# Middle Willamette Agricultural Water Quality Management Area Plan

**October 2020**

**Developed by the**

**Oregon Department of Agriculture**

and the

**Middle Willamette Local Advisory Committee**

with support from the

**Benton and Polk Soil and Water Conservation Districts**


**Oregon Dept. of Agriculture**
Water Quality Program
635 Capitol St. NE
Salem, OR 97301
(503) 986-4700

**Benton SWCD**
456 SW Monroe Avenue
Corvallis, OR 97333
(541) 753-7208
www.bentonswcd.org

**Polk SWCD**
580 Main Street
Dallas, OR 97338
(503) 623-9680
www.polkswcd.com


***Website:*** oda.direct/AgWQPlans

(This page is blank)

# Table of Contents

## Acronyms and Terms

**Ag Water Quality Program** – Agricultural Water Quality Program
**Area Plan** – Agricultural Water Quality Management Area Plan
**Area Rules** – Agricultural Water Quality Management Area Rules
**CAFO** – Confined Animal Feeding Operation
**CNPCP** – Coastal Nonpoint Pollution Control Program
**CWA** – Clean Water Act
**CZARA** – Coastal Zone Act Reauthorization Amendments
**DEQ** – Oregon Department of Environmental Quality
**GWMA** – Groundwater Management Area
**LAC** – Local Advisory Committee
**LMA** – Local Management Agency
**Management Area** – Agricultural Water Quality Management Area
**NPDES** – National Pollution Discharge Elimination System
**NRCS** – Natural Resources Conservation Service
**OAR** – Oregon Administrative Rules
**ODA** – Oregon Department of Agriculture
**ODF** – Oregon Department of Forestry
**ORS** – Oregon Revised Statute
**OWEB** – Oregon Watershed Enhancement Board
**OWRI** – Oregon Watershed Restoration Inventory
**PMP** – Pesticides Management Plan
**PSP** – Pesticides Stewardship Partnership
**SIA** – Strategic Implementation Area
**SWCD** – Soil and Water Conservation District
**TMDL** – Total Maximum Daily Load
**USDA** – United States Department of Agriculture
**US EPA** – United States Environmental Protection Agency
**WPCF** – Water Pollution Control Facility
**WQPMT** – Water Quality Pesticides Management Team

(This page is blank)

# Foreword

This Agricultural Water Quality Area Plan (Area Plan) provides guidance for addressing water quality related to agricultural activities in the Agricultural Water Quality Management Area (Management Area). The Area Plan identifies strategies to prevent and control water pollution from agricultural lands.

The Area Plan is neither regulatory nor enforceable (Oregon Revised Statute (ORS) 568.912(1)). The Area Plan refers to associated Agricultural Water Quality Management Area Rules (Area Rules). The Area Rules are Oregon Administrative Rules (OARs) and are enforced by the Oregon Department of Agriculture (ODA).

# Required Elements of Area Plans

Area Plans must describe a program to achieve the water quality goals and standards necessary to protect designated beneficial uses related to water quality as required by federal and state law (OAR 603-090-0030(1)).

# Plan Content

Chapter 1: Agricultural Water Quality Program Purpose and Background. Presents consistent and accurate information about the Ag Water Quality Program.

Chapter 2: Local Background. Provides the local geographic, water quality, and agricultural context for the Management Area. Describes the water quality issues, Area Rules, and potential practices to address water quality issues.

Chapter 3: Implementation Strategies. Presents goal(s), measurable objectives, strategic initiatives, proposed activities, and monitoring efforts.

Chapter 4: Progress and Adaptive Management. Describes progress toward achieving the goal of the Area Plan and summarizes results of water quality and land condition monitoring.

(This page is blank)

# Chapter 1: Agricultural Water Quality Program

## 1.1 Purpose of Agricultural Water Quality Program and Applicability of Area Plans

As part of Oregon's Agricultural Water Quality Program (Ag Water Quality Program), the Area Plan guides landowners and partners such as Soil and Water Conservation Districts (SWCDs) in addressing water quality issues related to agricultural activities. The Area Plan identifies strategies to prevent and control "water pollution from agricultural activities and soil erosion" (ORS 568.909(2)) on agricultural and rural lands within the boundaries of this Management Area (OAR 603-090-0000(3)) and to achieve and maintain water quality standards (ORS 561.191(2)). The Area Plan has been developed and revised by ODA and the Local Advisory Committee (LAC), with support and input from the SWCD and the Oregon Department of Environmental Quality (DEQ). The Area Plan is implemented using a combination of outreach, conservation and management activities, compliance with Area Rules, monitoring, evaluation, and adaptive management.

The provisions of the Area Plan do not establish legal requirements or prohibitions (ORS 568.912(1)).

Each Area Plan is accompanied by Area Rules that describe local agricultural water quality regulatory requirements. ODA will exercise its regulatory authority for the prevention and control of water pollution from agricultural activities under the Ag Water Quality Program's general regulations (OAR 603-090-0000 to 603-090-0120) and under the Area Rules for this Management Area (OAR 603-095-2300). The general regulations guide the Ag Water Quality Program, and the Area Rules for the Management Area are the regulations with which landowners must comply. Landowners are encouraged through outreach and education to implement conservation and management activities.

The Area Plan and Area Rules apply to all agricultural activities on non-federal and non-Tribal Trust land within this Management Area including:

- Farms and ranches,
- Rural residential properties grazing animals or raising crops,
- Agricultural lands that lay idle or on which management has been deferred,
- Agricultural activities in urban areas,
- Agricultural activities on land subject to the Forest Practices Act (ORS 527.610).

Water quality on federal land in Oregon is regulated by DEQ and on Tribal Trust land by the respective tribe, with oversight by the United States Environmental Protection Agency (US EPA).

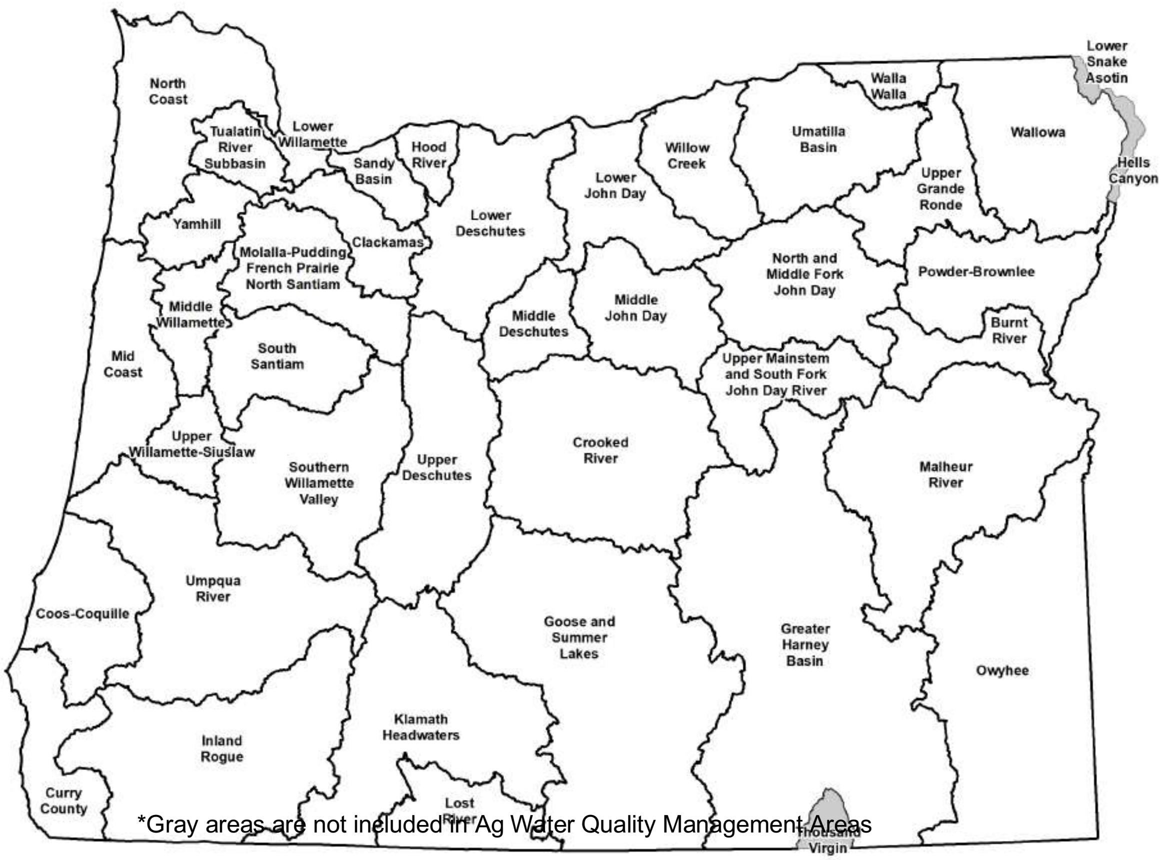
## 1.2 History of the Ag Water Quality Program

In 1993, the Oregon Legislature passed the Agricultural Water Quality Management Act directing ODA to develop plans to prevent and control water pollution from agricultural activities and soil erosion and to achieve water quality standards (ORS 568.900 through ORS 568.933). The Oregon Legislature passed additional legislation in 1995 to clarify that ODA is the lead agency for regulating agriculture with respect to water quality (ORS 561.191).

Between 1997 and 2004, ODA worked with LACs and SWCDs to develop Area Plans and Area Rules in 38 watershed-based Management Areas across Oregon (Figure 1.2). Since 2004, ODA, LACs, SWCDs, and other partners have focused on implementation including:

- Providing education, outreach, and technical assistance to landowners,
- Implementing projects to improve agricultural water quality,
- Investigating complaints of potential violations of Area Rules,
- Conducting biennial reviews of Area Plans and Area Rules,
- Monitoring, evaluation, and adaptive management,
- Developing partnerships with state and federal agencies, tribes, watershed councils, and others.

**Figure 1.2 Map of 38 Agricultural Water Quality Management Areas***



*Gray areas are not included in Ag Water Quality Management Areas

## 1.3 Roles and Responsibilities

### 1.3.1 Oregon Department of Agriculture

ODA is the agency responsible for implementing the Ag Water Quality Program (ORS 568.900 to 568.933, ORS 561.191, OAR 603-090, and OAR 603-095). The Ag Water Quality Program was established to develop and implement water quality management plans for the prevention and control of water pollution from agricultural activities and soil erosion. State and federal laws that drive the establishment of an Area Plan include:

- State water quality standards,
- Load allocations for agricultural or nonpoint source pollution assigned under Total Maximum Daily Loads (TMDLs) issued pursuant to the federal Clean Water Act (CWA), Section 303(d),
- Approved management measures for Coastal Zone Act Reauthorization Amendments (CZARA),
- Agricultural activities detailed in a Groundwater Management Area (GWMA) Action Plan (if DEQ has established a GWMA in the Management Area and an Action Plan has been developed).

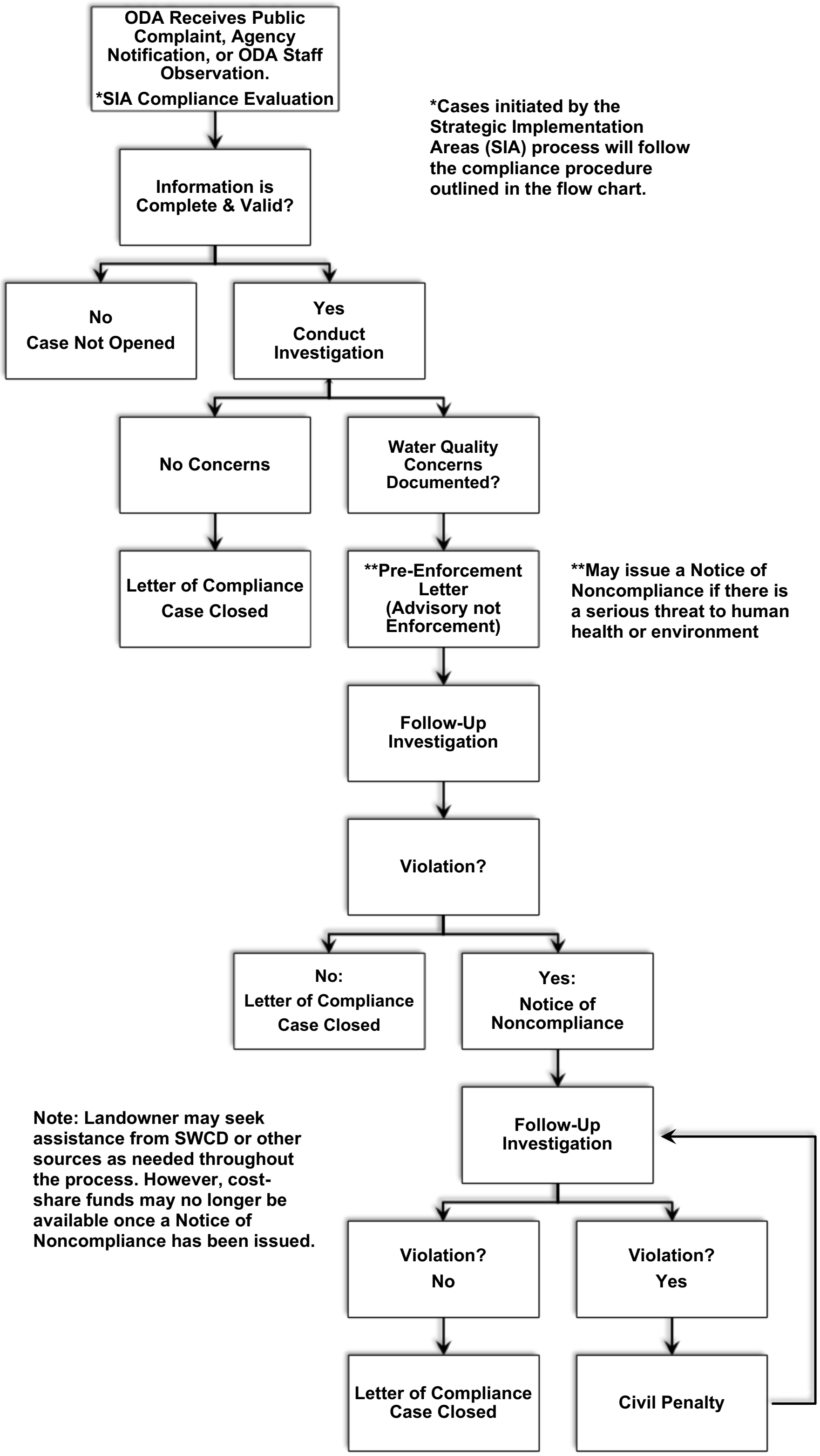
ODA bases Area Plans and Area Rules on scientific information (ORS 568.909). ODA works in partnership with SWCDs, LACs, DEQ, and other partners to implement, evaluate, and update the Area Plans and Area Rules. If and when other governmental policies, programs, or rules conflict with the Area Plan or Area Rules, ODA will consult with the appropriate agencies to resolve the conflict in a reasonable manner.

