **Existing Conservation Practice Standards Not Currently Included in AWMPs, but with Potential for Future Inclusion** are not typically included in the AWMPs in Oregon.

In addition, the standards are divided into structural practices or management practices. A structural best management practice (BMP) is one that results in a tangible structural improvement or addition appearing on the farm. The structure operates to allow a pollutant to be collected, stored, treated, transferred or applied. The management BMPs consist of operating the structural BMPs so that they deliver the designed water quality (or air quality) results. Management BMPs can also consist of implementation of

new management of the facility that does not require a structure but can result in pollutant reduction or modification.

III.B.1. Conservation Practice Standards for Dairy Management

III.B.1.a Waste Utilization — Conservation Practice Standard 633

This standard concerns managing the use of agricultural wastes such as manure, wastewater and other organic residues from on-farm processes to achieve desired results. Its purposes are to (1) protect water quality, (2) provide fertility for crops/forage, (3) improve/maintain soil structure, (4) provide feedstock for animals, and (5) provide a source of energy for the operation.

III.B.1.b Nutrient Management — Conservation Practice Standard 590

This standard involves managing the amount, sources, placement, form and timing of the application of nutrients and soil amendments. Its purposes are to (1) budget and supply nutrients for plant production, (2) properly utilize manure or organic by-products as a plant nutrient source, (3) minimize agricultural non-point source pollution of surface and ground water resources, and (4) to maintain or improve the physical, chemical and biological conditions of soil.

III.B.1.c Irrigation Water Management — Conservation Practice Standard 449

This standard involves the process of determining and controlling the volume, frequency and application rate of irrigation water in a planned, efficient manner. Its purposes are to (1) manage soil moisture to promote desired crop response, (2) optimize the use of available water supplies, (3) minimize irrigation induced soil erosion, (4) decrease non-point source pollution of surface and groundwater resources, (5) manage salts in the crop root zone, (6) manage air, soil, or plant micro-climate, (7) provide proper and safe chemigation or fertigation, and (8) improve air quality by managing soil moisture to reduce particulate matter movement.

III.B.1.d. Feed Management — Conservation Practice Standard 592

This standard involves managing the quantity of available nutrients fed to livestock for their intended purpose. Its purposes are twofold: (1) supply the quantity of available nutrients required by livestock and poultry for maintenance, production,

performance, and reproduction; while reducing the quantity of nutrients, especially nitrogen and phosphorus, excreted in manure by minimizing the over-feeding of these and other nutrients and (2) improve net farm income by feeding nutrients more efficiently.

III.B.1.e. Prescribed Grazing — Conservation Practice Standard 528

This standard involves managing the harvest of vegetation with grazing and/or browsing animals. Its purposes are to (1) improve or maintain desired species composition and vigor of plant communities, (2) improve or maintain quantity and quality of forage for grazing and browsing animals' health and productivity, (3) improve or maintain surface and/or subsurface water quality and quantity, (4) improve or maintain riparian and watershed function, (5) reduce accelerated soil erosion, and maintain or improve soil conditions, and (6) improve or maintain the quantity and quality of food and/or cover available for wildlife.

III.B.1.f. Forage Harvest Management — Conservation Practice Standard 511

This standard involves the timely cutting and removal of forages from necessary fields as hay, green-chop, or ensilage. Its purposes are to (1) optimize the economic yield of forage at the desired quality and quantity, (2) promote vigorous plant re-growth, (3) maintain stand life for the desired time period, (4) maintain desired species composition of the stand, (5) use forage plant biomass as a nutrient uptake tool, (6) control insects, diseases and weeds, and (7) maintain and/or improve wildlife habitat.

III.B.1.g. Atmospheric Resource Quality Management — Conservation Practice Standard 370

This standard involves applying a combination of treatments to manage resources that maintain or improve air quality. Its purposes are to (1) minimize or reduce emissions of Particulate Matter, Smoke, Odors, Greenhouse Gases, Ozone, and chemical drift; (2) maintain or increase visibility.

