AGRICULTURE WORKING GROUP REPORT

DRAFT

Southern Willamette Valley Groundwater Management Area

Prepared by the Agriculture Working Group
with assistance from the Oregon Department of Agriculture
March 2006

Acronyms and Terms Used in this Document

ARS – Agricultural Research Service

CPRCD – Cascade Pacific Resource Conservation and Development Council

DEQ - Oregon Department of Environmental Quality.

EPA – Environmental Protection Agency

LAC - Local Advisory Committee.

NRCS - Natural Resources Conservation Service.

ODA - Oregon Department of Agriculture.

OEC – Oregon Environmental Council

OSU Extension - Oregon State University Extension Service.

SB 1010 – Senate Bill 1010 or the Agricultural Water Quality Management Act. Directed the Oregon Department of Agriculture to develop an Agricultural Water Quality Management Area Plan and Rules wherever required by state or federal law.

SWCD - Soil and Water Conservation District.

303(d) List - The Clean Water Act, in Section 303(d), requires states to list waters that are "water quality limited."

US – United States

USDA - United States Department of Agriculture**.**

WSC – Watershed Council

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Executive Summary

The Willamette Valley is one of the most highly productive and beautiful agricultural areas in the world. After thousands of years of native peoples harvesting game and selected small-scale crops, European settlers began to arrive in the early 1800s with new livestock and crops. By the mid 1800s tens of thousands of livestock were already here, and many varieties of fruits, vegetables, and grains were produced. Some settlers were so excited about Willamette Valley agriculture that they claimed crop failures were unknown and fertilizer was unnecessary.

Today, hundreds of commodities are grown in the Willamette Valley, many of these in the Southern Willamette Valley (SWV). Producers use fertilizers to boost production and maintain economic viability in a competitive world marketplace. In 2002, SWV farms covered over 1,400,000 acres (NASS 2002), providing significant contributions to the rural, cultural and economic life in the area.

After years of water quality monitoring by various entities, the Oregon Department of Environmental Quality (DEQ) declared parts of three SWV counties a Groundwater Management Area (GWMA) in 2004 due to high nitrate levels in the shallow aquifers. Many valley communities and rural residents obtain their drinking water from these shallow aquifers. Many well water tests have shown nitrate levels at or above 7 parts per million (ppm), the DEQ Action Level that spurs additional testing because of concerns about human health impacts. Nitrate levels of 10 ppm may be dangerous to pregnant women and infants, and represent DEQ’s Maximum Contaminant Level (MCL) for nitrates in groundwater.

Some studies in the 1990s indicated that there has been nitrate leaching from agricultural soils in the Willamette Valley — and in the SWV in particular — which may contribute to nitrate groundwater contamination. These studies point to the need for greater awareness of potential nitrate issues and to incorporate this attentiveness into fertilizer and irrigation practices.

SWV agriculture has seen several changes in fertilization and irrigation practices, beginning in the 1990s, which resulted in greater nitrogen efficiency (and thus less loss — or leaching — below the root zone of crops) as well as lower overall fertilizer and irrigation water applications. Oregon State University Extension Service (OSU Extension) embarked on an intense outreach and education effort to area growers. Some experts believe that many producers responded with appropriate management changes.

At about the same time, the primary vegetable processing facility in the SWV closed, the price of peppermint declined, and nitrogen fertilizer began a rise in price that continues today. Vegetables and peppermint represent the primary high value crops in the SWV. They are also grown extensively on the highly productive but permeable Upper Sedimentary Unit – younger soils located mainly on the west side of the Willamette River. The loss of the primary vegetable processing facility and the lower price of peppermint resulted in a decline in acreage planted to these high value crops and

conversion primarily to grass seed production. While this conversion may result in a small decrease in total nitrogen applications (because of generally lower required rates), the primary benefit may be grass seed crops ability to scavenge and store soil nitrogen.

Today the area's best producers continually work to capture input efficiencies, and this on-going effort includes evaluating their operations to reduce nitrogen applications, increase irrigation efficiencies and take advantage of research to reduce nitrogen losses. Successful growers know this is vital to protect the area's natural resources as well as to operate a profitable business in an extremely competitive world marketplace.

SWV agriculture must continue to make changes as it works with neighboring land uses to lower groundwater nitrate levels. Strategies are presented here, within five goal areas of equal priority, that need to be addressed to achieve success. The five goals are

Goal 1: Coordinate Groundwater Pollution Control Efforts
Goal 2: Organize Education and Outreach Efforts
Goal 3: Monitor and Evaluate Groundwater Quality in Agricultural Areas
Goal 4: Research Best Management Practice Effectiveness and Best Management Practice Adoption, and Report on the Findings
Goal 5: Obtain Adequate Financial Resources to Fund Research and Provide Assistance for Best Management Practice Adoption

These goals and the associated strategies to accomplish the goals focus on integrating this effort with the three existing Agricultural Water Quality Management Area (AgWQMA) Plans in the SWV. Education and Outreach is the primary mode for helping producers understand the best and most economical means for making any necessary changes to reduce nitrate loading to groundwater. Monitoring and research goals are vital to enable us to accurately measure how well we're doing and to continually develop improved management options for our producers, options that will protect surface and groundwater and maintain the competitiveness they need in the marketplace. And finally, we need financial resources to fund the other four goals. The funding strategies suggest ways for producers, agribusiness, and government partners to collaborate to ensure success.

Introduction

Oregon's Willamette Valley is one of the premier agricultural areas in the world. Native Americans harvested the game and selected crops from this area for thousands of years, supporting multiple population centers. By sometime in the 1820s, European settlers had begun to introduce new species of livestock and crops. As described in The Willamette Valley: Migration and Settlement on the Oregon Frontier, by 1850 there were over 19,000 head of beef cattle, almost 10,000 milk cows, over 6,000 working oxen, close to 7,000 horses, about 4,000 sheep, and nearly 31,000 swine (Bowen 1978). Settlers were also growing crops and had reported total yields of approximately 208,000 bushels of wheat (about 20 bushels per acre), over 55,000 bushels of oats primarily for animal feed (averaging anywhere from 50 to 250 bushels per acre), about 3,500 bushels of peas and beans (courtesy of the French Canadian population), and upwards of 62,000 bushels of Irish Potatoes (primarily for local use) (Bowen 1978). Market gardens near trade centers were also developing. According to Bowen (1978), vegetables such as cabbage, pumpkins, turnips, tomatoes, carrots, parsnips, onions, rutabagas, lettuce and squashes were successfully grown. Also by 1850, orchards had begun, bearing apples, pears, and peaches (Bowen 1978).

By the early 1900s, the Oregon Agricultural College was established. A.B. Cordley, Dean of the School of Agriculture, was so excited about Willamette Valley agriculture he noted that "Crop failures are unknown, and yields of from three to four tons of hay, six or seven bushels of clover seed, fifteen to twenty-five bushels of vetch seed an acre are matters of record" (Cordley 1917). The Willamette Valley is blessed with highly fertile soils, a mild climate, and a long growing season. A wide variety of crops can be grown, "so that no commercial fertilizer is needed for ordinary farm crops" (Cordley 1917). Cordley also touted the many forage crops that supported livestock, and he gushed about how well all deciduous fruits do in the Valley – loganberries and other cane fruits, prunes, apples, pears, peaches, and cherries.