ODA is responsible for any actions related to enforcement or determination of noncompliance with Area Rules (OAR 603-090-0080 through OAR 603-090-0120). ORS 568.912(1) and ORS 568.912(2) give ODA the authority to adopt rules that require landowners to perform actions necessary to prevent and control pollution from agricultural activities and soil erosion.

The Area Rules are a set of standards that landowners must meet on all agricultural or rural lands. "Landowner" includes any landowner, land occupier, or operator per OAR 603-95-0010(24). All landowners must comply with the Area Rules. ODA will use enforcement where appropriate and necessary to achieve compliance with Area Rules. Figure 1.3.1 outlines ODA's compliance process. ODA will pursue enforcement action only when reasonable attempts at voluntary solutions have failed (OAR 603-090-0000(5)(e)). If a violation is documented, ODA may issue a pre-enforcement notification or an enforcement order such as a Notice of Noncompliance. If a Notice of Noncompliance is issued, ODA will direct the landowner to remedy any conditions through required corrective actions under the provisions of the enforcement procedures outlined in OAR 603-090-060 through OAR 603-090-120. If a landowner does not implement the required corrective actions, ODA may assess civil penalties for continued violation of the Area Rules.

Any member of the public may file a complaint, and any public agency may file a notification of a potential violation of the Area Rules. ODA also may initiate an investigation based on its own observation or from cases initiated through the Strategic Implementation Area process (See Figure 1.3.1).

## Figure 1.3.1 Compliance Flow Chart



### 1.3.2 Local Management Agency

A Local Management Agency (LMA) is an organization designated by ODA to assist with the implementation of an Area Plan (OAR 603-090-0010). The Oregon Legislature intended that SWCDs be LMAs to the fullest extent practical, consistent with the timely and effective implementation of Area Plans (ORS 568.906). SWCDs have a long history of effectively assisting landowners to voluntarily address natural resource concerns. Currently, all LMAs in Oregon are SWCDs.

The day-to-day implementation of the Area Plan is accomplished through an Intergovernmental Grant Agreement between ODA and each SWCD. Every two years, each SWCD submits a scope of work to ODA to receive funding to implement the Area Plan. Each SWCD implements the Area Plan by providing outreach and technical assistance to landowners. SWCDs also work with ODA and the LAC to establish implementation priorities, evaluate progress toward meeting Area Plan goals and objectives, and revise the Area Plan and Area Rules as needed.

### 1.3.3 Local Advisory Committee

For each Management Area, the director of ODA appoints an LAC (OAR 603-090-0020) with up to 12 members. The LAC serves in an advisory role to the director of ODA and to the Board of Agriculture. The role of the LAC is to provide a high level of citizen involvement and support in the development, implementation, and biennial reviews of the Area Plan and Area Rules. The LAC's primary role is to advise ODA and the LMA on local agricultural water quality issues as well as evaluate the progress toward achieving the goals and objectives of the Area Plan. LACs are composed primarily of agricultural landowners in the Management Area and must reflect a balance of affected persons.

The LAC is convened at the time of the biennial review, however, the LAC may meet as frequently as necessary to carry out its responsibilities, which include but are not limited to:

- Participate in the development and subsequent revisions of the Area Plan and Area Rules,
- Recommend strategies necessary to achieve the goals and objectives in the Area Plan,
- Participate in biennial reviews of the progress of implementation of the Area Plan and Area Rules,
- Submit written biennial reports to the Board of Agriculture and the ODA director.

### 1.3.4 Agricultural Landowners

The emphasis of the Area Plan is on voluntary action by landowners to control the factors affecting water quality in the Management Area. In addition, each landowner in the Management Area is required to comply with the Area Rules. To achieve water quality goals or compliance, landowners may need to select and implement an appropriate suite of measures. The actions of each landowner will collectively contribute toward achievement of water quality standards.

Technical assistance, and often financial assistance, is available to landowners who want to work with SWCDs or other local partners, such as watershed councils, to achieve land conditions that contribute to good water quality. Landowners may also choose to improve their land conditions without assistance.

Under the Area Plan and Area Rules, agricultural landowners are not responsible for mitigating or addressing factors that are caused by non-agricultural activities or sources, such as:

- Hot springs, glacial melt water, unusual weather events, and climate change,
- Septic systems and other sources of human waste,
- Public roadways, culverts, roadside ditches, and shoulders,
- Dams, dam removal, hydroelectric plants, and non-agricultural impoundments,
- Housing and other development in agricultural areas,
- Impacts on water quality and streamside vegetation from wildlife such as waterfowl, elk, and feral horses,
- Other circumstances not within the reasonable control of the landowner.

However, agricultural landowners may be responsible for some of these impacts under other legal authorities.

### 1.3.5 Public Participation

ODA, LACs, and LMAs conduct biennial reviews of the Area Plan and Area Rules. Partners, stakeholders, and the general public are invited to participate in the process. Any revisions to the Area Rules will include a formal public comment period and a formal public hearing.

## 1.4 Agricultural Water Quality

The federal CWA directs states to designate beneficial uses related to water quality, decide on parameters to measure to determine whether beneficial uses are being met, and set water quality standards based on the beneficial uses and parameters.

### 1.4.1 Point and Nonpoint Sources of Water Pollution

There are two types of water pollution. Point source water pollution emanates from clearly identifiable discharge points or pipes. Point sources are required to obtain permits that specify their pollutant limits. Agricultural operations regulated as point sources include permitted Confined Animal Feeding Operations (CAFOs), and all permitted CAFOs are subject to ODA's CAFO Program requirements. Irrigation return flow from agricultural fields may drain through a defined outlet, but is exempt under the CWA and does not currently require a permit.

Nonpoint-source water pollution originates from the general landscape and is difficult to trace to a single source. Nonpoint water pollution sources include runoff from agricultural and forest lands, urban and suburban areas, roads, and natural sources. In addition, groundwater can be polluted by nonpoint sources including agricultural amendments (fertilizers and manure).

### 1.4.2 Beneficial Uses and Parameters of Concern

Beneficial uses related to water quality are defined by DEQ for each basin. The most sensitive beneficial uses usually are fish and aquatic life, water contact recreation, and public and private domestic water supply. These uses generally are the first to be impaired because they are affected at lower levels of pollution. While there may not be severe impacts on water quality from a single source or sector, the combined effects from all sources can contribute to the impairment of beneficial uses in the Management Area. Beneficial uses that have the potential to be impaired in this Management Area are summarized in Chapter 2.

Many waterbodies throughout Oregon do not meet state water quality standards. The most common water quality concerns statewide related to agricultural activities are temperature, bacteria, biological criteria, sediment and turbidity, phosphorous, nitrates, algae, pH, dissolved oxygen, harmful algal blooms, pesticides, and mercury. Water quality impairments vary across the state; they are summarized for this Management Area in Chapter 2.

### 1.4.3 Impaired Waterbodies and Total Maximum Daily Loads

Every two years, DEQ is required by the CWA to assess water quality in Oregon, resulting in the "Integrated Report." CWA Section 303(d) requires DEQ to identify waters that do not meet water quality standards. The resulting list is commonly referred to as the "303(d) list" (www.oregon.gov/deq/wq/Pages/WQ-Assessment.aspx). In accordance with the CWA, DEQ must establish TMDLs for pollutants on the 303(d) list. For more information, visit www.oregon.gov/deq/wq/tmdls/Pages/default.aspx.

A TMDL includes an assessment of conditions (based on water quality data, land condition data, and/or computer modeling) and describes a plan to achieve water quality standards. TMDLs specify the daily amount of pollution a waterbody can receive and still meet water quality standards. TMDLs generally apply to an entire basin or subbasin, not just to an individual waterbody on the 303(d) list. In the TMDL, point sources are assigned waste load allocations that are then incorporated into National Pollutant Discharge Elimination System (NPDES) permits. Nonpoint sources (agriculture, forestry, and urban) are assigned a load allocation.

As part of the TMDL process, DEQ identifies Designated Management Agencies and Responsible Persons, which are parties responsible for submitting TMDL implementation plans. TMDLs designate ODA as the lead agency responsible for implementing the TMDL on agricultural lands. ODA uses the applicable Area Plan(s) as the implementation plan for the agricultural component of the TMDL. Biennial reviews and revisions to the Area Plan and Area Rules must address agricultural or nonpoint source load allocations from relevant TMDLs.

The 303(d) list, the TMDLs, and the agricultural load allocations for the TMDLs that apply to this Management Area are summarized in Chapter 2.

### 1.4.4 Oregon Water Pollution Control Law – ORS 468B.025 and 468B.050

In 1995, the Oregon Legislature passed ORS 561.191. This statute states that any program or rules adopted by ODA "shall be designed to assure achievement and maintenance of water quality standards adopted by the Environmental Quality Commission."

To implement the intent of ORS 561.191, ODA incorporated ORS 468B.025 and 468B.050 into all 38 of the Area Rules in Oregon.

ORS 468B.025 (prohibited activities) states that:
"(1) Except as provided in ORS 468B.050 or 468B.053, no person shall:
(a) Cause pollution of any waters of the state or place or cause to be placed any wastes in a location where such wastes are likely to escape or be carried into the waters of the state by any means.
(b) Discharge any wastes into the waters of the state if the discharge reduces the quality of such waters below the water quality standards established by rule for such waters by the Environmental Quality Commission.
(2) No person shall violate the conditions of any waste discharge permit issued under ORS 468B.050."

ORS 468B.050 identifies the conditions when a permit is required. A permit is required for CAFOs that meet minimum criteria for confinement periods and have large animal numbers or have wastewater facilities. The portions of ORS 468B.050 that apply to the Ag Water Quality Program state that:
"(1) Except as provided in ORS 468B.053 or 468B.215, without holding a permit from the Director of the Department of Environmental Quality or the State Department of Agriculture, which permit shall specify applicable effluent limitations, a person may not:
(a) Discharge any wastes into the waters of the state from any industrial or commercial establishment or activity or any disposal system."

Definitions used in ORS 468B.025 and 468B.050:

' "Pollution" or "water pollution" means such alteration of the physical, chemical, or biological properties of any waters of the state, including change in temperature, taste, color, turbidity, silt or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state, which will or tends to, either by itself or in connection with any other substance, create a public nuisance or which will or tends to render such waters harmful, detrimental or injurious to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses or to livestock, wildlife, fish or other aquatic life or the habitat thereof.' (ORS 468B.005(5)).

‘ “Water” or “the waters of the state” include lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Oregon and all other bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters which do not combine or affect a junction with natural surface or underground waters), which are wholly or partially within or bordering the state or within its jurisdiction.’ (ORS 468B.005(10)).

‘ “Wastes” means sewage, industrial wastes, and all other liquid, gaseous, solid, radioactive or other substances, which will or may cause pollution or tend to cause pollution of any waters of the state.’ (ORS 468B.005(9)). Additionally, the definition of “wastes” given in OAR 603-095-0010(53) ‘includes but is not limited to commercial fertilizers, soil amendments, composts, animal wastes, vegetative materials or any other wastes.’

### 1.4.5 Streamside Vegetation and Agricultural Water Quality

Across Oregon, the Ag Water Quality Program emphasizes streamside vegetation protection and enhancement. Streamside vegetation can provide three primary water quality functions: shade to reduce stream temperature warming from solar radiation, streambank stability, and filtration of pollutants. Other water quality functions from streamside vegetation include: water storage in the soil for cooler and later season flows, sediment trapping that can build streambanks and floodplains, narrowing and deepening of channels, and biological uptake of sediment, organic material, nutrients, and pesticides. In addition, streamside vegetation provides habitat for numerous species of fish and wildlife. Streamside vegetation conditions can be monitored to track progress toward achieving conditions that support water quality.