III.B(2). Conservation Practice Standards for Dairy Processes and Infrastructure

III.B(2)(a). Waste Storage Facility — Conservation Practice Standard 313

This standard pertains to a waste storage impoundment made by constructing an

embankment and/or excavating a pit or dugout, or by fabricating a structure. This structure's purpose is to temporarily store wastes such as manure, wastewater, and contaminated runoff as a storage function component of an agricultural waste management system.

III.B(2) (b). Manure Transfer — Conservation Practice Standard 634

This standard pertains to a manure conveyance system using structures, conduits, or equipment. This system's purpose is to transfer animal manure (including other residues associated with animal production such as bedding material, spilled feed, and process/wash water) through a hopper or reception pit, a pump (if applicable), a conduit, or hauling equipment to: (1) a manure storage/treatment facility, (2) a loading area, and (3) agricultural land for final utilization.

III.B(2)(c). Solid/Liquid Waste Separation Facility — Conservation Practice Standard 632

This standard pertains to a filtration or screening device, settling tank, settling basin, or settling channel used to separate a portion of solids from a liquid waste stream. The purpose of this equipment is to partition solids, liquids and their associated nutrients as part of a conservation management system to: (1) improve or protect air quality, (2) improve or protect water quality, (3) improve or protect animal health, and (4) meet management objectives.

III.B(2)(d). Roof Runoff Structure — Conservation Practice Standard 558

This standard pertains to structures that collect, control, and transport precipitation from roofs away from waste storage facilities. The purpose of this type of structure is to (1) improve water quality, (2) reduce soil erosion, (3) increase water infiltration to soil, (4) protect structures, and (5) increase water quantity.

III.B(2)(e). Waste Facility Cover — Conservation Practice Standard 367

This standard pertains to a fabricated rigid, semi-rigid, or flexible membrane over a waste treatment or storage facility. Its potential purposes include (1) improving water and air quality and (2) capturing biogas for energy production.

III.B(2)(f). Filter Strip — Conservation Practice Standard 393

This standard pertains to a strip or area of herbaceous vegetation situated between cropland, grazing land, or disturbed land (including forestland), and

environmentally sensitive areas. The purpose of this strip is to (1) reduce sediment, particulate organics, and sediment adsorbed contaminant loadings in runoff, (2) reduce dissolved contaminant loadings in runoff, (3) reduce sediment, particulate organics, and sediment adsorbed contaminant loadings in surface irrigation tailwater, (4) restore, create or enhance herbaceous habitat for wildlife and beneficial insects, and (5) maintain or enhance watershed functions and values.

III.B(2)(g). Composting Facility — Conservation Practice Standard 317

This standard pertains to the treatment of organic material to obtain biological stabilization for further use. This type of facility can reduce the pollution potential of organic agricultural wastes to surface and ground water.

III.B(2)(h). Use Exclusion — Conservation Practice Standard 472

This standard pertains to the temporary or permanent exclusion of animals, people, or vehicles from a given area. The purpose of this standard is to (1) prevent, restrict, or control access to an area, (2) maintain or improve the quantity and quality of natural resources, and (3) minimize liability and human health concerns.

III.B(2)(i). Fence — Conservation Practice Standard 382

This standard pertains to any constructed barrier to animals or people. The purpose of such a structure is to facilitate the application of conservation practices by providing a means to control movement of animals and people.

III.B(2)(j). Underground Outlet — Conservation Practice Standard 620

This standard pertains to a conduit installed beneath the surface of the ground to collect surface water and convey it to a suitable outlet. Its purpose is to dispose of excess water from terraces, diversions, subsurface drains, surface drains, trickle tubes or principal spillways from dams (outside the dam area only), or other concentrations without causing damage by erosion or flooding.