Today the high fertility, high production, and diversity of crops remain. However, despite elevated enthusiasm of earlier Oregonians, crop failures are part of Willamette Valley agriculture, and fertilizers are needed for maximum production and economic viability. Over two hundred commodities are grown in the 11,000 square mile Willamette Valley (Institute for a Sustainable Environment 2000). Of the top Oregon counties for gross farm and ranch sales in 2004, Willamette Valley counties made up four of the top five, and all nine Willamette Valley Counties were in the top 15 (of 36) (Oregon Department of Agriculture 2005). All this, yet Oregon's largest population centers are located in the Willamette Valley, where approximately 69% of the state's population calls home (about 54% if we exclude the City of Portland) (Population Research Center 2005).

There are over 1,400,000 acres in agricultural production in the Southern Willamette Valley (SWV), a six county area consisting of Benton, Lane, Linn, Marion, Polk, and Yamhill Counties (NASS 2002). Within the SWV sits the Groundwater Management Area (GWMA). Linn, Lane, and Benton Counties intersect at the SWV GWMA (Figure

1), and in 2004 made up the 6th, 11th, and 12th highest farm and ranch sales counties in the state, respectively (Oregon Department of Agriculture 2005). Total agricultural land use area within the SWV GWMA is about 111,350 acres, less than 10% of the total agricultural area of the entire SWV (Institute for a Sustainable Environment 2000). Grains, hay and forage, seed crops (grass and legume) field crops (primarily peppermint), vegetables, fruits, and various specialty crops make up the bulk of the crop production (Melbye 2005).

Currently there are 10 livestock facilities permitted by the Confined Animal Feeding Operation (CAFO) Program of the Oregon Department of Agriculture (ODA) (Oregon Department of Agriculture CAFO Program 2005). These include dairy, beef, swine, chicken, and other confined animal facilities. These facilities hold annual operating permits and must meet requirements that the state updated in 2001, and each facility is inspected once a year to ensure compliance with permit requirements. Requirements to protect groundwater are an important part of permit conditions. The CAFO program is further described below. There are an unknown number of farm animal facilities that do not require a permit for operation due to limited size, lack of confinement, etc. As throughout Oregon, it is widely expected that the number of horses and horse operations will continue to grow within the SWV GWMA.

Agriculture and Groundwater Nitrate

In an attempt to understand the potential for and to measure nitrate leaching from agricultural operations, the Oregon Department of Environmental Quality (DEQ), U.S. Geological Survey (USGS), Willamette Valley farmers, ODA, Oregon State University (OSU), and OSU Extension Service (OSU Extension) sponsored several studies in the mid 1990s.

Groundwater nitrate was perhaps first identified as a potential problem in the 1980s. DEQ identifies the first formal study of potential agricultural contributions as a 1988 study of domestic well water throughout the Willamette Valley (Fortuna et al. 1988). High nitrate levels of between 5 ppm and 10 ppm were measured in 27% of the wells. Of these, most of the wells were located north of Salem, outside the SWV GWMA (Fortuna et al. 1988). Nonetheless, this study linked elevated groundwater nitrate levels to the presence of agriculture in the Willamette Valley. The U.S. Geological Survey (USGS) in 1993-95 measured nitrate levels above 10 ppm in 6 of 70 (9%) wells in agricultural areas of the valley. Statistically significant correlations were found between higher nitrate levels and the presence of irrigated agriculture and the

<u>Nitrate measurement and level review</u>

Nitrate also commonly shown as NO_3^- N.
ppm is parts per million

At least one study has shown that 10 ppm of nitrate in drinking water may be unsafe for pregnant women and infants. DEQ has set this level of nitrate is the Maximum Contaminant Level or MCL.

7 ppm of nitrate is the DEQ Action Level. Nitrates at or above this Action Level trigger studies to more broadly measure groundwater nitrate levels to determine if a danger exists

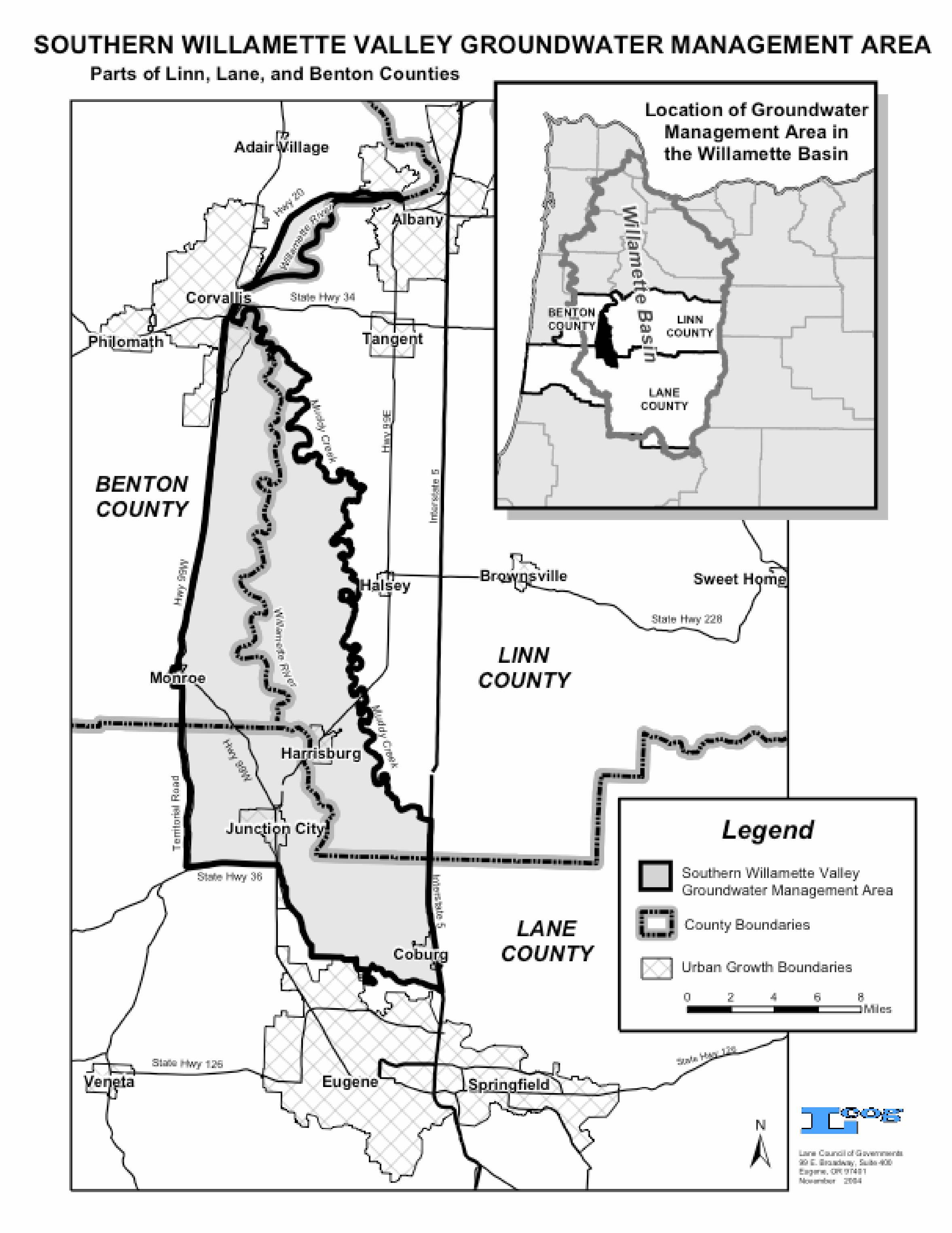

Figure 1
Southern Willamette Valley Groundwater Management Area Location and Boundaries