Site-Capable Vegetation

The Ag Water Quality Program uses the concept of “site-capable vegetation” to describe the streamside vegetation that can be expected to grow at a particular site, given natural site factors (e.g., elevation, soils, climate, hydrology, wildlife, fire, floods) and historical and current human influences that are beyond the program’s statutory authority (e.g., channelization, roads, modified flows, previous land management). Site-capable vegetation can be determined for a specific site based on: current streamside vegetation at the site, streamside vegetation at nearby reference sites with similar natural characteristics, Natural Resources Conservation Service (NRCS) soil surveys and ecological site descriptions, and/or local or regional scientific research.

The goal for Oregon’s agricultural landowners is to provide the water quality functions (e.g., shade, streambank stability, and filtration of pollutants) produced by site-capable vegetation along streams on agricultural lands. The Area Rules for each Management Area require that agricultural activities allow for the establishment and growth of streamside vegetation to provide the water quality functions equivalent to what site-capable vegetation would provide.

Occasionally, mature site-capable vegetation such as tall trees may not be needed along narrow streams. For example, shrubs and grass may provide shade, protect streambanks, and filter pollutants. However, on larger streams, mature site-capable vegetation is needed to provide the water quality functions.

In many cases, invasive, non-native plants, such as introduced varieties of blackberry and reed canarygrass, grow in streamside areas. This type of vegetation has established throughout much of Oregon due to historic and human influences and may provide some of the water quality functions of site-capable vegetation. ODA's statutory authority does not require the removal of invasive, non-native plants, however, ODA encourages landowners to remove these plants voluntarily. In addition, the Oregon State Weed Board identifies invasive plants that can impair watersheds. Public and private landowners are responsible for eliminating or intensively controlling noxious weeds, as described in state and local laws. For more information, visit www.oregon.gov/ODA/programs/weeds.

### 1.4.6 Soil Health and Agricultural Water Quality

An increasingly important concept in Oregon and across the United States is soil health. The Ag Water Quality Program promotes soil health to reduce erosion and keep sediment out of surface waters, thereby helping to maintain and improve water quality. Healthy soils have relatively high organic matter and well-formed soil structure. These characteristics may resist erosion and increase water infiltration, leading to less surface runoff and greater groundwater recharge; the resultant groundwater flows in some cases can help moderate stream water temperatures. According to the NRCS and others, there are four Soil Health Principles that together build highly productive and resilient soils: minimize disturbance and maximize cover, continuous living roots, and diversity above and below the surface.

Healthy soils make farms and ranches more resilient. The western United States is experiencing higher temperatures, more weather variability, and greater storm intensity. Forecasts predict continued high-intensity storms in the winter and spring, combined with more frequent droughts, which may result in more erosion, especially on bare ground. Building soil health increases resiliency to extreme weather, protects water quality, and helps keep farms and ranches viable. Incorporating soil health practices can help landowners adapt and reduce risks. For more information, visit www.nrcs.usda.gov/wps/portal/nrcs/detail/or/soils/health.

## 1.5 Other Water Quality Programs

The following programs complement the Ag Water Quality Program and are described here to recognize their link to agricultural lands.

### 1.5.1 Confined Animal Feeding Operation Program

ODA is the lead state agency for the CAFO Program, which was developed to ensure that operators do not contaminate ground or surface water with animal manure or process wastewater. The CAFO Program coordinates with DEQ to issue permits. These permits require the registrant to operate according to a site-specific, ODA-approved, Animal Waste Management Plan that is incorporated into the CAFO permit by reference. For more information, visit oda.direct/CAFO.

### 1.5.2 Groundwater Management Areas

Groundwater Management Areas (GWMAs) are designated by DEQ where groundwater is polluted from, at least in part, nonpoint sources. After designating a GWMA, DEQ forms a local groundwater management committee comprised of affected and interested parties. The committee works with and advises the state agencies that are required to develop an action plan to reduce groundwater contamination in the area.

Oregon DEQ has designated three GWMAs because of elevated nitrate concentrations in groundwater: Lower Umatilla Basin, Northern Malheur County, and Southern Willamette Valley. Each GWMA has a voluntary action plan to reduce nitrates in groundwater. After a scheduled evaluation period, if DEQ determines that voluntary efforts are not effective, mandatory requirements may become necessary.

If there is a GWMA in this Management Area, it is described in Chapter 2.

### 1.5.3 The Oregon Plan for Salmon and Watersheds

In 1997, Oregonians began implementing the Oregon Plan for Salmon and Watersheds, referred to as the Oregon Plan (www.oregon-plan.org). The Oregon Plan seeks to restore native fish populations, improve watershed health, and support communities throughout Oregon. The Oregon Plan has a strong focus on salmonids because of their great cultural, economic, and recreational importance to Oregonians, and because they are important indicators of watershed health. ODA's commitment to the Oregon Plan is to develop and implement Area Plans and Area Rules throughout Oregon.

### 1.5.4 Pesticide Management and Stewardship

ODA's Pesticides Program holds the primary responsibility for registering pesticides and regulating their use in Oregon under the Federal Insecticide Fungicide Rodenticide Act. ODA's Pesticide Program administers regulations relating to pesticide sales, use, and distribution, including pesticide operator and applicator licensing as well as proper application of pesticides, pesticide labeling, and registration.

In 2007, Oregon formed the interagency Water Quality Pesticide Management Team (WQPMT) to expand efforts to improve water quality in Oregon related to pesticide use. The WQPMT facilitates and coordinates activities such as monitoring, analysis and interpretation of data, effective response measures, and management solutions. The WQPMT relies on monitoring data from the Pesticides Stewardship Partnership (PSP) program and other federal, state, and local monitoring programs to assess the possible impact of pesticides on Oregon's water quality. Pesticide detections in Oregon's streams can be addressed through multiple programs and partners, including the PSP.

Through the PSP, state agencies and local partners work together to monitor pesticides in streams and to improve water quality (www.oregon.gov/ODA/programs/Pesticides/Water/Pages/PesticideStewardship.aspx). ODA, DEQ, and Oregon State University Extension Service work with landowners, SWCDs, watershed councils, and other local partners to voluntarily reduce pesticide levels while improving water quality and crop management. Since 2000, the PSPs have made noteworthy progress in reducing pesticide concentrations and detections.

ODA led the development and implementation of a Pesticides Management Plan (PMP) for the state of Oregon (www.oregon.gov/ODA/programs/Pesticides/water/pages/AboutWaterPesticides.aspx). The PMP, completed in 2011, strives to protect drinking water supplies and the environment from pesticide contamination, while recognizing the important role that pesticides have in maintaining a strong state economy, managing natural resources, and preventing human disease. By managing the pesticides that are approved for use by the US EPA and Oregon in agricultural and non-agricultural settings, the PMP sets forth a process for preventing and responding to pesticide detections in Oregon's ground and surface water.

### 1.5.5 Drinking Water Source Protection

Oregon implements its drinking water protection program through a partnership between DEQ and the Oregon Health Authority (OHA). The program provides individuals and communities with information on how to protect the quality of Oregon's drinking water. DEQ and OHA encourage preventive management strategies to ensure that all public drinking water resources are kept safe from current and future contamination. For more information, visit www.oregon.gov/deq/wq/programs/Pages/dwp.aspx.

## 1.6 Partner Agencies and Organizations

### 1.6.1 Oregon Department of Environmental Quality

The US EPA delegated authority to DEQ to implement the federal CWA in Oregon. DEQ is the lead state agency with overall authority to implement the CWA in Oregon. DEQ works with other state agencies, including ODA and the Oregon Department of Forestry (ODF), to meet the requirements of the CWA. DEQ sets water quality standards and develops TMDLs for impaired waterbodies, which ultimately are approved or disapproved by the US EPA. In addition, DEQ develops and coordinates programs to address water quality including NPDES permits for point sources, the CWA Section 319 grant program, the Source Water Protection Program (in partnership with OHA), the CWA Section 401 Water Quality Certification, and Oregon's Groundwater Management Program. DEQ also coordinates with ODA to help ensure successful implementation of Area Plans.

A Memorandum of Agreement between DEQ and ODA recognizes that ODA is the state agency responsible for implementing the Ag Water Quality Program. ODA and DEQ updated the Memorandum of

Agreement in 2012 and reviewed and confirmed it in 2018 (http://www.oregon.gov/ODA/shared/Documents/Publications/NaturalResources/DEQODAmoa.pdf).

The Environmental Quality Commission, which serves as DEQ's policy and rulemaking board, may petition ODA for a review of part or all of any Area Plan or Area Rules. The petition must allege, with reasonable specificity, that the Area Plan or Area Rules are not adequate to achieve applicable state and federal water quality standards (ORS 568.930(3)(a)).

### 1.6.2 Other Partners

ODA and SWCDs work in close partnership with local, state, and federal agencies and other organizations, including: DEQ (as described above), the United States Department of Agriculture (USDA) NRCS and Farm Service Agency, watershed councils, Oregon State University Agricultural Experiment Stations and Extension Service, tribes, livestock and commodity organizations, conservation organizations, and local businesses. As resources allow, SWCDs and local partners provide technical, financial, and educational assistance to individual landowners for the design, installation, and maintenance of effective management strategies to prevent and control agricultural water pollution and to achieve water quality goals.

## 1.7 Measuring Progress

Agricultural landowners have been implementing conservation projects and management activities throughout Oregon to improve water quality for many years. However, it has been challenging for ODA, SWCDs, and LACs to measure progress toward improved water quality. ODA is working with SWCDs, LACs, and other partners to develop and implement strategies that will produce measurable outcomes. ODA is also working with partners to develop monitoring methods to document progress.

### 1.7.1 Measurable Objectives

A measurable objective is a numeric long-term desired outcome to achieve by a specified date. Milestones are the interim steps needed to make progress toward the measurable objective and consist of numeric short-term targets to reach by specific dates. Together, the milestones define the timeline and progress needed to achieve the measurable objective.

The Ag Water Quality Program is working throughout Oregon with SWCDs and LACs toward establishing long-term measurable objectives to achieve desired conditions. ODA, the LAC, and the SWCD will establish measurable objectives and associated milestones for each Area Plan. Many of these measurable objectives relate to land conditions and primarily are developed for focused work in small geographic areas (section 1.7.3). ODA's longer-term goal is to develop measurable objectives, milestones, and monitoring methods at the Management Area scale.

The State of Oregon continues to improve its ability to use remote-sensing technology to measure current streamside vegetation conditions and compare these to the conditions needed to meet stream shade targets. As the State's use of this technology moves forward, ODA will use the information to help LACs and LMAs set measurable objectives for streamside vegetation. These measurable objectives will be achieved through implementing the Area Plan, with an emphasis on voluntary incentive programs.

At each biennial review, ODA and its partners will evaluate progress toward measurable objectives and milestone(s) and why they were or were not achieved. ODA, the LAC, and LMA will evaluate whether changes are needed to continue making progress toward the measurable objective(s) and will revise strategies to address obstacles and challenges.

The measurable objective(s) and associated milestone(s) within the Management Area are in Chapter 3 and progress toward achieving the measurable objective(s) and milestone(s) is summarized in Chapter 4.

### 1.7.2 Land Conditions and Water Quality

Land conditions can serve as useful surrogates (indicators) for water quality parameters. For example, because shade blocks solar radiation from warming the stream, streamside vegetation, or its associated shade, generally is used as a surrogate for water temperature. In some cases, sediment can be used as a surrogate for pesticides or phosphorus, which often adhere to sediment particles.

The Ag Water Quality Program focuses on land conditions, in addition to water quality data, for several reasons:

- Landowners can see land conditions and have direct control over them,
- Improved land conditions can be documented immediately,
- Water quality impairments from agricultural activities are primarily due to changes in land conditions and management activities,
- It can be difficult to separate agriculture's influence on water quality from other land uses,
- There is generally a lag time between changes on the landscape and the resulting improvements in water quality,
- Extensive monitoring of water quality would be needed to evaluate progress, which would be expensive and may not demonstrate improvements in the short term.

Water quality monitoring data will help ODA and partners to measure progress or identify problem areas in implementing Area Plans. However, as described above, water quality monitoring may be slower to document changes than land condition monitoring.

### 1.7.3 Focused Implementation in Small Geographic Areas

Focus Areas

A Focus Area is a small watershed with water quality concerns associated with agriculture. The Focus Area process is SWCD-led, with ODA oversight. The SWCD delivers systematic, concentrated outreach and technical assistance. A key component is measuring conditions before and after implementation to document the progress made with available resources. The Focus Area approach is consistent with other agencies' and organizations' efforts to work proactively in small watersheds.

Focus Areas have the following advantages: a proactive approach that addresses the most significant water quality concerns, multiple partners that coordinate and align technical and financial resources, a higher density of projects that may lead to increased connectivity of projects, and a more effective and efficient use of limited resources.

The current Focus Area for this Management Area is described in Chapter 3.

<u>Strategic Implementation Areas</u>

Strategic Implementation Areas (SIAs) are small watersheds selected by ODA, in consultation with partners, based on a statewide review of water quality data and other available information. ODA conducts an evaluation of likely compliance with Area Rules and contacts landowners with the results and next steps. The Oregon Watershed Enhancement Board (OWEB) and other partners make funding and technical assistance available to support conservation and restoration projects. These efforts should result in greater ecological benefit than relying solely on compliance and enforcement. Landowners have the option of working with the SWCD or other partners to voluntarily address water quality concerns. ODA follows up, as needed, to enforce the Area Rules. Finally, ODA completes a post-evaluation to document progress in the SIA.