III.B(3) Existing Conservation Practice Standards Not Currently Included in AWMPs, but with Potential for Future Inclusion

III.B(3)(a) Waste Treatment — Conservation Practice Standard 629

This standard applies to the mechanical, chemical or biological treatment of agricultural waste. The purpose of this type of treatment is to (1) improve ground and surface water quality by reducing the nutrient content, organic strength, and/or pathogen levels of agricultural waste, (2) improve air quality by reducing odors and gaseous emissions, (3) produce value added by-products, and (4) facilitate desirable waste handling, storage, or land application alternatives.

III.B(3)(b) Waste Treatment Lagoon — Conservation Practice Standard 359

This standard applies to a waste treatment impoundment made by constructing an embankment and/or excavating a pit or dugout. The purpose of this type of structure is to biologically treat waste, such as manure and wastewater, and thereby reduce pollution potential by serving as a treatment component of a waste management system.

III.B(3)(c) Anaerobic Digester with Controlled Temperature — Conservation Practice Standard 366

This standard pertains to a managed temperature waste treatment facility. The purpose of this type of facility is to biologically treat waste as a component of a waste management system to: (1) produce and capture biogas and for energy production, (2) improve air quality, (3) reduce greenhouse gas emissions, (4) reduce pathogens, and (5) improve nutrient management.

III.B(3)(d) Animal Mortality Facility — Conservation Practice Standard 316

This standard applies to an on-farm facility for the treatment or disposal of livestock carcasses. This type of facility supports (1) a decrease in non-point source pollution of surface and groundwater resources, (2) a reduction of the impact of odors that result from improperly handled animal mortality, (3) a decrease in the likelihood of the spread of disease or other pathogens that result from the interaction of animal mortality and predators, and (4) provides contingencies for normal and catastrophic mortality events.

III.B(3)(e) Amendments for Treatment of Agricultural Waste — Conservation Practice Standard 591

This standard pertains to the treatment of manure, process wastewater, storm water runoff from lots or other high intensity areas, and other wastes with chemical or biological additives. This type of process alters the physical and/or chemical

characteristics of the waste stream to: (1) improve or protect air quality, (2) improve or protect water quality, (3) improve or protect animal health, and (3) alter the consistency of the waste stream to facilitate implementation of a waste management system.

The storage and disposal of the dairy waste is one area where ammonia emissions can be reduced, aerobic biological treatment of wastewater being a common and effective way of reducing ammonia emissions. Other management practices can be employed to reduce VOC, hydrogen sulfide, and other emissions. This is a very active area of research, which is important for assessing the viability of various BMPs. A number of papers describing this work are summarized in Appendix D.

III.B.2. National Incentives

The EPA has awarded eight million dollars in grant funds to two organizations that will provide technical assistance at no cost to livestock operators. Technical assistance provided will include comprehensive assessments of water and air quality environmental challenges and recommendations for strategies to mitigate challenges, and development or review of a facility's nutrient management plan. The technical assistance will be available to any livestock operation in the United States beginning the summer of 2008 through October 2011.

It is estimated that more than 500 million tons of animal waste is produced annually at animal feeding operations throughout the United States. These operations are continually faced with the challenge of how best to manage waste to minimize adverse impacts to the environment. These grants will assist livestock operations by educating them of the environmental impacts and how best to address them. For more information on this program, visit *http://www.epa.gov/npdes/afo*. A report prepared by USDA in 2005 assesses the potential economic and environmental tradeoffs between air and water quality policies.

III.B.3. Regional Efforts

The Western States Dairy Producers Association sponsored symposia in 2006 and 2007 where researchers and policy makers could explore the latest policy-relevant information on managing air emissions from dairy operations. A number of the papers that were presented are summarized in Appendices E and F. These papers describe a variety of structural and management options that can be employed and their

effectiveness at reducing air emissions.

III.B.4. Washington

Within Washington State, there are seven regional air quality authorities, in addition to the State Department of Ecology, which have jurisdiction over air quality issues in Washington. Under the Washington Clean Air Act, Washington Administrative Code stipulates that all sources of air pollution must register with one of the seven regional clean air authorities, or with the state's Department of Ecology. Except for registration, Washington law currently exempts agricultural operations for air quality regulation.