presence of pesticides (Hinkle 1997). In 1993 a DEQ study of 20 groundwater sites near Junction City found nitrate in 14 wells; eight of these (40% of the total) violated the nitrate Maximum Contaminant Level (MCL) of 10 ppm. Similarly, in 1994 DEQ sampled 20 water wells in the Coburg area. It found nitrate in all sampled wells. Five of the wells exceeded the MCL of 10 ppm nitrate. Both the Junction City and Coburg studies linked agriculture to measured well water nitrate levels (Cole 2004). DEQ broadened groundwater sampling throughout the SWV during 2000 – 2002. Of the 476 samples taken in 2000 - 2001, 249 locations (52%) measured at least 3 ppm nitrate, and 35 locations (7%) measured over 10 ppm. In 2002 sampling of 100 sites of primarily from the 2000 – 2001 locations, DEQ found that 48 showed nitrate concentrations of 10 ppm or above. In both studies, the bulk of the high nitrate sites were along the main stem of the Willamette River, which also coincides with a permeable, highly productive soil (formally referenced as the Upper Sedimentary Unit - Younger of the Willamette Aquifer) (Eldridge 2003). It is also generally the same area where the highest value, highest input irrigated agricultural crops are grown (for example, peppermint and vegetables) (Figure 2).

In addition to the body of work developed by DEQ, Oregon State University (OSU) and OSU Extension researchers have looked more directly at the potential impacts of agricultural practices on groundwater nitrate levels. In a cooperative effort between Oregon growers, OSU, OSU Extension, DEQ, and ODA, a series of studies were conducted. Twenty-one privately managed agricultural fields were measured for contributions to groundwater nitrates. In four years (1993 – 1997) of measurements of nitrate loss to groundwater from vegetable fields, groundwater nitrate levels exceeded the MCL of 10 ppm throughout the year except for late winter when it appeared that high volumes of water diluted the nitrate levels. In five years (1993 – 1998) of measurements under Lane County mint fields, a similar pattern developed (Feaga et al. 2004). Feaga et al. (2004) reported that the average nitrogen (N) fertilizer rates were 200 lb/acre for the vegetable crops and 250 lb/acre for the mint. They estimated the N losses at approximately 93 and 82 lb/acre for the vegetable and mint fields, respectively.

Organic growing operations were represented in the study as well, and also showed high nitrate levels below the root zone (Feaga and Selker 2004). In this case, poultry manure had been applied above agronomic rates for nitrogen (the amount of nitrogen needed for adequate crop growth and production). Management changes implemented in 1996 resulted in lowered soil nitrate concentrations.

In a separate 8-year study at the OSU North Willamette Research and Extension Center (NWREC), researchers used controlled experiments to look at nitrate leaching. In general, over a range of summer vegetables using winter fallow or winter cover crops, nitrogen applications at the recommended agronomic rates to maximize crop yield resulted in groundwater nitrate levels above 10 ppm (Feaga et al. 2004). However, the use of winter cover crops did reduce nitrogen loss to groundwater while maintaining adequate surface soil nitrogen levels.

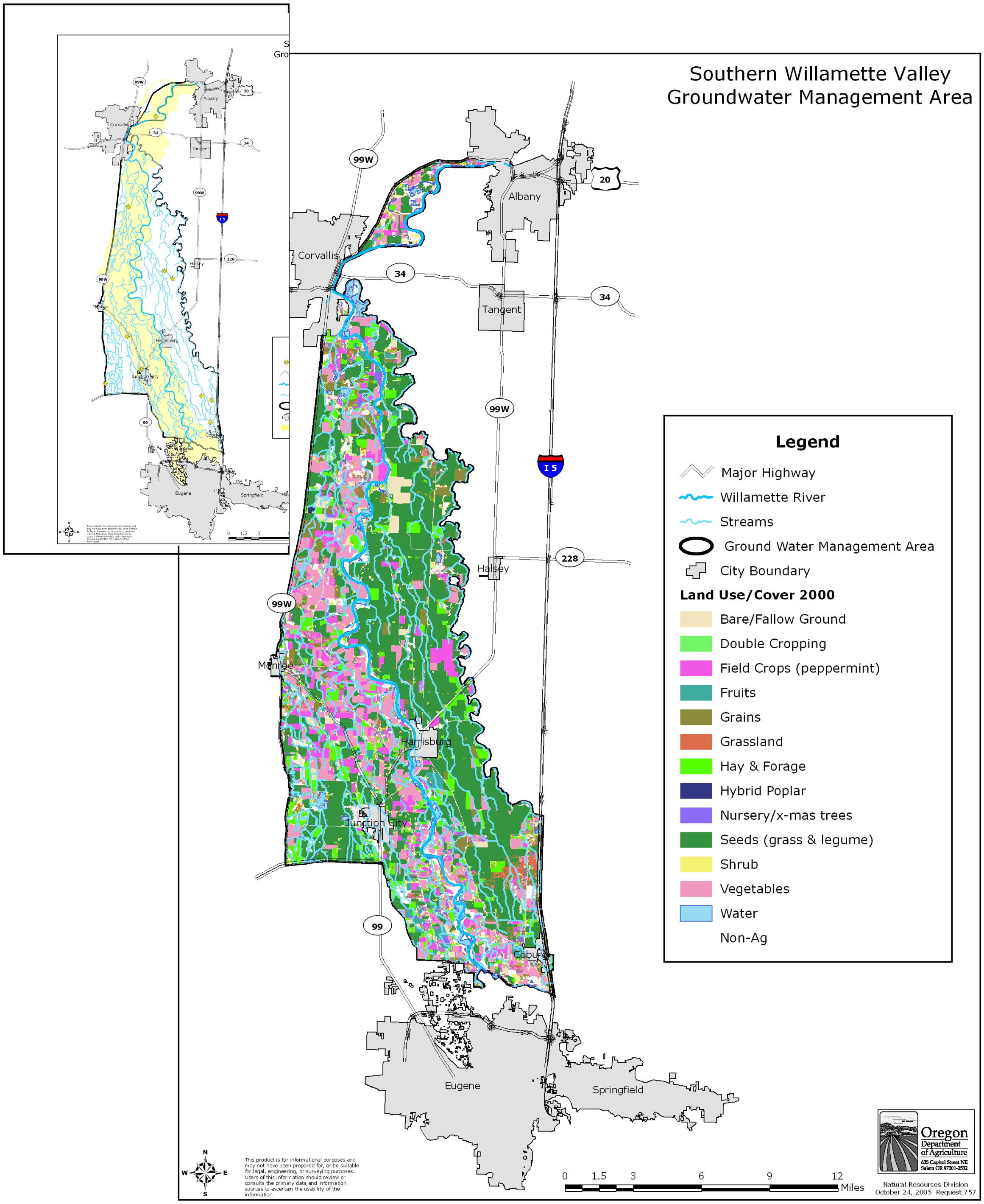

Figure 2
Southern Willamette Valley Groundwater Management Area Crops and Aquifer Sediment.