Any SIAs in this Management Area are described in Chapter 3.

## 1.8 Progress and Adaptive Management

### 1.8.1 Biennial Reviews

The ODA, LAC, LMA, and partners evaluate progress of Area Plan implementation through the biennial review process. At each biennial review, they discuss: 1) progress toward meeting measurable objectives and implementing strategies, 2) local monitoring data from other agencies and organizations, including agricultural land conditions and water quality, and 3) ODA compliance activities. As a result of these discussions, ODA and partners revise implementation strategies and measurable objectives in Chapter 3 as needed.

ODA provides information from the Oregon Watershed Restoration Inventory (OWRI) on restoration project funding and accomplishments at biennial reviews and uses the information for statewide reporting. The majority of OWRI entries represent voluntary actions of private landowners who have worked in partnership with federal, state, and local groups to improve aquatic habitat and water quality conditions. OWRI is the single largest restoration information database in the western United States. For more information, visit www.oregon.gov/oweb/data-reporting/Pages/owri.aspx.

### 1.8.2 Water Quality Monitoring

In addition to monitoring landscape conditions, ODA relies on water quality monitoring data where available. These data may be provided by other state or federal agencies or local entities; ODA seldom collects water quality samples outside of compliance cases.

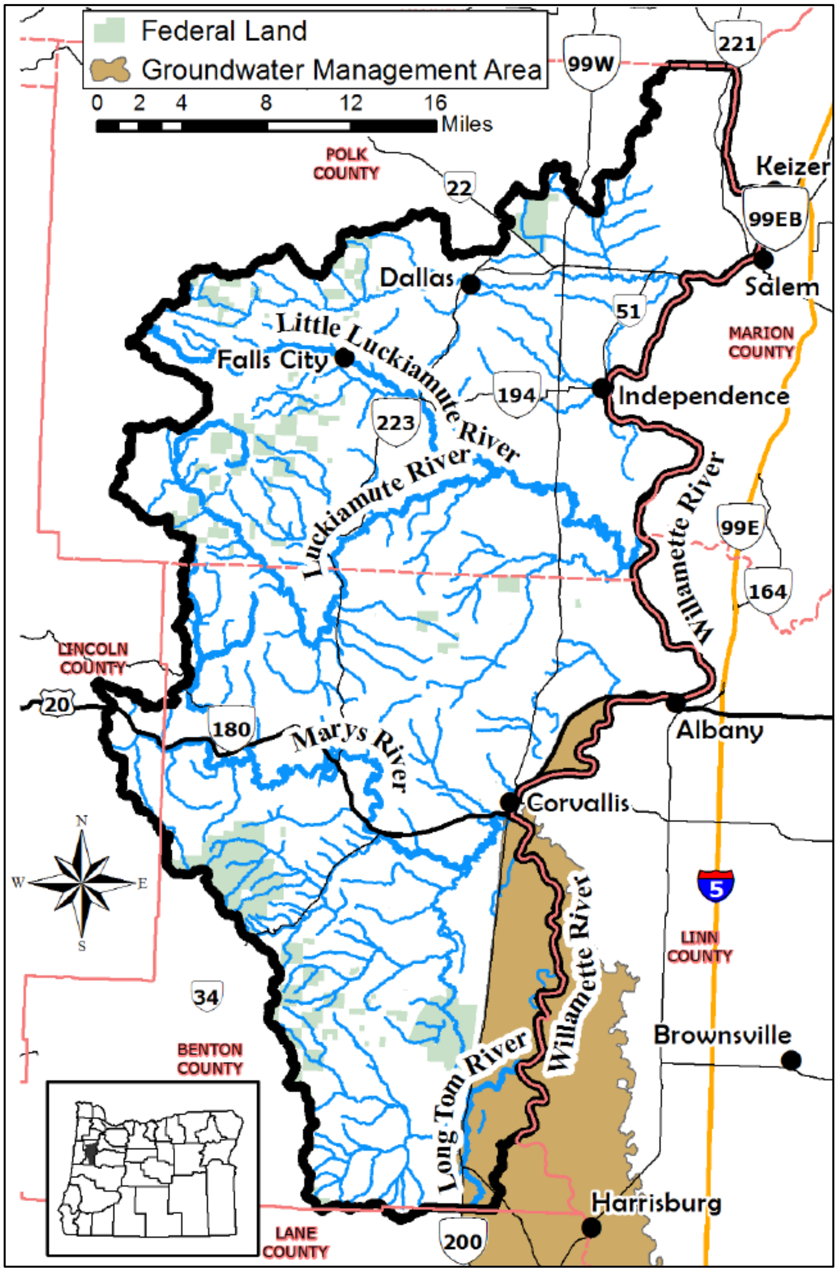
As part of monitoring water quality status and trends, DEQ regularly collects water samples every other month throughout the year at over 130 sites on more than 50 rivers and streams across the state. Sites are located across the major land uses (forestry, agriculture, rural residential, and urban/suburban). Parameters measured include alkalinity, biochemical oxygen demand (BOD), chlorophyll a, specific conductance, dissolved oxygen (DO), DO percent saturation, bacteria (*E. coli)*, ammonia, nitrate and nitrite, pH, total phosphorus, total solids, temperature, and turbidity.

DEQ provides status and trends reports for selected parameters in relation to water quality standards. ODA will continue to work with DEQ to summarize the data results and how they apply to agricultural activities.

Water quality monitoring efforts in this Management Area are described in Chapter 3, and the data are summarized in Chapter 4.

# Chapter 2: Local Background

**Figure 2. Management Area**




The Management Area (Figure 2) includes the Ash, Dixon, Frazier, Glenn, Luckiamute, Marys, Rickreall, and Spring Valley watersheds, as well as several small streams that drain directly into the Willamette River. A small part of the northern Long Tom watershed is also within the Management Area. The Management Area includes much of Benton and Polk counties and a small portion of east Lincoln County. Included in the Management Area are the communities of Adair Village, Airlie, Buena Vista, Blodgett, Corvallis, Dallas, Eola, Falls City, Independence, Kings Valley, Monmouth, Monroe, North Albany, Philomath, Rickreall, and West Salem.

Boundaries of the Management Area are the crest of the Coast Range on the west, the Willamette River on the east (approximate river miles 75-160), the Yamhill River watershed boundary to the north, and the Lane-Benton county line (approximately) to the south.

## 2.1 Local Roles

### 2.1.1 Local Advisory Committee

The Area Plan was developed with the assistance of the LAC. The LAC was formed to assist with the development of the Area Plan and Area Rules and with subsequent biennial reviews. Table 2.1.1 lists the current members of the LAC.

**Table 2.1.1 Current LAC members**

| Name | Geographic Representation | Agricultural Product or Interest Representation |
|---|---|---|
| Eric Horning (Chair) | Monroe | Row crops, grass seed, cattle, hazelnuts |
| Frank Bricker | Albany | Rye grass, wheat |
| Madeline Hall | Monmouth | Sheep, eggs |
| Frank Nusbaum | Monroe | Grass seed, Christmas trees, beef cattle, woodland |
| Larry Venell | Corvallis | Grass seed, row crops |
| Scott Setniker | Independence | Irrigated crops |
| Mark Taratoot | Corvallis | City of Corvallis |
| George Ice | Monroe | Hybrid poplar, timber |
| Bogdan Caceu | Dallas | Olives |
| Jock Dalton | Dallas | Woodland, rock quarry, Polk SWCD |
| Vacant | | |
| Vacant | | |

### 2.1.2 Local Management Agency

Implementation of the Area Plan is accomplished through Intergovernmental Grant Agreements between ODA and the Benton and Polk SWCDs. These Intergovernmental Grant Agreements define the SWCDs as the LMAs for implementation of the Ag Water Quality Program in this Management Area. The SWCDs were also involved in development of the Area Plan and Area Rules.

The LMAs implement the Area Plan by conducting the activities detailed in Chapter 3, which are intended to achieve the goals and objectives of the Area Plan.

## 2.2 Area Plan and Area Rules: Development and History

The director of ODA initially approved the Area Plan and Area Rules in 2002. Since approval, the LAC has met biennially to review the Area Plan and Area Rules. The biennial review process includes an assessment of progress toward achieving the goals and objectives in the Area Plan.

## 2.3 Geographical and Physical Setting

**Physical Features**

The Luckiamute River, Marys River, and Rickreall Creek are the largest drainages in the Management Area (Tables 2.3.1 and 2.3.2). Each stream's headwaters are in the Coast Range and are relatively fast flowing. These streams flow down steep gradients until they reach the Willamette Valley floor. The streams then meander slowly through agricultural, rural, and urban lands, eventually emptying into the Willamette River.

***Marys River***

The Marys River mainstem flows nearly twenty miles through the Coast Range and foothills before reaching the Willamette Valley floor near Philomath. It then passes through developed lands, including parks, industrial areas, agricultural areas, and downtown Corvallis, where it reaches its confluence with the Willamette River.

A major tributary, Muddy Creek, also originates in the Coast Range. Headwater streams flow for a few miles through mountain forestlands, then through rural residential areas, pasture lands, Christmas tree farms, and mixed coniferous and deciduous woodlands in the foothills.  On the valley floor, Muddy Creek flows primarily through agricultural areas and Finley National Wildlife Refuge.

***Luckiamute River***

The Luckiamute River flows southeast through the Coast Range for approximately fifteen miles. Most of its headwater streams are deeply incised with narrow ridge-tops and floodplains. The river then flows northeast through Kings Valley, where its gradient flattens significantly, and passes through pastures, cropland and small woodlands. The river flows southeast after its intersection with Highway 99W and after passing through more agricultural lands and wetlands, empties into the Willamette River north of Albany.

Major tributaries include the Little Luckiamute River and Soap Creek. The Little Luckiamute River flows down a steep gradient through the Coast Range. It then reaches Falls City and its gradient flattens as it flows through the Coast Range foothills. Its confluence with the Luckiamute River is southwest of Monmouth. Soap Creek drains much of McDonald and Dunn forests, as well as Soap Creek Ranch, then flows through more agricultural lands and reaches the Luckiamute near its confluence with the Willamette River.

***Long Tom River***
Part of the lower Long Tom River watershed, the area approximately north of the Lane-Benton County line, is within the Management Area. This portion of the river has a very flat gradient and meanders across a broad floodplain. Two small tributaries, Miller Creek and Shafer Creek, join the mainstem in this area. This part of the watershed is mostly agricultural land.

***Rickreall Creek***
Rickreall Creek's headwaters are on Laurel Mountain in the Coast Range and 3,600 feet above sea level. The Creek flows northeast, flattening just west of Dallas and meandering toward its confluence with the Willamette River. Most of the watershed west of Dallas is commercial timber and much of the land east of Dallas is in agriculture. Baskett Slough Creek is a major tributary that flows through agricultural lands and a large wildlife refuge before reaching Rickreall Creek near its confluence with the Willamette River.

***Small Willamette River Tributary Streams***
Several smaller streams within the Management Area flow directly into the Willamette River, including Ash Creek, Glenn Creek, Frazier Creek, Dixon Creek, and Spring Valley Creek. Most of these streams drain agricultural, rural residential, and urban lands. The north, middle, and south forks of Ash Creek flow just north and south of Monmouth. The mainstem flows through Independence and into the Willamette River. Glenn Creek, and its tributary Gibson Creek, drain through West Salem and adjacent agricultural and rural residential areas. Frazier Creek drains part of the McDonald research forest, rural residential areas north of Corvallis, and agricultural bottomlands along the Willamette River. Dixon Creek is almost entirely an urban stream that drains through most of north Corvallis.

**Table 2.3.1. Average Gradients of the Marys, Luckiamute, and Rickreall mainstems in the Coast Range, foothills, and Willamette Valley (Oregon Water Resources Board, 1963).**

| Water Body | Gradient (feet/mile) | | |
|---|---|---|---|
| | Coast Range | Foothills | Willamette Valley |
| Luckiamute River | 340 | 56 | 5 |
| Marys River | N/A | 14 | 6 |
| Rickreall Creek | 490 | 55 | 11 |

**Table 2.3.2. Acreages and major tributaries of watersheds in the Management Area (Benton and Polk County Geographic Information Systems Departments, 2001).**

| Watershed | Mainstem Length (mi) | Area (acres) | Seasonality | Major tributaries |
|---|---|---|---|---|
| Marys River | 40 | 191,360 | Perennial | Newton Creek, Blakesley Creek, Oak/Squaw Creek, Tumtum River, Horton Creek, Wren Creek, Shotpouch Creek, Bark Creek, Laskey Creek, Mulkey Creek, LaBare Creek, Oleman Creek, Norton Creek, Greasy Creek (includes Rock Creek), Woods Creek, and Muddy Creek (includes North Fork, Middle Fork, South Fork, Evergreen Creek, Bull Run |

| | | | | |
|---|---|---|---|---|
| | | | | Creek, Beaver Creek, Reese/Oliver Creek, Gray Creek, and Hammer Creek) |
| Luckiamute River | 58 | 198,400 | Perennial | Little Luckiamute River (includes Cooper Creek, Fern Creek and Teal Creek), Jont Creek, Dry Creek, McTimmonds Creek, Pedee Creek, Ritner Creek, Bump Creek, Berry Creek, Maxfield Creek, Price Creek, Plunkett Creek, Vincent Creek, Soap Creek |
| Rickreall Creek | 32 | 64,230 | Perennial | Baskett Slough Creek (includes Goodwin Branch, McNary Branch, Mud Slough), Hayden Slough (Includes Oak Point Creek) |
| Long Tom River | 9 | 5,300 | Perennial | Shafer Creek, Miller Creek |
| Ash Creek | 8 | 34,110 | Perennial | North Fork, Middle Fork, South Fork |
| Glenn Creek | 7 | 7,620 | Perennial | Gibson Creek |
| Spring Valley Creek | 9 | 16,194 | Perennial | Walker Creek, King Creek |
| Frazier Creek | 7 | 24,140 | Perennial | Bowers Slough, Jackson Creek |
| Dixon Creek | 4 | 2,632 | Perennial | |
| "North Albany" Streams | N/A | 5,055 | Intermittent | N/A |

**Geology and Soils**

***Coast Range***

The Coast Range was created by compression and uplift as the Juan de Fuca, Kula, and Farallon plates subducted under the North American plate along the Pacific coast. The mountains are composed primarily of sedimentary rocks such as shale, sandstone, and siltstone, as well as some volcanic material.