In the mid 1990's, the Board of the Yakima Regional Clean Air Authority excluded dairies from the registration process for air emissions registry. The YRCAA responds to complaints from adjacent residences regarding dust and odors from animal feeding operations, primarily in the summer months. An agricultural task force advisory committee was formed and YRCAA took the lead in the state in developing and distributing literature on Best Management Practices for dairy operations (see Appendix R). Anecdotally, since implementing the educational program of voluntary BMPs for dairy operations the agency has seen a dramatic decrease in the volume of complaints across all sectors, but has not identified a cause and effect relationship between the two events.[74]

III.B.5. California

The Dairy Manure Technology Feasibility Assessment Panel was created in February 2005 to evaluate technologies that have a potential to improve the management and treatment of dairy manure in the San Joaquin valley. This panel evaluated each technology for its environmental and economic performance, based on information supplied by each technology vendor, and considered the quality of supporting data and the development status of the technology.[75]

III.B.5. Iowa

In 2002, the Iowa Legislature directed the Iowa Department of Natural Resources (DNR) to perform a field study to determine airborne levels of ammonia, hydrogen sulfide, and odor near animal feeding operations. The DNR Best Management Practices Workgroup addressed the following issues related to BMPs:

- What types of BMPs are there to mitigate the emissions of pollutants from AFOs?
- What is the effectiveness of the BMPs?
- What are the associated costs (installation, maintenance, operation) of the

BMPs?

- What is the availability of the BMPs?
- Will the BMPs have other environmental impacts that may need to be considered?
- How should information be provided to producers on the availability of BMPs?
- How will future technologies be approved and ranked?[76]

In the process of answering the above questions, the workgroup identified four fact sheets and associated flow charts, published by Iowa State University, on BMPs for reducing air emissions of ammonia, hydrogen sulfide, odor and dust from Animal Feeding Operations (AFOs). The workgroup decided to adopt the fact sheets and flow charts for incorporation in their report to the legislature, and are currently being distributed to dairy operations throughout the state. These fact sheets have been included as reference with this report in Appendix K.

The Humboldt County, Iowa Ordinance #22 provides guidance regarding reporting and other requirements for owners and operators of large livestock confinement feeding facilities in rural areas of Humboldt County to provide details of the operation to the county for review by the general public.[77]

III.C. What options are currently in use in Oregon, including options primarily implemented to improve water quality?

The manure handling systems for each operation are equally diverse. On the Coast, the majority of manure is collected and stored in animal waste holding ponds (AWHP), and concrete and glass lined steel tanks. In the Willamette Valley, manure is generally flushed with water or scraped into underground collection tanks, AWHPs or lagoons. Some operations separate the solids from the liquid prior to flushing the liquid into the ponds. On the East side of the Cascades, flush systems are often used to dispose of waste into holding ponds or lagoons. Across the state, when applicable, dairy waste is used, collected, and held on-site to fertilize crops.

Table 10. Current use of Manure Management Practices

Oregon Statewide Summary (ODA Survey,	**Heifer Raising Facilities**	**Milking Facilities**	**All Facility Types**