The yellow area of the insert map indicates the permeable, highly productive Upper Sedimentary Unit - Younger of the Willamette Aquifer. Field crops are primarily grown in this area.

During the 1990s OSU Extension and the Oregon Mint Commission cooperated in a five-year study of nitrogen fertilizer practices. OSU soil scientists showed that spreading nitrogen applications out too late in the season results in excess soil nitrogen remaining after harvest. The same resulted when applying nitrogen at a rate above the OSU recommendation of 225 lbs/acre per year. At 320 lb/acre nitrogen per year in a South Valley field after two years, there was no increase in mint oil yield but an increase in soil nitrogen after harvest, increasing the likelihood of nitrate-leaching to the groundwater (Melbye 2003). Another study of 16 peppermint fields in the Willamette Valley (12) and the Grande Ronde Valley (4) in Oregon showed high levels of residual soil nitrate after harvest, contributing to the potential for nitrate leaching to groundwater (Christensen et al. 2003).

Some work has also been done on grass seed. In one example, Mark Melbye (2002) showed that residual soil nitrate levels greatly increased at annual nitrogen application rates of 180 lb/acre and above on annual ryegrass. Maximum Economic Yield – maximum profit per acre (versus maximum yield per acre) -- was also reached at the lower nitrogen application rates, showing that careful fertilizer applications can protect water quality and maximize income (Melbye 2002).

These studies show that where intensive agricultural production occurs with high nitrogen inputs, groundwater nitrate levels can be expected to approach and exceed the 10 ppm MCL (Feaga et al. 2004; Melbye, personal communication, March 23, 2005; Selker, personal communication, March 24, 2005). However, this problem can be controlled, and alternative management options exist to make it happen.

Changes in Southern Willamette Valley Agriculture

Producers have recently made important management changes in response to new information and market mechanisms that have resulted in more efficient nitrogen use on agricultural lands (Melbye, personal communication, March 23, 2005; Penhallegon, personal communication, March 22, 2005; Selker, personal communication, March 24, 2005). Revised CAFO regulations also have lessened the threat to groundwater from confined animal facilities.

New Research
In research performed cooperatively by the OSU Department of Bioresources Engineering, Lane County vegetable and mint growers, and OSU Extension, an average of 93 lb/ac for vegetables and 82 lb/ac for mint were lost to below the root zone (Feaga and Selker 2004). They note that " … both excellent yields and environmental stewardship can be achieved by managing [nitrogen] and water inputs, as illustrated by sites with low [nitrate] losses under each cropping system."

As a result of their and other research, Feaga and Selker recommend the following management options:

Reduction of N Inputs

- Determining most efficient rate and timing of fertilizer applications
  Avoid excessively high rates. In general, for:
  - ✓ Grass seed, use minimum nitrogen in the fall (<40 lb N/acre) plus optimum levels in the spring. Do not fertilize too early in late winter (i.e. late Jan or early Feb.) before crops really start to grow.
  - ✓ Peppermint, apply recommended N fertilizer rates. Do not apply excess late in the season.
  - ✓ Other row crops and irrigated crops, do not use excessive nitrogen fertilizer. Use cover crops where possible.
- Soil sampling
- Accounting for mineralization of soil nitrogen
- Stem NO_3^{-}N tests for peppermint

Use of cover crops to scavenge for N

Irrigation Management

- Operating pressure – check for uniformity
- Nozzles – recommends replacing every 4 years with consistent make and diameter
- Sprinklers – make sure sprinklers discharge at the correct angle and that they rotate properly
- Soil water monitoring
- Schedule irrigation based on expected evapotranspiration rates
- Train workers to understand the importance of efficient operation of the equipment

(Feaga and Selker 2004; Selker 2004; Melbye, personal communication, March 6, 2006).

In their work, Selker and Rupp (2004) show that stem testing is a proven way of identifying nitrogen supply issues in mint, and provides an accurate guide for making split applications. Several recent authors discuss the effectiveness of ensuring the efficiency of irrigation applications and maintenance of the equipment to provide improved control of nitrogen soil movement (Christensen et al 2003; Louie and Selker 2000; Selker and Rupp 2004).

Following on this research, OSU and OSU Extension staff have worked hard to disseminate this information to the agricultural community in the Willamette Valley. Experienced extension agents indicate that producers have used this information and support to more accurately tailor nitrogen applications to their crops and soils, and instituted processes to more closely monitor yearly nitrogen needs (Melbye, personal communication, March 23, 2005; Penhallegon, personal communication, March 22, 2005).

Market Alterations

In late 1998 the farmer cooperative Agripac, Oregon's second-largest vegetable and fruit processor at the time, went bankrupt and closed. Agrifrozen then bought the Agripac assets, entered into purchase agreements with area producers, and attempted to revive the business. However, before paying contracted growers for their product, Agrifrozen too went out of business in June of 2001 (Engler 2003; Marguth, personal communication, November 30, 2005). Additional attempts to bring in other processors failed. This resulted in the loss of the bulk of vegetable processing for the growers within the SWV GWMA. At about the same time, the market for peppermint oil was weakening.

With the loss of the primary vegetable processor for the SWV and the decline of the peppermint oil market for Oregon growers, producers moved out of these crops into the grass and legume seed crops. In 1990, vegetable and field crops (primarily peppermint) made up approximately 21,000 acres or about 22% of SWV major crops. By 2004, the number of acres had reduced to roughly 12,000 acres, 12% of major SWV crops. Conversely, grass and legume seed crops increased about 22%, from over 59,000 acres in 1990 to over 72,000 acres in 2004 (Table 1).

OSU Extension nitrogen fertilizer recommendations for grass seed crops normally vary from about 120 – 140 lbs/acre per year. For various vegetable crops, recommendations vary from a low of 50-lbs/acre to a high of 225 lbs/acre, with 100-to 150-lbs/acre nitrogen representing an approximate core average annual application rate. Peppermint recommendations hover around 180 – 200 lbs/acres of nitrogen. These numbers tell us that the switch from vegetables to grass seed has not resulted in a decreased application rate overall, but we do see a small potential decrease from peppermint to grass seed (Doerge et. al. 2000a; Doerge et. al 2000b; Doerge et. al. 2000c; Jackson et. al. 1983; Jackson et. al. 2000; Hart et. al. 2000; Hart et. al. 2003; Mack et. al. 2000; Mansour et. al. 1983; Mansour et. al. 2000; Melbye et. al. 2003).