Soils in the Coast Range Mountains formed primarily from sedimentary material as well as some volcanic material. They are relatively unstable and subject to puddling and active erosion. Soils in the Coast Range foothills formed from alluvial and colluvial deposits, which have been weathered extensively. They are less subject to slumping than soils in steeper areas.

***Willamette Valley***

Willamette Valley lowlands are composed of alluvial material deposited during the Missoula floods and by the rivers and their tributaries. The alluvial material is underlain by sedimentary and volcanic formations, deposited through erosion as uplift processes created the Coast Range. Depending on the composition of the deposited material, soils in bottomlands, and terraces range from excessively drained loams and well-drained gravelly loams to poorly drained silty clay loams and silt loams. (Knezevich 1975; Knezevich 1982)

## Climate

Like most of Western Oregon, the climate of the Management Area is relatively mild throughout the year. Temperatures rarely fall below zero during the winter and exceed 90°F for only a few days during the summer each year (Taylor and Hannan, 1999). Average summer temperatures range from the low 50s to low 80s, and average temperatures in the winter are generally between the low 30s to about 40°F. The mean growing season (the 32°F frost-free period) is 150 to 180 days on the Valley floor to 110 to 130 days in the foothills. (Taylor and Hannan, 1999)

Precipitation in the Management Area ranges from approximately 40 to 45 inches on the Valley floor to 60 to 120 inches in the foothills and Coast Range. Approximately 70 percent of the precipitation falls during November through March. Less than five percent of the precipitation occurs from June through August (Knezevich 1975; Knezevich 1982). Most of the precipitation is in the form of rain on the Willamette Valley floor. The amount of snowfall increases with elevation.

## Land Use/Land Ownership

### *Agriculture and Forestry*

Forestry and agriculture are the predominant land uses in the area. Most of the approximately 277,500 acres of forestlands in the area are located in the Coast Range and foothills (Benton and Polk County GIS, 2001). Major forest landowners and managers include the Bureau of Land Management, the U.S. Forest Service, Weyerhaeuser, Starker Forests, Georgia Pacific, Forest Capital, and numerous individual private forest landowners.

Forest management on both federal and private lands has changed significantly in the past few decades. In federal forests, management objectives have diversified in recent years, and fish and wildlife habitat has increased in priority. While timber harvest still occurs, there is less emphasis on timber production. Private landowners, from industrial timber companies to small woodland owners, are not only regulated by the Forest Practices Act but have also made voluntary efforts to manage forestlands for multiple objectives including water quality.

Agricultural lands are scattered throughout the foothills and cover much of the Valley floor. They account for approximately 227,000 acres in the Management Area (Benton and Polk County GIS, 2001). A wide variety of commodities can be grown in the area's highly productive agricultural soils.

Major crops in the area include grass seed, small grains, fruit and nut orchards, row crops such as sweet corn, broccoli and snap beans, hay, cattle, sheep, nursery products, wine grapes, Christmas trees, and dairy products. Along the Marys River mainstem, most of the agricultural land is in pasture or hay land. Sheep, cattle, and horses are pastured on ranches and small hobby farms. In the Muddy Creek watershed, row crops, grass seed, Christmas trees, and orchards are some of the main crops. In the Luckiamute watershed, agricultural land in the Coast Range foothills is mostly pasture and hay land. From Kings Valley eastward, grass seed, Christmas trees, nursery crops, vineyards, meadowfoam, row crops, livestock, and hay are predominant. Above Dallas, agricultural land in the Rickreall Creek watershed is mostly pasture and hay land. Below Dallas, major crops include grass seed, row crops, orchards and vineyards, small grains, dairy, and nursery stock.

***Industrial***

Industrial sites, totaling approximately 1,900 acres, are located throughout the Management Area, mostly near urban areas or in rural areas on the Willamette Valley floor (Benton and Polk County GIS, 2001). Major industrial sites include lumber mills, waste disposal sites, food processing businesses, and high-tech equipment production facilities such as Hewlett-Packard. Many of these companies, including Georgia Pacific, Smurfit Newsprint, and Valley landfills have permits for wastewater discharge in or near waterbodies.

***Roads***

There is an extensive network of roads throughout the Management Area, including highways, city and county roads, private residential, forest, and farm roads, and roads on federal and state lands. Major highways in the area include OR 99W, OR 221, OR 22, OR 51, US 20, and OR 34.

***Natural Areas***

There are several wildlife areas in the Management Area. The Oregon Department of Fish and Wildlife manages E.E. Wilson Wildlife Area near Adair Village. The Wildlife Area provides recreational opportunities such as hunting, fishing, and wildlife viewing, and also provides habitat for migratory waterfowl, songbirds, reptiles, amphibians, and fish. The two U.S. Fish and Wildlife Service refuges in the area, Baskett Slough and William Finley, are located in agricultural areas near Dallas and Monroe, respectively. Besides the seasonal wetlands that host migratory waterfowl, habitats at the refuges include oak savannah, ash swales, and mixed oak and maple woodland.

Primary management objectives of the wildlife areas include the protection of dusky Canada geese and other waterfowl. Canada geese populations in the Willamette Valley are estimated to be five to ten times higher than historical levels (Budeau, 2001). The water quality impacts of these population increases are unknown; however, recent studies indicated that goose droppings contain high concentrations of fecal bacteria. The U.S. Department of Agriculture's Wildlife Research Center initiated a Canada Goose Disease Surveillance Study in 2006 that will evaluate goose droppings from sites throughout the United States, including two sites in Oregon.

Outside of designated wildlife areas, there are many other natural areas in the Management Area on public and private lands. Many private landowners in the area have maintained or restored riparian areas and seasonal wetlands on their property.

***Urban***

North Albany, Corvallis, and West Salem are the largest urban areas in the Management Area. There are also several smaller cities and rural communities, including Adair Village, Airlie, Alpine, Dallas, Philomath, Maple Grove, Monroe, Falls City, Monmouth, Rickreall, Independence, Kings Valley, Wren, Pedee, and

Suver. The 2013 population of Polk and Benton counties is 165,790 (Center for Population Studies, 2013). Parts of these counties fall outside of the Management Area but the bulk of the population from these counties falls within the Management Area.

Wastewater treatment plants exist for most incorporated cities within the area. Treatment plants for the cities of Falls City, Philomath, Independence, Monmouth, and Dallas discharge in or near the Little Luckiamute River, Marys River, Willamette River, Ash Creek, and Rickreall Creek, respectively. In addition, the Corvallis wastewater treatment plant discharges into the Willamette River.

***Commercial***

Most commercial lands within the Management Area are within urban areas. There are a few unincorporated commercial lands in Polk County along Highway 22 near Grand Ronde, Rickreall, Eola, and Highway 99W near Lewisburg.

***Rural Residential***

Rural residential lands in the area total approximately 27,930 acres (Benton and Polk county GIS, 2001). Many rural residential lands are in transitional areas between farm and forestlands in the foothills of the Coast Range or in agricultural areas.

**Water Resources**

*Water Availability*

Like most streams with headwaters in the Coast Range, rainfall provides much of the surface water supply in Management Area watersheds. Seasonal fluctuations in stream flow are much more pronounced in the Luckiamute, Marys, and Rickreall Creek watersheds than in streams with headwaters in the Cascade Mountains because snowmelt supplies a relatively small portion of the stream flow. For example, flow in the Luckiamute River during the highest flow month is 54 times the flow during the lowest flow month, much "flashier" than the high-flow, low-flow difference of just five times in the McKenzie River. Historical and current conditions for streamflow for streams in the Management Area can be found at https://waterdata.usgs.

Groundwater resources in much of the area are relatively meager because there are few porous, permeable geologic formations to absorb and transmit water, except on the Valley floor near the Willamette River. Alluvial material in the valleys and along major streams and rivers are the most abundant source of groundwater; however, on the east foothills of the Coast Range yields are still relatively low because the material is of the same geologic origin as material throughout the Coast Range.

Consumptive uses of water in the Management Area include irrigation, domestic use, municipal use, and commercial use. Non-consumptive uses include recreation, power generation, and fish and wildlife habitat. Sources of appropriated water are reservoirs, surface water, and groundwater.

Drinking water is an important beneficial use in the Management Area. Numerous active public water systems serve approximately 166,000 people. Seven cities withdraw drinking water from waterways. The city of Dallas withdraws drinking water from Mercer Reservoir on Rickreall Creek. Philomath receives its drinking water from the Marys River; and Corvallis, Wilsonville, and Adair Village receive either part or all of their drinking water from the Willamette River. Monroe uses surface water from the Long Tom River, and Falls City receives surface water from Glaze and Teal creeks. Keizer, Rickreall, Monmouth, and Independence all use groundwater as their drinking water source. The Luckiamute Domestic Water Cooperative provides groundwater for many rural residents in southern Polk County. In addition, many entities, such as non-municipal community water systems, schools, camps, industry, and parks rely on groundwater wells. Rural residents mainly rely on individual private groundwater wells as their drinking water source. A complete list of public water systems within the Management Area can be found on DEQ's Drinking Water Protection program web page at https://www.oregon.gov/deq/wq/programs/Pages/DWP-Maps.aspx.

## 2.4 Agricultural Water Quality

### 2.4.1 Water Quality Issues

The DEQ evaluates data from its own monitoring program, the Oregon Department of Fish and Wildlife, city of Corvallis, and other partners to determine the listing status of stream segments in the Management Area. Several stream segments were determined to exceed state standards for temperature, bacteria (*E. coli)*, dissolved oxygen, biological criteria, mercury and other toxics (legacy pesticides, dieldrin, copper, and lead).

Water quality concerns occur seasonally throughout the Management Area. Temperature standard violations in Rickreall Creek, Marys River, and Long Tom River occur during the summer months and on the mainstem Willamette River. In addition, there are temperature violations year-round on the following creeks; Little Luckiamute, Little Muddy Creek, Luckiamute River, Maxfield Creek, McTimmonds Creek, Oak Creek, Pedee Creek, Ritner Creek, and Soap Creek. Bacteria problems have been identified during the fall, winter, and spring, when storm-related runoff and discharges are most likely to occur from a variety of sources in Oak Creek and the Luckiamute, Marys, and Long Tom rivers. Dissolved oxygen concerns occur in Glenn, Gibson, and Soap creeks and in the Marys River. Mercury concern is a Willamette Basin-wide parameter because of potential bioaccumulation and human consumption of fish. Some seasonal variation in water quality likely occurred before European settlement of the area because of seasonal fluctuations in stream flow and other factors. Nutrients from manure or fertilizer can contribute to harmful algal blooms in surface waters.

Nitrate and bacteria (particularly *E.* coli) are important groundwater quality concern in the Management Area, especially in aquifers that serve as drinking water sources. Nitrate levels are especially elevated in the Southern Willamette Valley Groundwater Management Area (Figure 2.4.1.5). Nitrate levels of up to three parts-per-million (ppm) in groundwater may be naturally-occurring and are considered to be safe for consumption. However, high levels of nitrate may present a serious health concern for infants, pregnant or nursing women, and other sensitive populations.

#### 2.4.1.1 Beneficial Uses

Beneficial uses impacted by these water quality concerns include fish and aquatic life, water contact recreation, fish consumption and human health concerns for drinking water.

*Temperature*
DEQ developed the temperature TMDL to protect salmonid spawning in the fall, migration, and rearing year-round as the most sensitive beneficial uses in the Upper and Middle Willamette Subbasin. On agricultural lands, absence of streamside vegetation, water withdrawals, and land management that leads to widened stream channels contribute to elevated stream temperatures. DEQ has identified the existing nonpoint source pollution sources as solar heating of the Management Area's waterways due to a lack of riparian vegetation from forestry, agriculture, rural-residential, and urban activities.

*Bacteria*
DEQ has set the bacteria TMDL to protect human water contact recreation (risk of infection and disease to people who come in contact with fresh water while fishing, swimming, or boating) as the most sensitive beneficial use. Bacteria in waterways and groundwater also pose a risk to drinking water sources. On agricultural lands, *E. coli* generally comes from livestock waste, either deposited directly into waterways or carried to waterways via runoff and soil erosion. Runoff and soil erosion from agricultural lands may also carry bacteria from other sources. There are numerous sources of bacteria in streams, including humans (from recreation or failing septic systems) and wildlife.