Feb. 12, 2008)										
	State CAFOs	Medium Federal CAFOs	Large Federal CAFOs	State CAFOs	Medium Federal CAFOs	Large Federal CAFOs	**Total**	State CAFOs	Medium Federal CAFOs	Large Federal CAFOs
# of Facilities	20	18	8	137	146	39	**368**	157	164	47
# of Lagoons	12	20	23	62	124	79	**320**	74	144	102
# of UGLMTs	17	20	2	165	212	52	**468**	182	232	54
# of AGLMTs	5	2	0	56	81	11	**155**	61	83	11
# of Mechanical Separators	3	3	1	10	54	38	**109**	13	57	39
# of Settling Ponds	1	3	0	3	21	38	**66**	4	24	38
# of Advanced SMSs (centrifuge / flocculation / clarifier / etc)	0	0	0	0	0	3	**3**	0	0	3
# of Composting Facilities	2	6	0	16	41	24	**89**	18	47	24
Manure Digestion for CH_4 Recovery? (1=Y, 0=N)	0	0	0	2	6	1	**9**	2	6	1
Use Manure Treatment Additives? (1=Y, 0=N)	0	0	0	2	4	1	**7**	2	4	1
# of Solid Manure Storage Facilities	16	18	8	133	165	45	**385**	149	183	53
Flush Collection System? (1=Y, 0=N)	1	4	0	4	36	26	**71**	5	40	26
Scrape Collection System? (1=Y, 0=N)	17	16	8	134	136	27	**338**	151	152	35
Deep Pack Bedded System? (1=Y, 0=N)	10	8	7	51	45	12	**133**	61	53	19
Solids Application w/ Spreader? (1=Y, 0=N)	16	13	7	126	138	30	**330**	142	151	37
Solids Application by Grazing? (1=Y, 0=N)	15	13	0	96	110	18	**252**	111	123	18
Liquids	9	12	1	76	117	30	**245**	85	129	31

Application: Big Gun? (1=Y, 0=N)										
Liquids Application: Pivot? (1=Y, 0=N)	0	0	0	0	2	10	**12**	0	2	10
Liquids Application: Truck/Tank Spreader? (1=Y, 0=N)	6	4	0	72	92	18	**192**	78	96	18

III.D. What are the potential benefits and negative impacts of the top structural and management options using following factors:

1. **The diverse nature and economic viability of dairies and the economic contribution dairies make to the state economy;**
2. **The impact that federal Clean Air Act regulations have, and that actions to address air emissions would have, on Oregon's dairies in the Pacific Northwest markets;**
3. **The protection of human health, the environment, and scenic and cultural resources;**
4. **The impact of available alternatives on other environmental media, energy and the cost of producing dairy products; and**
5. **The feasibility of implementation, given the above factors.**

The in depth discussion and evaluation of the potential benefits and negative impacts of individual dairy Best Management Practices (i.e. structural and management options), considering the five criteria above, has been deferred to the Dairy Air Quality Advisory Committee (DAAC) that will be convened by DEQ and ODA.

IV. OPTIONS FOR IMPLEMENTING THE PREFERRED STRUCTURAL AND MANAGEMENT OPTIONS? (HOW CAN IT BE DONE?)

IV.A. How are structural and management options being implemented in other western states? (California, Idaho, and Washington)

IV.A.1. Idaho

In 2007, Idaho codified Best Management Practices (BMP) for the control of ammonia emissions from dairy operations. The Idaho Department of Environmental Quality adopted IDAPA 58.01.01, providing guidance for the control of ammonia emissions from licensed dairy operations in Idaho through the use of BMP. The rule applies to new dairies as well as to existing dairies that change size or type of operation.

The rule provides a matrix of employable BMPs, providing for variation amongst waste collection systems, BMP type, and overall effectiveness in controlling ammonia emissions. Generically, the matrix allocates points based on the type of practice employed. Dairy operations subject to the rule must employ any combination of BMPs that will total 27 points.

The Table representing the checklist of Ammonia Control Best Management Practices for Idaho Dairies has been included as Appendix S of this report.

In April 2007, University of Idaho Extension Service Professor, Ron Sheffield, and Idaho Department of Environmental Quality Modeling and Monitoring Manager, Bruce Louks, presented their paper, submitted to the Journal of Environmental Regulation, a titled "Ammonia-Based Air Quality Permits for Idaho Dairies," at the Western Dairy Air Quality Symposium sponsored the Western States Dairy Producers Trade Association. The paper describes the BMP–based air permitting program that has been developed in Idaho. The study reported that inspections of Idaho dairies by the Idaho Department of Agriculture reflect a 95% compliance rate with the Rules for the Control of Ammonia from Dairy Farms. Solid separation of manure, corral harrowing, low pressure irrigation, composting and rapid manure removal from outdoor lots were found to be the most common BMPs in use. The summary concludes that while the rule is not intended to control odor emissions, it will have beneficial aspects for odor control.