Perhaps the more important characteristic is that grass seed crops, with their deeper root systems, scavenge for soil nitrogen better. In addition, most grass seed crops are perennial (developing very deep and widespread root systems), and annual ryegrass is sometimes also established in the fall to take up and store nitrogen on annual cropland during the wet season. Moreover, as shown in Figure 2, vegetable and peppermint crops have primarily been grown west of the Willamette River, where the more highly productive but more permeable Upper Sedimentary Unit – Younger is located. The substitution with grass seed crops over this permeable layer can be expected to result in lowered nitrate leaching.

Today the area's best producers continually work to capture efficiencies, and this on-going effort includes evaluating their operations to reduce nitrogen applications and take advantage of research to reduce nitrogen losses. Minimizing nitrogen losses reduces production costs and saves money. Successful growers know this is vital to protect the natural resources where they live as well as to operate a profitable business in an extremely competitive world marketplace.

Table 1
Change in Crop Acreage in the Southern Willamette Valley Groundwater Management Area from 1990 to 2004.

(Melbye 2006)

The change in crop acreage in the South Willamette Valley Groundwater Management Area from 1990 to 2004.
Estimates based on OSU Extension Service annual crop estimates and commodity commission reports.

Crop Category	Linn			Benton			Lane			Three County summary
1990	Total Acres		GWMA	Total Acres		GWMA	Total Acres		GWMA	**Acres in GWMA**
Grain	16,700	0.08	1,336	12,600	0.23	2,898	11,700	0.20	2,340	**6,574**
Hay & Forage	31,200	0.06	1,872	11,900	0.20	2,380	31,900	0.20	6,380	**10,632**
Seeds (grass & legume)	184,450		0	33,410		0	27,510		0	**59,278**
Field Crops (peppermint)[1]	7,600	0.15	1,140	4,370	0.80	3,496	7,180	0.95	6,821	**11,457**
Vegetables	1,425	0.95	1,354	4,975	0.95	4,726	4,325	0.95	4,109	**10,189**
Fruits	2,445	0.05	122	755	0.10	76	4,275	0.25	1,069	**1,267**
Specialty	260	0.05	13	260	0.33	86	260	0.33	86	**185**
										99,581
1997	Total Acres		GWMA	Total Acres		GWMA	Total Acres		GWMA	**Acres in GWMA**
Grain	6,900	0.12	828	6,000	0.48	2,880	3,300	0.40	1,320	**5,028**
Hay & Forage	22,840	0.06	1,370	12,230	0.20	2,446	32,100	0.20	6,420	**10,236**
Seeds (grass & legume)	195,700		0	35,480		0	25,700		0	**63,980**
Field Crops (peppermint)[1]	10,250	0.10	1,025	3,100	0.80	2,480	4,200	0.85	3,570	**7,075**
Vegetables	3,518	0.95	3,342	5,230	0.95	4,969	3,501	0.95	3,326	**11,637**
Fruits	2,494	0.05	125	900	0.10	90	4,719	0.25	1,180	**1,394**
Specialty	130	0.05	7	340	0.33	112	340	0.33	112	**231**
										99,581
2004	Total Acres		GWMA	Total Acres		GWMA	Total Acres		GWMA	**Acres in GWMA**
Grain	10,800	0.12	1,296	3,250	0.55	1,788	3,000	0.33	990	**4,074**
Hay & Forage	36,200	0.06	2,172	13,450	0.15	2,018	30,550	0.18	5,499	**9,689**
Seeds (grass & legume)	194,850		0	37,690		0	29,210		0	**72,213**
Field Crops (peppermint)[1]	4,900	0.10	490	2,250	0.80	1,800	2,500	0.75	1,875	**4,165**
Vegetables	3,962	0.95	3,764	2,837	0.95	2,695	1,473	0.95	1,399	**7,858**
Fruits	2,620	0.05	131	1,057	0.10	106	4,782	0.25	1,196	**1,432**
Specialty	300	0.05	15	0	0.33	0	410	0.33	135	**150**
										99,581

Total area in the SWVGWMA = 111,350 acres
Sum of major crop categories = 99,581 acres

1Field crops includes peppermint, sugarbeets, and other minor acreage irrigated crops. In these counties, 92% of this category is peppermint.

Passage of the 1993 Agriculture Water Quality Management Act – Senate Bill 1010

In 1993 the Oregon Legislature passed Senate Bill 1010, the Agriculture Water Quality Management Act (commonly referred to in Oregon by the legislative acronym SB 1010). The legislation authorized ODA to develop Agricultural Water Quality Management (AgWQM) Area Plans (Area Plans) to address water quality issues associated with agricultural activities. It also gave ODA the authority to adopt administrative rules (Area Rules) to implement the Area Plans. The Area Rules also describe land conditions that must be established, and are enforceable by ODA.

The AgWQM watershed planning process is begun by ODA once water quality issues in a watershed have been identified and a watershed plan is required by state or federal law. One example of such a "trigger" for the planning process is a listing under section 303(d) of the federal Clean Water Act. Another trigger is the designation of a Groundwater Management Area. The watershed-based plans identify measures and strategies for landowners to prevent and control water pollution resulting from agricultural activities.

Within the SWV GWMA, three Area Plans intersect and are already being implemented – the Middle Willamette, the Upper Willamette and Upper Siuslaw, and the South Santiam. ODA developed each watershed plan with the assistance of a Local Advisory Committee (LAC) consisting of stakeholders residing in the watershed. Under each Area Plan, local operators are asked to deal with identified problems such as soil erosion, excess nutrient loss from fields, inappropriate manure storage, or degraded streamside areas. Farmers and ranchers are allowed to choose their own ways of meeting established water quality goals as long as they are following their local Area Rules to help meet watershed goals and objectives. However, those who are asked to deal with a problem but continually refuse to do so could be assessed a civil penalty.

Technical assistance from local Soil and Water Conservation Districts (SWCDs) and others, notably OSU Extension and USDA Natural Resources Conservation Service, is provided for those who request it. The bottom line is reducing agriculture's contribution to water pollution as part of the broader effort to protect our surface and groundwater resources. Within the SWV GWMA the Benton (located in Corvallis), East Lane (located in Eugene), and Linn (located in Tangent) SWCDs provide technical and financial assistance to local producers.

The Middle Willamette, Upper Willamette and Upper Siuslaw, and South Santiam Area Plans and associated Area Rules represent the primary planning and implementation mechanisms for SWV agriculture to implement the GWMA Action Plan. ODA works with each LAC and SWCD to review and revise Area Plans and Area Rules every two to three years. All partners will work to incorporate critical elements of the SWV GWMA Action Plan into the Area Plans. Through this process we will implement groundwater protection goals, strategies and actions, including monitoring of progress and evaluation of success measures.