*Mercury*
Human fish consumption is the most sensitive beneficial use for which DEQ has set the Willamette mercury TMDL. Primary sources of mercury include air deposition from national and international sources, discharge from specific legacy mining sites, and erosion of soils containing mercury. In addition, some fertilizers have minimal amounts of mercury in them. Mercury contributions from agricultural lands originate primarily through soil erosion and transport. The goal is to lower mercury levels in rivers, lakes, and streams throughout the basin, allowing for the safe eating of fish and shellfish.

*Dissolved Oxygen*
Based on the 303(d) listing for dissolved oxygen, a TMDL was established for dissolved oxygen in December 1993 for Rickreall Creek. Dissolved oxygen levels were below state standards in Rickreall Creek downstream of the Dallas Seweage Treatment Plant and did not protect beneficial uses for resident aquatic life or steelhead. In the TMDL, the city of Dallas Sewage Treatment Plant received a waste load allocation that, if met, would likely eliminate dissolved oxygen standard violations in Rickreall Creek. DEQ has identified multiple nonpoint sources of pollutants, including storm water discharges, agricultural run-off, and insufficient riparian vegetation.

### 2.4.1.2 WQ Parameters and 303(d) list

The DEQ evaluates data from its own monitoring program and multiple partners to determine the listing status of stream segments in the Management Area. Several stream segments exceed state standards for temperature, bacteria (*E. coli)*, dissolved oxygen, biological criteria, mercury and other toxics (legacy pesticides, dieledrin, copper, and lead).

An update to the 2012 Integrated Report is currently going through final review at DEQ. Until final EPA approval, the most current, active Integrated Report is the 2012 version. Both reports can be found at http://www.oregon.gov/deq/wq/Pages/2012-Integrated-Report.aspx.

### 2.4.1.3 TMDLs and Agricultural Load Allocations

DEQ completed the Willamette Basin TMDLs for temperature, bacteria, and mercury, and US EPA approved them in September of 2006. These TMDLs include temperature, bacteria, and mercury loads specific to the Upper and Middle Willamette Subbasin. The Management Area falls within both of these subbasins. In addition, DEQ defined a TMDL for dissolved oxygen for Rickreall Creek in 1994. The load allocations and reductions needed to meet water quality standards and protect beneficial uses are summarized in Table 2.4.1.3.

**Table 2.4.1.3: Nonpoint Source Agricultural TMDL Load Allocations/Reductions**

| TMDL | Basin/Watershed | Allocations |
|---|---|---|
| Bacteria *(E. coli)* | Middle and Upper Subbasins Mainstem Willamette, including: Glenn Creek, Luckiamute River, Rickreall Creek, Spring Valley, Long Tom, Marys River and their tributaries | Bacteria load reductions as high as 84% are needed to meet the water quality criteria in the Upper Willamette overall. Geographic focused percent reductions include: Long Tom 47% and Luckiamute 63%. Bacteria load reductions as high as 95% are needed to meet the water quality criteria in the Middle Willamette during the Summer. Bacteria load reductions as high as 61% are needed to meet the water quality criteria in the Middle Willamette during the fall-winter-spring. |
| Dioxin (2,3,7,8-TCDD) | Middle and Upper Subbasins Mainstem Willamette (river mile 84-149) | Established for eight chlorine-bleach pulp mill point sources. Insufficient information to establish additonal allocations for other point and nonpoint sources. TMDL reserve held to capture contributions from these other potential sources. |
| Dissolved Oxygen | Rickreall Creek | Reduce oxygen-demanding pollutants into Rickreall Creek (e.g., nutrients, bacterial pollution). Riparian protection and restoration measures developed to address stream temperature concerns in the basin will benefit dissolved oxygen levels. Implementation of best management practices designed to reduce nonpoint sources of pollution support dissolved oxygen improvements. |

| | | |
|---|---|---|
| Mercury | Middle and Upper Subbasins Mainstem Willamette, including: Glenn Creek, Luckiamute River, Rickreall Creek, Spring Valley, Long Tom, Marys River and their tributaries | Currently 27% Willamette Basinwide Reduction; Best Management Practices employed to minimize soil erosion and control the use of products that contain mercury, such as some fertilizers |
| Temperature | Middle and Upper Subbasins Mainstem Willamette, including: Glenn Creek, Luckiamute River, Rickreall Creek, Spring Valley, Long Tom, Marys River and their tributaries | Preservation of effective shade levels. Preservation and attainment on smaller tributaries associated with system potential vegetation will eliminate most anthropogenic nonpoint source heat loads. 91% thermal pollution is from nonpoint sources. Surrogate measure is percent effective shade targets and a heat load equivalent of 0.05 ºC of the Human Use Allowance. Other important measures— preserving and restoring cool water refuges where salmonids rear and migrate to when the river warms up in the summer; protect and restore instream flow quantity. |

#### 2.4.1.4 Drinking Water

Agricultural land uses (e.g. grass seed/sod, vegetables, vegetable seed, peppermint) are present near many public water system wells, springs, and surface water intakes in the Management Area. Lands in the eastern side of the Management Area have the majority of both intensive agriculture area and human population. Privately owned forestland is prevalent in the uplands in the west side of the area, comprising a large portion of the watersheds contributing to streams in the Management Area (many used for public and private domestic water supply).

The most common public water system issues potentially associated with agricultural activities in the Management Area include *E. coli* and nitrate. Most of the public water systems have agricultural land uses (irrigated and fertilized crops, pasture, livestock grazing, and/or manure management) within their source areas, although intensity of use varies, and sources of contamination may come from other land uses. Storm water runoff and leaching can mobilize *E. coli* and/or nitrate on agricultural lands and transport them as contaminants to waterways and groundwater.

OHA has determined that the majority of public water system wells in the Management Area are moderately to highly susceptible to contamination from land use activities. This rating is based on Source Water Assessments, aquifer characteristics, and well locations and construction. The nitrate and other contamination issues described above and the ready movement of nitrogen into aquifers in the area verify this susceptibility. Measures to reduce leachable nitrate in soils would reduce risk to groundwater sources of drinking water.

Approximately 80 percent of the 82 public water systems in the Management Area have recent alerts for bacteria. Three of those systems had *E. coli* contaminant limit violations: Bellfountain Cornerstone

Christian, Linn County Parks-Peoria Parks, and Calvary Corvallis. The sources of *E. coli* for these alerts are unknown.

In addition, numerous public water systems in the Management Area have nitrate alerts (Table 2.4.1.4).

**Table 2.4.1.4 Public Water Systems within the Management Area with recent nitrate alerts. Systems in bold font are within the SWV GWMA.**

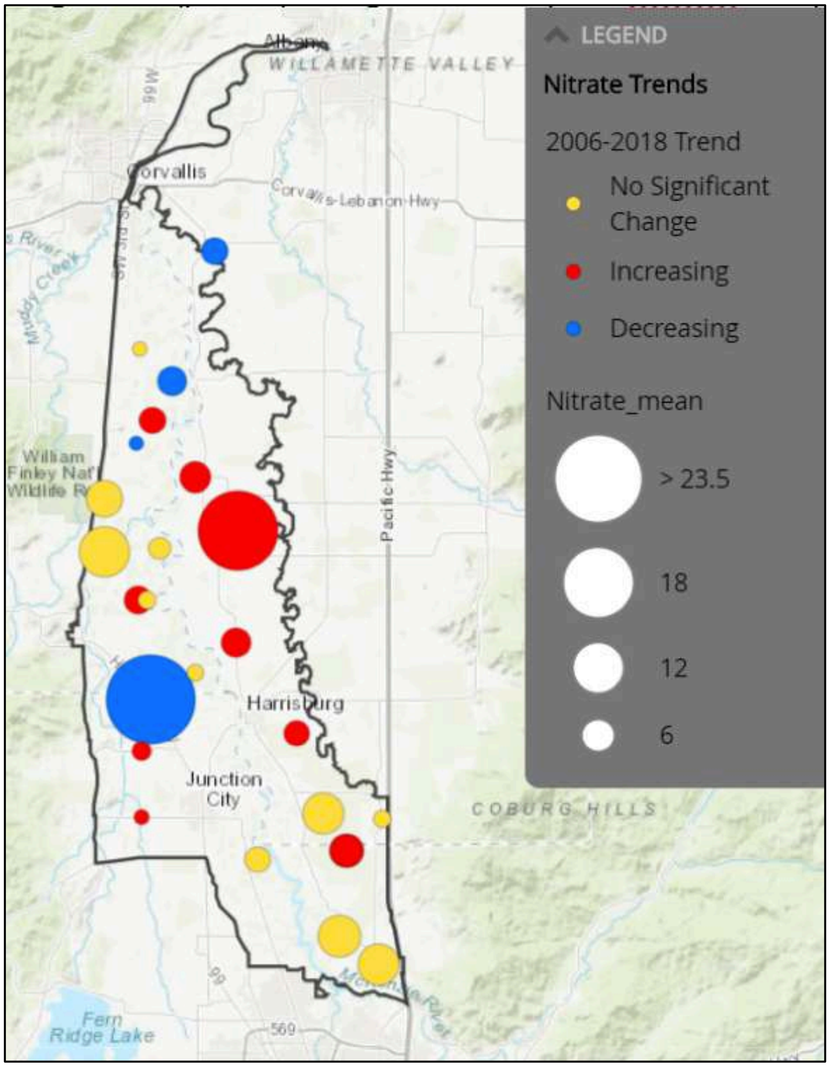
| County | Water System Name | Nitrate Alerts (> 5 ppm)-Last 10 years | Population |
|---|---|---|---|
| **Benton** | **Childrens Farm Home Campus** | **54 alerts (5.4-9.9 ppm)** | **200** |
| | **The Pub** | **5 alerts (5.0-6.1 ppm)** | **100** |
| | **Fairplay Elementary** | **24 alerts (7.2-11.5 ppm),** | **180** |
| | Kings Valley Charter School | 1 alert (5.1 ppm) | 225 |
| | **RFP Family Store** | **1 alert (5.5 ppm)** | **100** |
| | **Garland Nursery** | **10 alerts (8.7–10.7 ppm)** | **14** |
| Linn | Peoria Parks | 10 alerts (5.6-6.42 ppm) | 25 |
| Marion | City of Keizer | 17 alerts (5.13-5.82 ppm; mostly from now unused wells) | 37,505 |
| Polk | City of Monmouth | 27 alerts (5.1-9.82 ppm | 9,855 |
| | Luckiamute Valley Charter Schools | 2 alerts (5.85 ppm) | 50 |
| | **Eola Inn** | **1 alert (5.91 ppm)** | **100** |
| | Rickreall Water Association | 116 alerts (5.0-12.4 ppm) | 1,650 |
| | Luckiamute Domestic Water | 5 alerts ( 5.1-7.1 ppm) | 2,738 |
| | Green Villa Farms | 6 alerts (5.09-6.44) | 50 |
| | Rogue Farms | 15 alerts (5.53–15.1 ppm) | 25 |

Most of the public water systems and private wells with high nitrate are along the Willamette River and approximately half of these are within the SWV GWMA. The location of wells with nitrate contamination aligns closely with agricultural activities, as opposed to forestry. The NRCS identifies the land throughout the Management Area as having either high or very high nitrate leaching potential. Nitrate from fertilizers and septic systems can readily penetrate to the aquifers used for drinking water, and bacteria removal through soil filtration can be less effective in permeable soils.

The Domestic Well Testing Act database (real estate transaction testing data) for 1989-2018 shows 11 out of 667 private wells in the Management Area had nitrate over 7 ppm, and three of the wells had concentrations ≥10 ppm. The private wells with high nitrate are concentrated along the Willamette River, including within the SWV GWMA. Since most well tests were under 7 ppm, important factors such as well depth, well construction, and proximity to nutrient sources such as septic systems, fertilizer use sites, and high concentrations of livestock should be considered.

Additional drinking water contaminants that are possibly related to agriculture in the Management Area include disinfection by-product alerts (related to excessive organic carbon in source water) and pesticides. For details, please contact DEQ or OHA drinking water program staff). For additional information go to DEQ's Drinking Water Protection program at https://www.oregon.gov/deq/wq/programs/Pages/DWP-Maps.aspx.

## 2.4.1.5 GWMA




In May 2004, DEQ declared a portion of the Southern Willamette Valley a GWMA because of elevated groundwater nitrate levels. A portion of the Management Area is within the SWV GWMA (Figure 2.4.1.5).

**Figure 2.4.1.5 SWV GWMA Map**
**Nitrate concentrations and trends in the SWV GWMA (2006-2018). Size of the dot illustrates the concentration range, and color indicates the long-term trend. Wells that are stable did not have a significant (p<0.10) change over time (from Piscitelli 2019).**

Although low background levels of nitrate (2 to 3 ppm) can be naturally occurring, various human activities have increased nitrate concentrations in the groundwater. Currently, 93 percent of the land area within the GWMA is in agricultural use. Although agricultural use makes up the vast portion of land area, there are also many non-agricultural potential sources of nitrate such as urban or rural residential land uses. Detailed information about the SWV GWMA can be found at http://gwma.oregonstate.edu. A new DEQ storymap provides background and analysis of the groundwater nitrate trends. Find the storymap at https://arcg.is/1H4ynu.