The Idaho Rule will be re-visited by the negotiated parties on an annual basis to determine compliance issues and effectiveness in reducing ammonia emissions. As more scientific information emerges regarding ammonia emission factors, including the results of the EPA consent agreement monitoring program, efforts to quantify emission reductions as a direct benefit of the Rule will be more credible and provide for better decision–making. Implementation of this regulatory system in Idaho was described by Sheffield at the 2006 Western Dairy Air Quality Symposium. A summary is provided in Appendix F.

It should be noted that using the criteria for regulating ammonia emissions under the Idaho model, only four dairies in Oregon would be required to regulate ammonia emissions.

IV.A.2 Washington

Within Washington State, there are seven regional air quality authorities, in addition to the State Department of Ecology, which have jurisdiction over air quality issues in Washington. Under the Washington Clean Air Act, Washington Administrative Code stipulates that all sources of air pollution must register with one of the seven regional Clean Air Authorities, or with the state's Department of Ecology. Except for registration, Washington law currently exempts agricultural operations for air quality regulation.

In the mid 1990's, the Board of the Yakima Regional Clean Air Authority excluded dairies from the registration process for air emissions registry. The YRCAA responds to complaints from adjacent residences regarding dust and odors from animal feeding operations, primarily in the summer months. An agricultural task force advisory committee was formed and YRCAA took the lead in the state in developing and distributing literature on Best Management Practices for dairy operations (see Appendix R). Anecdotally, since implementing the educational program of voluntary BMPs for dairy operations, the agency has seen a dramatic decrease in the volume of complaints across all sectors, but has not identified a cause and effect relationship between the two events.[78]

IV.A.4. National Incentives

It is estimated that more than 500 million tons of animal waste is produced annually at animal feeding operations throughout the United States. These operations are continually faced with the challenge of how best to manage waste to minimize adverse

impacts to the environment. These grants will assist livestock operations by educating them of the environmental impacts and how best to address them.

The EPA has awarded eight million dollars in grant funds to two organizations that will provide technical assistance at no cost to livestock operators. Technical assistance provided will include comprehensive assessments of water and air quality environmental challenges and recommendations for strategies to mitigate challenges, and development or review of a facility's nutrient management plan. The technical assistance will be available to any livestock operation in the United States beginning the summer of 2008 through October 2011.

For more information on this program, visit http://www.epa.gov/npdes/afo.

IV.B. How are structural and management options being implemented in other parts of the country and world?

The Task Force did not have sufficient time to explore how dairy emissions are currently regulated in other countries, or how these emissions types are regulated in non-agricultural sectors.

IV.C. What are the options for how structural and management options could be implemented in Oregon, including consideration of technical studies, voluntary actions, regulation, and proposed legislation?

The Task Force explored ways to reduce emissions using the following chart and the explanation of the implementation options that follow. This included an analysis of the Approaches/Framework, Implementation, and Triggers. It used the factors listed in ORS 462A.020 Section 3 to shape its recommendations about whether a voluntary, regulatory, or legislative approach would be best for solving these identified problems. Those factors were:

1) The diverse nature and economic viability of dairies and the economic contribution dairies make to the state economy;

2) The impact that federal Clean Air Act regulations have, and that actions to address air emissions would have, on Oregon's dairies in Pacific Northwest markets;
3) The protection of human health, the environment, and scenic and cultural resources;
4) The impact of available alternatives on other environmental media, energy and the cost of producing dairy products; and
5) The feasibility of implementation, given the above factors.

The Task Force considered the following options, or combinations of options, to reduce dairy emissions.