Confined Animal Feeding Operation Program Changes

A Confined Animal Feeding Operation, or CAFO, is a livestock operation that meets at least one of the following criteria:

- Animals confined in a building or pen or lot with an improved surface (e.g., concrete, rock, or fibrous material)
- The facility has a waste treatment works (manure pile, lagoon, tank, etc.), or
- The facility has potential to discharge or is discharging waste.

In Oregon there are permitted and non-permitted CAFOs. Operations that require a permit are those where the animals are confined for at least 120 days and have a waste treatment works or have the potential to discharge or are discharging. Non-permitted CAFOs are those that are not required to operate with a permit.

In the early 1980s the Oregon Legislature required Confined Animal Feeding Operations (CAFOs) to receive a permit to operate. DEQ and ODA jointly administered the program, issuing Water Pollution Control Facilities (WPCF) permits. These permits prohibited discharge of CAFO wastes to surface waters and prohibited conditions that could negatively impact groundwater. In 1993 the Oregon Legislature directed the complete transfer of the program from DEQ to ODA, and in 1995 the transfer was completed.

Initially the CAFO program was a complaint driven program; ODA only responded to complaints. In 1999 ODA introduced the Performance Based Inspection (PBI). The change to PBI meant that all permitted CAFOs had to receive at least one routine inspection per year. Today, this allows CAFO staff to annually visit or inspect every permitted CAFO in the state. The switch to PBI also included strengthened groundwater protection requirements (Alan Youse, personal communication, October 31, 2005).

In response to new federal CAFO standards adopted by the US Environmental Protection Agency (EPA) in 2003, Oregon again revised the CAFO program. Changes brought in a segment of Oregon livestock operations that had never before been permitted (Oregon Department of Agriculture CAFO 2004). The new CAFO permit also represents a strengthening of CAFO regulations and incorporates increased protection for both surface and groundwater.

A 2002 Memorandum of Agreement (MOA) between DEQ and ODA requires all CAFOs covered under the new Oregon CAFO General Permit to develop and implement an Animal Waste Management Plan (AWMP). Each permitted CAFO must prepare and provide an AWMP for ODA to review and approve. Each AWMP must be adequate for the existing population of animals, be prepared in accordance with the terms and conditions of the permit and state laws and rules, and implement the USDA-NRCS Nutrient Management practice 590 for Oregon. This nutrient management practice is based on current soil tests and is designed to accomplish the following:

- Budget and supply nutrients for plant production.
- Properly utilize manure or organic by-products as a plant nutrient source.
- Minimize agricultural non-point source pollution of surface and groundwater resources.
- Maintain or improve the physical, chemical and biological condition of soil (NRCS 2001).

All permitted CAFOs must be operating in accordance with an approved AWMP by December 31, 2006 (Oregon Department of Agriculture CAFO 2004). When CAFOs include a lagoon as part of the waste management system, the lagoons must operate under standards set by DEQ and adopted and enforced by ODA.

In addition to the AWMP requirement, new legislation and the 2002 MOA fostered the following changes in the CAFO program:

- Whole farm nutrient balance is now required; producers must account for all the nutrients (including nitrogen) entering and leaving the operation
- Nutrients must be applied based on the most limiting nutrient. For example, if the fertilizer applied to a field meets the phosphorus demands of the crop but exceeds the nitrogen requirement, the total applied must be decreased to meet the nitrogen requirement (rather than exceed it) and another source of phosphorus found to meet that need. The NRCS Agronomy Technical Note #26 and phosphorous index are required to determine whether nitrogen or phosphorous is the most limiting nutrient.
- Operators must provide ODA with an annual report showing the amount of manure generated on farm and how much was exported off farm
- CAFOs must sample and measure soil nutrient levels once every five years
- Manure application records must be maintained and available for annual inspection
- Inspectors look for situations where a CAFO could potentially have permit violations, not just whether they are discharging at the time of the inspection.
- All permitted CAFOs are inspected at least once a year for compliance with the above requirements as well as additional permit requirements (Matthews, personal communication, May 5, 2005).

ODA may also issue individual permits to CAFOs located in a groundwater management area, employing new or experimental technology in their waste system or requiring more than 24 months to come into compliance with permit conditions. (Oregon Department of Agriculture CAFO 2004). General permits contain a constant set of requirements that each operation must attain. Individual permits are those with requirements written for a specific operation. In the SWV GWMA, the need to issue individual permits will be on a case-by-case basis since the new Oregon CAFO General Permit covers many of the same monitoring requirements placed in individual permits (Alan Youse, personal communication, October 31, 2005).

In the SWV GWMA there are currently nine permitted CAFOs that include dairy, beef, hog, and chicken facilities (Figure 3). These CAFOs cover about 2,400 acres, approximately 2% of the total agricultural area within the GWMA.

Smaller animal operations such as horse farms may not require a CAFO permit. These operations are regulated by their local SB 1010 AgWQM Area Rules. Oversight is based on a complaint-driven system, and are also prohibited from discharging pollution to surface and groundwater. The number of farms with low numbers of animals continues to increase in Oregon, and likely within the SWV GWMA as well. The total impact of this growth is still unknown. However, the local SWCDs and other partners continue to work with this segment of the rural population in an effort to protect surface and groundwater.