The SWV GWMA stakeholder committee Action Plan for the SWV GWMA was finalized in 2009. The SWV GWMA Action Plan is not a regulatory document but includes many recommendations and voluntary strategies to address the issue of excess nitrate in groundwater from four focus sectors: (1) agricultural, (2) residential, (3) commercial/industrial/municipal, and (4) public water supplies. The agricultural portion of the action plan is carried out by many partners; actions implemented by ODA and the Benton SWCD are provided in Appendix B. Agricultural practices to address nitrates in groundwater are integrated into Section 2.5.

Five surface water public water systems and eight groundwater public water systems with drinking water source areas are at least partially within both the GWMA and the Management Area (Table 2.4.1.5). Seven of these groundwater systems have reported detections of nitrate high enough to trigger alerts by OHA (over 5 ppm) (Table 2.4.1.4)

**Table 2.4.1.5. Water Providers in the SWV GWMA Portion of the Management Area**

| Public Water System Name | Water Source | Population Served |
|---|---|---:|
| Adair Village | Surface Water (Willamette River) | 875 |
| City of Corvallis | Surface Water (Willamette River) | 56,000 |
| City of Monroe | Surface Water (Long Tom River) | 615 |
| City of Wilsonville | Surface Water (Willamette River) | 22,729 |
| Cascade Pacific Pulp LLC | Surface Water (Willamette River) | 800 |
| Children's Farm Home Campus | Groundwater | 200 |
| The Pub | Groundwater | 100 |
| Eola Inn | Groundwater | 100 |
| Fairplay Elementary, SD 509J | Groundwater | 180 |
| Highway 20 Market | Groundwater | 150 |
| RFP Family Store | Groundwater | 100 |
| Garland Nursery | Groundwater | 14 |

### 2.4.2 Sources of Impairment

Many factors may affect water quality in the Management Area. Sources impacting temperature include wastewater treatment plants, industrial operations, removal of riparian vegetation, seasonal reductions in stream flow, and stream channel and floodplain alteration. Contributors to bacteria and nutrient concerns include wastewater treatment plant overflows during heavy rains or generalized leaching to groundwater, legal and illegal waste dumping sites, leaching septic systems, leaching of fertilizers to groundwater, leaching and/or runoff of bacteria and nutrients from animal manure piles, runoff from urban and rural areas and roads, runoff from agricultural lands, and natural sources such as geese and other wildlife. Elevated stream temperatures, as well as nutrient levels, can contribute to low dissolved oxygen levels. Mercury can enter waterbodies from industrial and municipal wastewater discharges, erosion of soils that naturally contain mercury, runoff of atmospherically deposited mercury, and runoff from abandoned mines.

## 2.5 Regulatory and Voluntary Measures

The focus of the Agricultural Water Quality Management Program is voluntary and cooperative efforts by landowners, SWCDs, ODA, and others to protect water quality. However, the Agricultural Water Quality Management Act also provides for a regulatory backstop to ensure prevention and control of water pollution from agricultural sources in cases where landowners or operators refuse to correct problem conditions. The Area Rules serve as this backstop while allowing landowners flexibility in how they protect water quality. Area Rules are goal-oriented and describe characteristics that should be achieved on agricultural lands, rather than practices that must be implemented.

In this section, there are three Prevention and Control Measures that describe water quality issues, relevant definitions, and water quality concerns affected, and five categories of preferred management practices (Tables 2.5.4.1 to 2.5.4.4). Area Rules are referenced in each Prevention and Control Measure. Each Area Rule has a border around it and appears in italics.

The Prevention and Control Measures and Area Rules relate directly to water quality concerns identified on the 303(d) list in the Management Area, for the dissolved oxygen TMDL for Rickreall Creek in 1994, and for the bacteria, mercury, and temperature TMDLs that were established in September 2006 for the Willamette Basin. In addition, nitrate is discussed because of potential impacts to groundwater. Area Rules are not listed specific to mercury, dissolved oxygen, or nitrate, but prevention and control measures for erosion target these.

### 2.5.1 Nutrients and Manure Management

**Bacteria Issue:**

Animal and human wastes are a potential source for about 150 diseases (Terrell and Perfetti, 1989). The most commonly used indicator of animal or human waste pollution in a waterbody is the organism *E. coli*. It is a type of fecal coliform bacteria. These bacteria reside in the intestines of warm-blooded animals, including humans, livestock, wild birds, and mammals. The presence of *E. coli* alone does not confirm the contamination of waters by pathogens. It does, however, indicate contamination by sewage or animal manure and the potential for health risks.

Numerous factors influence the nature and amount of bacteria that reach waterways. Some of these factors are climate, topography, soil types, infiltration rates, animal species, and animal health. Typically, bacteria levels in streams are elevated after the first major storm event of the rainy season.

Bacteria also settle into sediments in a streambed and can live there for an extended period of time. If sediments are disturbed by increased stream turbulence following a runoff event, human or animal traffic, or other means, sediment-bound bacteria may be re-suspended into the water column (Sherer et al 1992). Sediment disturbance may account for erratic bacteria levels typically measured in water quality monitoring programs.

Oregon's water quality standard for bacteria was established to protect the most sensitive beneficial use affected by bacteria levels, water contact recreation. Within the Management Area, the Luckiamute River from mouth to Pedee Creek and the Marys River from mouth to Greasy Creek exceed water quality standards for bacteria during the fall, winter, and spring.

Livestock manure is a potential source of bacteria, nutrients, and oxygen-consuming material. If stored and applied at agronomic rates, manure can be a beneficial source of nitrogen and phosphorus, as well as organic matter (Mikkelsen and Gilliam, 1995). Nothing in this prevention and control measure is intended to discourage the use of manure or other amendments; rather, it seeks to ensure that they are applied correctly.

**Nitrate Issue:**

Nitrate is a form of oxidized nitrogen that is soluble in water (can be an issue in surface or ground water). Oregon Groundwater Quality Protection Rules (OAR 340-40) has a numerical groundwater quality reference level for nitrate of 10 mg/L. Public drinking water systems must adhere to the EPA Maximum Contaminant Limit for nitrate of 10 mg/L, which was established due to health concerns. Individuals with household wells are not required to adhere to any drinking water standards.

Nitrate is highly soluble in water, easily mobile in the soil, and can potentially leach through the soil and into the groundwater. Shallow groundwater is hydrologically connected to surface water in many areas, and is more or less so at certain times of the year depending on water availability (usually precipitation). Potential sources of nitrate pollution include fertilizer, animal waste, septic systems, and wastewater. In the recent analysis of groundwater nitrate trends in the SWV GWMA, important factors in explaining the nitrate concentrations in the long-term monitoring sites included water source, estimated fertilizer input, and proximity to a dairy operation (Piscitelli, 2019). The paper can be found at https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/cr56n703s.

Nutrients can also contribute to harmful algae blooms.

**Area Rule**

| |
|---|
| ***OAR 603-095-2340***<br>***(1)(a) Effective upon rule adoption, no person subject to these rules shall violate any provision of ORS 468B.025 or ORS 468B.050.*** |

**Definitions**

See Section 1.4.4 for definitions of waste, pollution, and waters of the state.

Other substances that will or may cause pollution include eroded sediment, commercial fertilizers, soil amendments, composts, animal wastes, pesticides and vegetative materials.

**Parameters That May Be Affected by this Prevention and Control Measure:**

Dissolved oxygen, bacteria, nutrients, toxics (e.g. mercury, pesticides, copper and lead).

### 2.5.2 Streamside Area Management

Across Oregon, the Ag Water Quality Program emphasizes streamside vegetation protection and enhancement to prevent and control agricultural water pollution. Streamside vegetation provides three primary water quality functions: shade for cooler stream temperatures, streambank stability, and filtration of pollutants. Other water quality functions include: water storage for cooler and later season flows, sediment trapping that builds streambanks and floodplains, narrowing and deepening of channels, and biological uptake of sediment, organic material, nutrients, and pesticides.

Additional reasons for the Ag Water Quality Program's emphasis on streamside vegetation include:

- Streamside vegetation improves water quality related to multiple pollutants, including: temperature (heat), sediment, bacteria, nutrients, toxics, and pesticides.
- Streamside vegetation provides fish and wildlife habitat.
- Landowners can improve streamside vegetation in ways that are compatible with their operation.
- Streamside vegetation condition can be monitored readily to track the status and trends of agriculture's progress in addressing water quality concerns.

**Issue**

The importance and effect of stream temperatures on aquatic life, including salmonids, has been the subject of much debate in recent years. There is general agreement that salmonids and other coldwater aquatic organisms require cool water temperatures to survive. Dissolved oxygen levels, which are necessary to support fish and other aquatic life, have an inverse relationship with stream temperatures; as water temperature falls, dissolved oxygen levels rise. Elevated stream temperatures, in addition to affecting the metabolic processes of aquatic animals, cause further physical stress by lowering the dissolved oxygen available for respiration. Furthermore, warmer stream temperatures can contribute to the growth of algae blooms, including harmful cyanobacteria species. This can exacerbate dissolved oxygen concerns and also pose a threat to drinking water sources.

It is very difficult to determine exact temperature requirements of coldwater aquatic life in natural settings, where temperatures may vary several degrees in a stream reach.

For many years, researchers have investigated factors that influence stream temperatures. Several authors emphasize the importance of water stored in the landscape and its importance in maintaining stream temperatures (Krueger et al, 1999; Moore and Miner, 1997; Naiman and Decamps, 1997). Clark (1998) explains that watershed conditions strongly influence riparian areas by affecting the infiltration of precipitation and the storage and release of water. Adequate ground cover in upland areas increases the likelihood of precipitation infiltrating the soil profile and decreases the possibility of overland flow, soil loss and resulting sediment delivery to streams. Many studies also highlight the significance of streamside shade in the maintenance of stream temperatures (Brown, 1969; Beschta, 1997). Other influences on stream temperature include stream channel width, stream depth, channel substrate, air temperature, and elevation (Bilby, 1984; Chen et al, 1998; Larson and Larson, 1996; Krueger et al, 1999; Ward, 1995).

Site Capable Vegetation
The Ag Water Quality Program uses the concept of "site-capable vegetation" to describe the vegetation that agricultural streams can provide to protect water quality (Section 1.4.5).

**Example**
Historically, Llama Creek meandered through a narrow coastal valley until it reached the Pacific Ocean. Historical vegetation along Llama Creek included a canopy of Douglas fir, western red cedar, big leaf maple and alder in the headwaters, and a combination of alder, willow, red osier dogwood, grasses, and sedges in the lower reaches (site potential). The vegetation provided many functions, including shade, bank stability, infiltration of runoff water, and filtration of sediment and nutrients.

In the upper reaches of Llama Creek, there are generally more of the younger age classes and less of the older age classes of vegetation than there were historically, but vegetation is still composed mostly of Douglas fir, western red cedar, big leaf maple and alder. Streamside sites in upper Llama Creek are still able to produce plant communities that were historically present, and those plant communities provide the water quality-related functions listed above.

Over the past few decades, the lower reaches of Llama Creek were channelized and straightened. As a result, streambanks eroded, lower Llama Creek became much wider and shallower, and the water table dropped. Presently, lower Llama Creek is capable of supporting those plant species that can establish and grow under the constraints of a lower water table and competitive pressure from invasive plant species. Depending on the site, the plant community will likely include blackberry, native shrubs, herbaceous species, and tree species capable of establishing and growing in these modified conditions. Some sites dominated by blackberry and other invasive vegetation do not provide riparian functions at the same level as the historic plant community, but at other sites the vegetation still promotes infiltration of runoff water, filters sediment and nutrients from runoff, provides shade, and provides for some bank stability.

**How site capability applies in a Management Area**
Site capability can be applied in several ways in a Management Area. It can be used in voluntary conservation and outreach projects to illustrate the vegetation landowners might expect given a management regime and the capability of a site. For example, it could predict the likelihood of success of "passive restoration," which involves reducing management pressure on the existing plant community, versus more "active restoration," which involves reducing management pressure, planting desirable vegetation, and/or controlling undesirable vegetation. Site capability can also predict the consequences or benefits of planting desirable species in specific locations in a riparian area. It can also help provide a clearer picture of the functions a near-stream area can be reasonably expected to provide given natural limiting factors such as soil type and climate, and legacy conditions such as channel deepening or streambank erosion associated with natural events or past management activities.

**Area Rule**

| |
|---|
| ***OAR 603-095-2340*** |
| ***(1)(b) By January 1, 2003, agricultural activities shall allow the growth and establishment of vegetation along perennial streams consistent with site capability to promote infiltration of overland flow, streambank stability and provide moderation of solar heating. Minimal breaks in shade vegetation for essential management activities are considered appropriate.*** |

**Definitions**

**Site Capability** - The vegetation, ecological, and functional status that an area is capable of producing/attaining given political, social, or economical constraints, which are often referred to as limiting factors.

**Perennial stream** – Natural channel in which water flows continuously and which is shown on a United States Geological Survey quadrangle map.

**Parameters That May Be Affected by this Measure:**
Temperature, dissolved oxygen, sediment, nutrients, turbidity, chlorophyll a, bacteria, nutrients, toxics, (e.g. mercury, pesticides, copper and lead).

### 2.5.3 Soil Erosion Prevention and Control

**Mercury**

**Issue**

Mercury is a metal, liquid at room temperature, commonly used in the recent past for thermometers. It continues to have many dental, medical, and industrial uses. In addition, it is found naturally in the soils of the Willamette Valley. It is also found in fossil fuels and is released into the air upon combustion. In the air, mercury can travel over continents and oceans to be deposited on land, added to naturally occurring mercury, and is carried by stormwater and erosion into Oregon's waterways. Fish consumption is the most common way humans are exposed to elevated levels of mercury (DEQ, 2007).