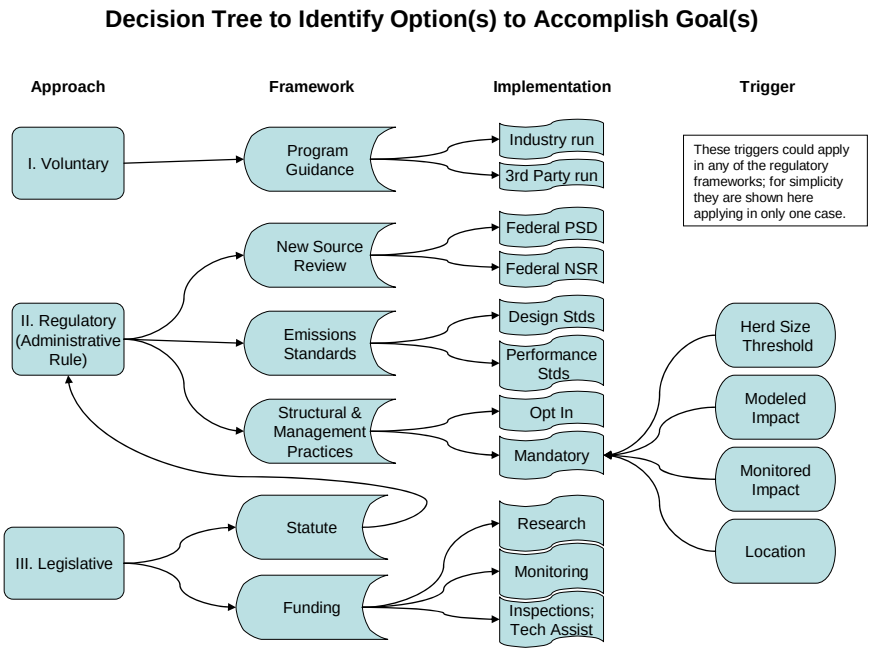


Figure 19: Options to reduce emissions

B.1. Approaches / Framework

The three main options are Voluntary, Regulatory, and Legislative. A description of each follows, as does the Task Force's analysis of the associated advantages and disadvantages of each option, and the Task Force's recommendation.

I. Voluntary – A voluntary program is one that allows individuals the option to participate and in return provides some recognition for practices that reduce emissions. It can include voluntary measures, education, demonstration projects, incentives, or other elements. It may include procedures to monitor implementation and a metric to report on the program's effectiveness in reducing emissions.

A. The Task Force could recommend supporting the Oregon Dairy Farmers Association's intent to develop a program that provides guidance and assistance to dairies on best management practices to reduce air emissions. The Oregon Dairy Farmers Association would manage the program, monitor it, and report on implementation.

B. The Task Force could recommend that an independent party, such as the OSU Extension Service, would develop or operate portions of the voluntary program. This could include providing guidance and assistance, managing the program, and/or monitoring and reporting on implementation. Dairy operations would still be free to participate and would receive recognition from this independent entity.

II. Regulatory – A regulatory program is one that is adopted by the Environmental Quality Commission as Oregon Administrative Rules based on existing statutory authorities. Because of the unique authority in ORS 468A.020 (2) (C), the Task Force could recommend administrative rules that the Environmental Quality Commission could adopt without new legislation.

Administrative rules could follow one of three paths generally used in the Air Quality program.

A. New Source Review is the process used to prevent air quality conditions from degrading as a result of constructing a new emissions source. New sources are typically required to meet more stringent requirements than existing sources, such as the use the best available emission reduction measures. Prior to

construction, the developer of a larger emission source must demonstrate through an air quality analysis that the effect of the new emissions on air quality would be less than some incremental amount.