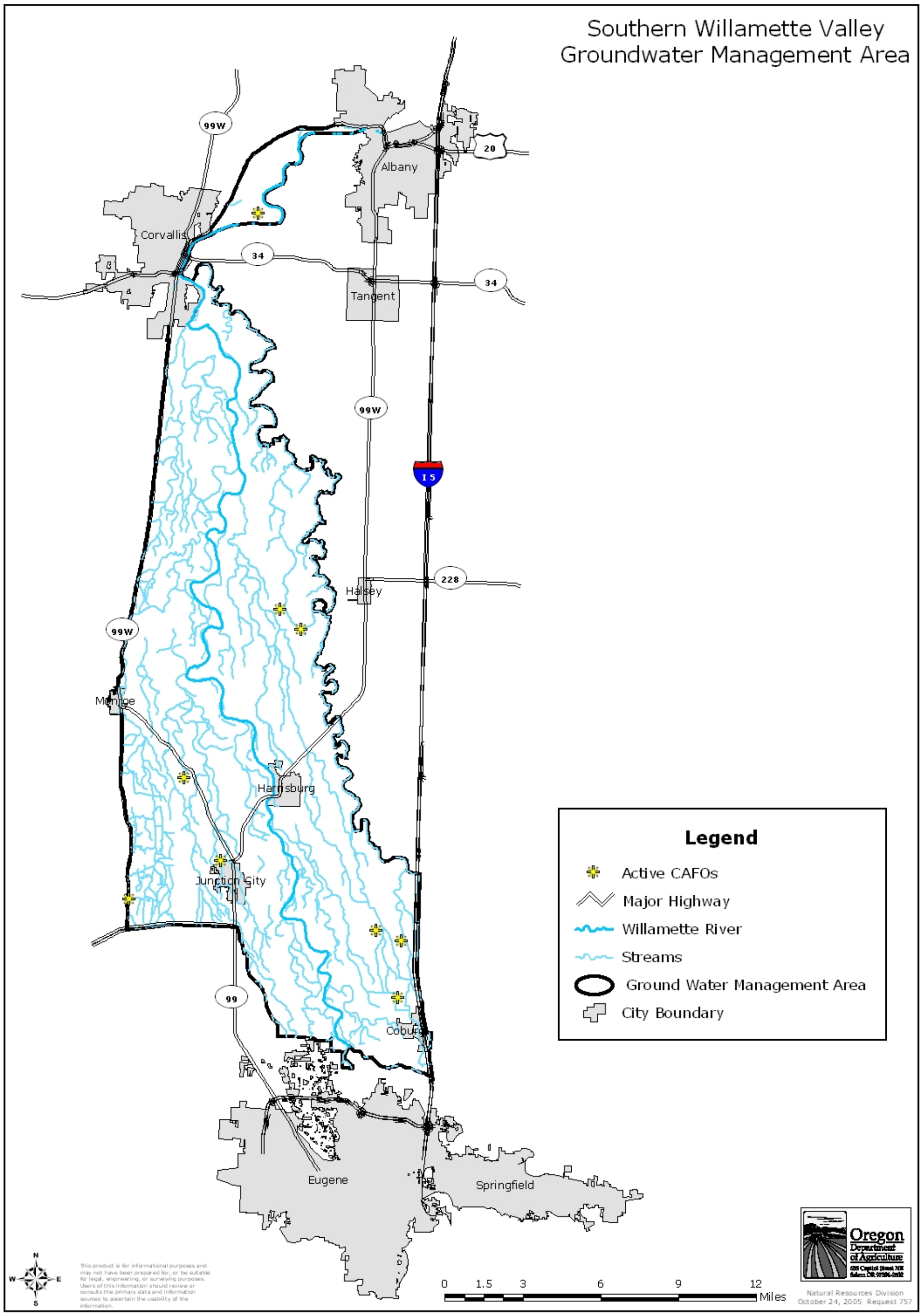

Figure 3
Location of permitted Confined Animal Feeding Operations (CAFOs) in the Southern Willamette Valley Groundwater Management Area

Goals and Strategy Recommendations

Changes in SWV agriculture in the last 10 to 15 years have resulted in improved nitrogen management and more stringent monitoring and documentation. Nonetheless, agriculture makes up 93% of the land use in the SWV GWMA and stands as a potential contributor to high nitrate levels in groundwater. Agriculture can make additional changes. The following Goals and Strategy Recommendations outline how SWV agriculture – producers, agribusiness, and local, state, and federal partners – will, in cooperation with other land uses, continue to help decrease groundwater nitrate levels and protect the water that agricultural communities and their neighbors rely on for drinking and production uses.

Goal 1: Coordinate Groundwater Pollution Control Efforts

Integration Strategies

- Within the SWV GWMA, coordinate agricultural surface water and groundwater pollution control efforts.

  Actions

  - ❑ Revise the Benton, East Lane, and Linn Soil and Water Conservation District (SWCD) Scopes of Work (SOW) to include groundwater quality task items. This should be accomplished in state fiscal year 2006-2007.
  - ❑ Revise the South Santiam, Middle Willamette, and Upper Willamette Agricultural Water Quality Management Area (AgWQMA) Plans to include groundwater quality items in the Goals and Objectives sections. This should be accomplished during the next biennial review for each Management Area.

  Implementation Responsibility

  Primary; ODA
  Secondary: SWCDs, LACs

Goal 2: Organize Education and Outreach Efforts

Education and Outreach Strategies

- Write and publish articles to promote/improve the agricultural community's awareness of water quality issues in the Groundwater Management Area.

  Actions

  - ❑ Once a year, provide an update on the status of the SWV GWMA and associated water quality data in each of the Benton, East Lane, and Linn SWCD newsletters. This should begin in the first state fiscal year after DEQ approves and implements the Action Plan.

- Publish three media articles or public service announcements per year in the SWV GWMA about successful agricultural resource management practices. Primary publication outlets include the Corvallis *Gazette-Times*, the Eugene *The Register-Guard*, the Junction City *Tri-County News*, and the OSU Extension *Update*.

Implementation Responsibility
Primary: SWCDs
Secondary: ODA, OSU Extension, DEQ, LCOG

- Share information and coordinate with agribusiness, producers, and producer groups to promote groundwater quality.

Actions

- Starting in the first state fiscal year after DEQ approves the Action Plan, meet with agribusiness field representatives active in the SWV GWMA to review the groundwater nitrate issue and share appropriate outreach materials from ODA, DEQ, SWCDs, OSU Extension, and other appropriate sources. This should occur once every two years. Some example ways to meet with field representatives include:
    - Grower meetings
    - Individual company meetings
    - Oregon Agriculture Chemical and Fertilizer safety training workshops
    - Breakfast or lunch for local field representatives sponsored by local SWCDs and partners such as ODA, OSU Extension, and NRCS
- Each SWCD will deliver one groundwater quality presentation (either as a stand-alone presentation or part of a broader presentation) at one agribusiness or producer group meeting per year.
- Target one producer group per year and distribute OSU Extension Best Management Practice (BMP) descriptions to producers and field representatives.
- Make at least 100 groundwater quality contacts per year within the areas served by the Benton, East Lane, and Linn SWCDs. The service areas of these SWCDs intersect within the SWV GWMA. These contacts will be to provide information, answer questions, help with technical assistance, obtain financial assistance, etc.

Implementation Responsibility
Primary: SWCDs, OSU Extension
Secondary: ODA, DEQ, CPRCD, NRCS

- Organize and deliver workshops and demonstration projects aimed at producers to show Best Management Practice implementation and foster improved Best Management Practice use. Focus on priority BMPs provided on page 11.

Actions

- Develop two demonstration projects at least once every two years showcasing successful Best Management Practices (BMPs) and systems.

- ❑ Each year organize one tour of each demonstration project for agricultural managers and producers.
- ❑ Each year sponsor two small acreage resource management workshops that provide presentations on groundwater and surface water quality issues to horse, small livestock, natural resource, recreation, education, and other groups.
- ❑ Attract at least 100 participants annually to these demonstrations and workshops.

Implementation Responsibility
Primary: SWCDs, OSU Extension
Secondary: ODA, CPRCD, NRCS

- Hold workshops to education producers about federal assistance programs and sustainable agriculture opportunities that provide market incentives to protect surface and groundwater

Actions
- ❑ Hold Conservation Security Program (CSP) information and assessment workshops. Eight to 12 workshops should be held when CSP becomes available, likely in state 2006 – 2007 or 2007 – 2008 fiscal year. Enroll 200 producers in CSP.
- ❑ Hold workshops to educate producers of sustainable practices, incentive programs, and third-party certification. Six workshops should be held in state 2006 – 2007 fiscal year. Attract 100 producers to these workshops and enroll 20 producers in third-party certification programs.
- ❑ Enroll 1000 acres per year in NRCS conservation practices on cropland.

Implementation Responsibility
Primary: NRCS, CPRCD, SWCDs, Oregon Environmental Council (OEC)
Secondary: ODA, OSU Extension, Food Alliance

Goal 3: Monitor and Evaluate Groundwater Quality in Agricultural Areas

Groundwater Monitoring and Evaluation Strategies
- Develop a groundwater monitoring plan for agricultural areas.

Actions
- ❑ Coordinate local, state, and federal partners conducting groundwater monitoring to evaluate the completeness of existing programs and identify additional monitoring needs.
- ❑ Agree on consistent protocols to gather baseline groundwater data. This must precede deployment of the monitoring network.
- ❑ Establish a plan for monitoring groundwater that will accurately identify baseline conditions.
- ❑ Establish a plan for accurately monitoring groundwater trends and more clearly identifying sources of contamination.

- Coordinate surface water and groundwater monitoring where feasible and advantageous.
- Complete these actions during the state 2006 – 2007 fiscal year.

Implementation Responsibility

Primary: DEQ, ODA
Secondary: OSU, OSU Extension, US EPA, NRCS, SWCDs, CPRCD, WSCs

- Document groundwater-related violations of Agricultural Water Quality Management Area Rules, and CAFO permit conditions within the SWV GWMA.

Actions

- Each year document the amount, subject, validity, and outcome of complaints regarding potential violations of Agricultural Water Quality Management Area (AgWQMA) Rules where the violations could impact groundwater.
- Each year document CAFO violations and outcomes.
- Incorporate these results into the periodic review.
- Begin these actions in the first state fiscal year after DEQ approval of the Action Plan.

Implementation Responsibility

Primary: ODA
Secondary:

Goal 4: Research Best Management Practice Effectiveness and Best Management Practice Adoption, and Report on the Findings

Research and Reporting Strategies

- Research and document BMP effectiveness. Place emphasis on coordinating state, federal, and university efforts.

Actions

- Bring representatives of DEQ, ODA, OSU, OSU Extension, NRCS, USDA ARS in Corvallis, producers, and agribusiness together to discuss and create a priority list of ideas to research and document BMP and systems effectiveness in the SWV GWMA.
- Design a program to follow-up OSU nitrate leaching studies at a scale that provides a general characterization of SWV GWMA agriculture.
- Develop a prioritized research plan, with identified sources of funding. Focus should be placed on identifying the greatest factors in agricultural contributions to groundwater nitrate
- The three actions above should occur during the state 2006 – 2007 fiscal year.
- Implement new research to measure BMP and systems effectiveness and to identify the priority factors affecting groundwater nitrate levels from agricultural practices.

- The action above should begin during the state 2007 – 2008 fiscal year and continue until DEQ rescinds the GWMA declaration.
- Publish a summary of research findings every five years as part of the DEQ periodic review. The first summary should be prepared five years after DEQ approval of the Action Plan.

Implementation Responsibility

Primary: OSU, OSU Extension, ODA,
Secondary: DEQ, NRCS, USDA ARS, US EPA

- Measure the success of BMP Implementation efforts.

Actions

- Measure producer awareness of groundwater quality issues and the level of BMP implementation and improvement to create a baseline of BMP use.
- Measure the ease of implementing BMPs and barriers to BMP implementation.
- Repeat the first and second action measurements every five years.
- Publish the findings every five years as part of the DEQ periodic review.
- Implement this suite of actions in the first state fiscal year after DEQ approval of the Action Plan.

Implementation Responsibility

Primary: OSU, OSU Extension
Secondary: DEQ, ODA, NRCS, USDA ARS, EPA, producers

<u>Goal 5: Obtain Adequate Financial Resources to Fund Research and Provide Assistance for Best Management Practice Adoption</u>

Funding Strategies

- Obtain sufficient funding to support priority research needs.

Actions

- After research needs are identified and prioritized (see Goal 4), submit research grant applications to support high priority research needs. Potential grant sources include the DEQ 319 Program, ODA, US EPA, US Department of Agriculture, and other agencies and private organizations.
- This should begin in the state 2006 – 2007 fiscal year.
- Funding should be reviewed every five years until DEQ rescinds the GWMA designation.

Implementation Responsibility

Primary: OSU, OSU Extension, DEQ, ODA,
Secondary: EPA, NRCS, USDA ARS, producers

- Obtain sufficient financial assistance to support implementation of resource management practices, technical assistance to producers, and outreach and education.

  Actions
  - Seek an ODA SWCD Technical Assistance grants allocation 20% higher than the 2003 – 2005 allocation in order to provide groundwater protection assistance to producers. This should begin in the state 2006 –2007 fiscal year in preparation for the state 2007 – 2009 biennium.
  - Seek increased funds for USDA incentive-based cost-share programs to assist producers. For example, seek to increase funding levels for the Environmental Quality Incentive Program (EQIP), the Conservation Reserve Program (CRP), and the Conservation Reserve Enhancement Program (CREP). Efforts must focus on the 2007 Farm Bill. This should occur immediately to influence federal decisions on funding levels.
  - Seek DEQ 319 Program funds to bolster agricultural on-the-ground projects and management practices that minimize groundwater nitrate pollution. This should occur immediately and yearly for at least the first five years, and thereafter as ODA and DEQ deem it necessary.
  - Insert Scope of Work (SOW) tasks in SWCD work plans to promote the Pollution Abatement Tax Credit and Riparian Tax Credit programs with producers in the SWV GWMA. This should happen each year of the GWMA Action Plan.
  - Continue to include the promotion and support of USDA programs such as EQIP and CREP in SWCD work plans and Scopes of Work. This should happen yearly.

  Implementation Responsibility
  Primary: ODA, SWCDs, Soil and Water Conservation Commission, DEQ,
  Secondary: NRCS, OSU, OSU Extension, CPRCD

Conclusion

The soonest we can expect to measure changes in SWV groundwater nitrate levels as a response to changes made today is about 20 years (Selker, personal communication, March 24, 2005). We believe that Willamette Valley agriculture has been making significant changes for about the last 10 years. Therefore, with the help of our partner residential, industrial, and public sector groundwater users, the earliest we should expect to see positive measurements of these management changes is in 10 to 15 years from the present.

It will take approximately 20 years to measure the impacts of the changes we implement now. During that time we may also experience decreasing incremental changes. As we work to eliminate the most obvious nitrate threats to groundwater quality, we should expect to measure the greatest incremental decreases in groundwater nitrate levels. Later as we move to eliminate lesser threats we should expect to experience smaller decreases.

Adequate baseline monitoring must be an early priority to clearly and confidently mark our present condition. All partners must then focus on changes in management practices to continue our positive trend. Financial and technical assistance to SWV producers will be critical to this effort. Support to OSU and OSU Extension for research and reporting of results will be a significant component of success. Funding levels will directly affect our level of success. It is difficult to predict when all SWV groundwater nitrate levels will reach target levels. However, fully implemented, we can be confident in our expectation to begin to measure success.

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