1. The Task Force could recommend that Oregon should implement only the current requirement for new dairies, which is equal to the federal requirement. Under this approach, a new dairy over the emission threshold would be required to follow the New Source Review procedure established by EPA; conducting an air quality analysis and implementing best available emissions reduction measures. In areas that are not violating federal air quality standards, emissions of certain pollutants (excluding ammonia) over the threshold of 250 tons per year would start the process.
2. The Task Force could recommend that a new dairy would be required to follow a State specific New Source Review procedure that could include a different threshold of applicability, and different analyses of impact and of potential emissions reduction measures. For example, new dairies above a certain herd size could be required to implement specified structural or management practices, could be required to participate in a "menu" program adopted under II. C., below, or could be required to implement more measures than existing sources under a menu program.

B. <u>Emissions standards</u> generally are written to apply to specific categories of sources. They can be applicable to existing and/or new operations; generally, the standards are more stringent for new sources. In most cases, standards are determined from the most effective existing practices, which are both technically and economically feasible, used by that category of sources.

1. The Task Force could recommend that these standards take the form of design standards; that is, they would specify exactly what controls or abatement procedures would be required. In air quality terms, these controls would be technology standards or work practices, but in the dairy context, we have called them structural or management practices.

2. The Task Force could recommend that these standards require a certain level of performance, or emissions reduction, for example 90% reduction of ammonia emissions.

(Note: the Idaho BMP menu and points system is a hybrid of a design and performance based program. It sets a performance standard to achieve a certain number of points, but presumes that adoption of a group of measures will achieve a certain level of reduction rather than requiring air quality monitoring to demonstrate that the reductions have been achieved.)

C. Menu of Best Management Practices can take the form of either Structural or Management Practices at a dairy. Structural practices include such things as building a manure storage lagoon, while an example of a management practice is carrying out specific feeding regimens for individual or groups of animals. This option is very similar to the approach used by Idaho.

1. The Task Force could recommend that the program be set up so that the menu, points, and verification procedures are established by rule, but that individual dairies choose voluntarily to participate "opt in" and receive recognition. While the choice to participate would still be voluntary, the participating operations would be inspected and excluded from the program if they do not meet the programs requirements.
2. The Task Force could recommend that the program be set up so that some or all individual dairies are required to participate. For example, new dairies, dairies above a certain size, or dairies anticipated or shown to cause local impacts could be required to participate.

Any regulatory program would require some measure of effectiveness. This could be accomplished by looking at the number and type of management practices adopted, or those practices could be converted into emissions reduced. Implementation of the program could be monitored by ODA through an MOU with DEQ as is done for water quality.

III. Statutory - Although the Legislature has already given the Task Force authority to make implementation recommendations directly to the Environmental Quality Commission, further direction from the Legislature may be desired.

A. The Task Force could recommend that the Legislature specify authorities and the framework for an emissions reduction program for dairies. This would then lead to administrative rules adopted by the Environmental Quality Commission.
B. The Task Force could recommend that the Legislature provide funding for activities that would reduce emissions from dairies. These efforts could stand alone, or be used to support one or more of the other options for reducing emissions. Funding could be recommended for:

1. Research by OSU;
2. Air monitoring by DEQ; and
3. An expanded inspection / technical assistance and educational program by ODA.

B.2. Triggers

The main trigger options are New Source, Herd Size, Modeled, Monitored, and Location. A description of each follows, as does the Task Force's analysis of the associated advantages and disadvantages of each option, and the Task Force's recommendation.

The triggers shown on the graphic could be applied in any of the regulatory frameworks, although for simplicity they are only shown applying to a mandatory program.

1. New dairies could include existing ("newly discovered") operations that are over a threshold, or alternatively, existing sources could be "grandfathered" and not be subject to the rules.
2. Herd size would be based on some general knowledge about emissions.

3. Modeling would require a farm-specific estimate of emissions followed by dispersion modeling to determine if predicted off-site concentrations are over an established ambient air quality threshold.
4. Monitoring would require actual measurements, taken and averaged over an established specified timeframe, that exceed an ambient air quality threshold.
5. Location, perhaps in a ventilation-restricted valley or near a school or hospital, could also be used as a determinant of applicability.

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