Mercury is also a severe poison, and small children and fetuses are most sensitive to mercury's toxic effects (DEQ, 2007).

Mercury from point and non-point sources is bioaccumulating in fish tissue to levels that adversely affect public health. Mercury binds to particles; thus, there are both higher levels of total suspended solids as well as higher mercury levels in the wet season. In setting the 2006 TMDL for mercury, DEQ found that erosion of native soil makes up almost 48 percent of the mercury in the Willamette Basin. Some industrial facilities and domestic wastewater treatment facilities also discharge mercury, but at low levels.

The current DEQ mercury TMDL consists of interim targets and allocations.

Refer to ORS 468B.025 and 468B.050 for the Administrative Rules and Statutes that apply to mercury, dissolved oxygen, and nitrate.

**Dissolved Oxygen**

Dissolved oxygen refers to the amount of oxygen that is dissolved in water. Oregon's dissolved oxygen standards protect cool and coldwater aquatic life, which require relatively high levels of dissolved oxygen to breathe.

Dissolved oxygen levels can vary over the course of the day based on algal growth and decay. An increase in available nutrients may result in elevated algal production, eventually depleting dissolved oxygen when algae decay. Temperature and dissolved oxygen exhibit an inverse relationship; as water temperature falls, dissolved oxygen levels rise; as water temperature rises, dissolved oxygen levels fall. Elevated stream temperatures, in addition to affecting the metabolic processes of aquatic animals, cause further physical stress by lowering the dissolved oxygen available for respiration.

**Area Rule**

***OAR 603-095-2349(1)***
***Effective upon rule adoption, no person subject to these rules shall violate any provision of ORS 468B.025 or 468B.050.***

**Definitions**

See Section 1.4.4 for definitions of waste, pollution, and waters of the state.

Other substances that will or may cause pollution include eroded sediment, commercial fertilizers, soil amendments, composts, animal wastes, pesticides, and vegetative materials.

**Parameters That May Be Affected by this Prevention and Control Measure:**

Dissolved oxygen, bacteria, nutrients, toxics (e.g., mercury, pesticides, copper, lead)

### 2.5.4 Preferred Management Practices

The following tables are intended as recommendations for landowners to meet Area Rules and generally maintain and enhance natural resources on their property. The practices below benefit a variety of water quality parameters monitoring for drinking and surface water, not just those parameters of concern within the Management Area. For example, streamside area management also serves as soil erosion prevention and control. The tables provide some idea of the water quality benefits of each practice as well as potential costs and benefits to landowners. The tables are organized by resource, such as nutrients and manure.

Landowners who want more information on any of the following practices should contact their local SWCD. The scientific basis for these practices is provided in Appendix A.

**Table 2.5.4.1. Riparian Areas and Streams**

| Practice | Resource Concerns Addressed | Benefits to Producer | Costs to Producer |
|---|---|---|---|
| a. Preserve existing vegetation. | Functions currently provided are protected. | Ensures compliance with regulations. | Unable to use land for production. |
| b. Light rotational grazing in riparian area; timed when growth is palatable to animals and when riparian areas are not saturated. | Helps establish desirable riparian vegetation, promotes streambank integrity; helps filter nutrients and sediment from runoff; helps reduce stream temperatures by providing shade. | May lessen streambank erosion and loss of pastures; allows limited use of riparian area for grazing, improves wildlife habitat, and may control weeds. Practice may be eligible for cost-sharing programs. | May require time and financial investment for livestock control and off-stream watering facilities. |
| c. Livestock exclusion from riparian area; establish off-stream watering facilities. | Helps promote desirable riparian vegetation; promotes streambank integrity; helps filter nutrients and sediment from runoff; may help narrow channel and reduce erosion in channel. | May lessen streambank erosion and loss of pastures; less time involved in managing livestock grazing in riparian area, improves wildlife habitat. Practice may be eligible for cost-sharing programs. | May require higher weed control costs than seasonal riparian grazing. May require financial investment for livestock control and off-stream watering facilities. |
| d. Remove invasives and plant perennial vegetation in riparian area. Recommend using native vegetation, or if using non-native vegetation, avoid using invasives. | Helps establish perennial riparian vegetation rapidly; promotes streambank integrity; may help narrow channel and reduce erosion in channel. | May lessen streambank erosion and loss of pastures. If livestock are excluded from riparian area, area may be eligible for federal cost-share programs. Some alternative perennial agricultural products may be harvested from riparian areas. Practice may be eligible for cost-sharing programs. | Costs of vegetation and weed control. May require financial investment for riparian fencing and off-stream watering facilities while vegetation establishes. |

**Table 2.5.4.2. Nutrient and Manure Management**

| Practice | Resource Concerns Addressed | Benefits to Producer | Costs to Producer |
|---|---|---|---|
| a. Apply nutrients according to soil test results. | Helps prevent nutrient runoff into waters of the state and leaching into groundwater. | May help reduce fertilizer costs; ensures that plants receive needed nutrients for growth; makes plants more competitive against weeds. Practice may be eligible for cost-sharing programs. | Costs of soil testing; time associated with taking soil samples. |
| b. Store manure under a tarp or roof; preferably on an impervious surface such as concrete or plastic and away from seasonally flooded areas. | Helps prevent nutrient and bacteria runoff into waters of the state and leaching into groundwater. | Prevents nutrient leaching so manure applied on crops or pasture has higher nutrient content; may save some fertilizer costs; producers may be eligible for cost-sharing programs. | Cost of constructing manure storage facilities. |
| c. Establish animal heavy-use areas where animals are confined during the winter to protect other pastures from trampling and compaction. Limit livestock access to pastures when soils are saturated; cover heavy-use areas with rock, hogged fuel, and/or geotextile. Clean manure regularly from heavy-use area. | Helps prevent sediment, nutrient and bacteria runoff into waters of the state and leaching into groundwater. Helps protect streamside areas. | Protects pastures from compaction during the winter, improving growth. May improve animal health by covering heavy-use areas with material so animals are not wading in mud. Practice may be eligible for cost-sharing programs. | Cost of fencing heavy-use area; cost of feeding hay during the winter; cost of materials for protecting heavy-use area. |
| d. Site barns and heavy-use areas away from streams and seasonally flooded areas. | Helps prevent sediment, nutrient, and bacteria runoff into waters of the state. Helps protect streamside areas. | Helps prevent flooding in barns and heavy-use areas. Practice may be eligible for cost-sharing programs. | Need either off-stream watering facility or other source of water for livestock. |
| e. Prevent silage leaching and/or store and manage leachate from silage and other vegetative materials. | Helps prevent nutrient runoff into waters of the state and leaching into groundwater. | Preventing leaching maintains higher nutrient content of ensiled feed material. Practice may be eligible for cost-sharing programs. | May require cost of facility development and purchase of moisture-absorbing materials. |
| f. Installing gutters and downspouts in areas with high livestock use. Connect downspout water to drainage system or, if possible, route clean | Helps prevent sediment, nutrient and bacteria runoff into waters of the state. Helps protect streamside areas. | May improve animal health by lessening mud during the winter, so animals are not wading in mud. Practice may be eligible for cost-sharing programs. | Cost of installation and maintenance of gutters and downspouts. |

| | | | |
|---|---|---|---|
| downspout to a location where it can soak into the ground. | | | |
| g. Cover heavily used animal walkways with sand, rock, and/or geotextile. | Helps prevent sediment, nutrient and bacteria runoff into waters of the state. Helps protect streamside areas. | Can improve animal health because animals are not wading in mud. Can help prevent animal health problems such as scratches, hoof or foot rot, and worms. Practice may be eligible for cost-sharing programs. | Cost of sand, rock or other materials. Owners should be aware that feeding equine species on sand may result in sand colic. |

**Table 2.5.4.3. Erosion and Sediment Control**

| Practice | Resource Concerns Addressed | Benefits to Producer | Costs to Producer |
|---|---|---|---|
| a. Grazing management: graze pasture plants to appropriate heights, rotate animals between several pastures; provide access to water in each pasture. | Helps prevent sediment, nutrient, and bacteria runoff into waters of the state. Helps protect streamside areas. | May improve pasture production; easy access to water may increase livestock production as well. May improve composition of pasture plants and help prevent weed problems. Practice may be eligible for cost-sharing programs. | Cost of installing fencing, watering facilities for rotational grazing system; time involved in moving animals through pastures. |
| b. Farm road construction: construct fords appropriately, install water bars or rolling dips to divert runoff to roadside ditches. | Helps prevent sediment runoff to waters of the state. | May help prevent water damage on farm roads. Practice may be eligible for cost-sharing programs. | Cost of installation and maintenance. |
| c. Plant appropriate vegetation along drainage ditches; seed ditches following construction. | Helps prevent sediment runoff into waters of the state. | May help prevent ditch bank erosion and slumping. Practice may be eligible for cost-sharing programs. | Costs of establishing vegetation. |
| d. Plant cover crops on erosion-sensitive areas. | Helps prevent sediment runoff into waters of the state; filters nutrients and slows runoff. | May reduce weed problems; prevents loss of applied nutrients. Practice may be eligible for cost-sharing programs. | Costs of establishing cover crops; cover crops may compromise primary crop. |

| Practice | Resource Concerns Addressed | Benefits to Producer | Costs to Producer |
|---|---|---|---|
| e. Irrigate pasture or crops according to soil moisture and plant water needs. | Helps prevent irrigation return flow and associated nutrients and sediment to waters of the state. | May reduce costs of irrigation; may help crop or pasture production. Practice may be eligible for cost-sharing programs. May reduce the amount of fertilizer needed. | Installation/ maintenance cost. Monitoring time. |
| f. Install/maintain diversions or French drains to prevent unwanted drainage into barnyards and heavy-use areas. | Helps prevent nutrient runoff into waters of the state. | Decreases mudiness and shortens saturation period in protected areas. Practice may be eligible for cost-sharing programs. | Cost of installation. |
| g. In areas where gullies repeatedly appear, install underground outlet or grassed waterway to capture and convey water. | Prevents gully erosion and sediment runoff to waters of the state. | Prevents loss of soil and fertilizers, lessens inconvenience of driving equipment over gullies. Practice may be eligible for cost-sharing programs. | For underground outlet, costs of installing inlets and plastic pipe; for grassed waterways, costs of installation, seeding, weed control, and any land put out of production. |
| f. Install and manage field borders/filter strips along field boundaries. | Controls sediment and nutrient movement to waters of the state. Erosion control during high water events. | Prevents loss of soil and fertilizers. Practice may be eligible for cost-sharing programs. | Cost of installation.<br>Cost of management. |

**Table 2.5.4.4. Pest Management**

| Practice | Resource Concerns Addressed | Benefits to Producer | Costs to Producer |
|---|---|---|---|
| a. Apply pesticides and herbicides according to the label. Use the correct rate and timing. Comply with label restrictions and precautions. | Reduces risk of pesticide runoff to streams or other water resources. | Compliance with federal and Oregon law; reduces health risks to applicator, may decrease costs. | N/A |
| b. Triple rinse pesticide application equipment; apply rinsates to sites; dispose of or recycle clean containers according to Oregon law. | Reduces risk of pesticide runoff to streams. | Dilutes pesticide residues; correct disposal of rinsate ensures compliance with federal and Oregon law; eliminates disposal costs of collected rinsates identified as hazardous waste. | Triple rinsing creates more volume that must be disposed of. |
| c. Calibrate, maintain, and correctly operate application equipment. | Reduces risk of pesticide runoff to streams. | May reduce use and therefore cost of pesticides; reduces health risks to applicator. If not | Time used to calibrate equipment. |

| Practice | Resource Concerns Addressed | Benefits to Producer | Costs to Producer |
|---|---|---|---|
| | | calibrated correctly, a second application may be necessary, increasing use and cost. | |
| d. Integrated pest management practices such as pheromone traps, beneficial insect release, and field monitoring. (either in combination with pesticide use or as a replacement to pesticide use) | Reduces risk of pesticide runoff to streams, may reduce loss of non-target species. | May improve effectiveness of pest control system. Practice may be eligible for cost-sharing programs. | Time involved to scout fields is usually offset by reduced or more effective pesticide use. |
| e. Store and mix pesticides on leak-proof facilities. | Reduces risk of pesticide runoff to streams. | Helps protect drinking water; reduces health risks to applicator. | Cost of installation and maintenance. |
| f. Store petroleum products such as fuel and oil in leak proof containers and facilities; clean up spills of petroleum products properly. | Reduces risk of runoff of petroleum products to streams or soil contamination. | Helps protect drinking water, reduces health risks to landowner or operator. | |

**Table 2.5.4.5. Nutrient and Irrigation Efficiencies**

| Practice | Resource Concerns Addressed | Benefits to Producer | Costs to Producer |
|---|---|---|---|
| a. Apply fertilizer at the correct rate and time applications for crop uptake. | Reduces the risk of excess nitrogen in the soil at the end of the growth season. | Precise application saves the producer money in fertilizer costs. | Time related to precision application. |
| b. Sample soil prior to fertilizer application to know existing nutrients. | Prevents the application of excess nutrients. | Precise application can save the producer money in fertilizer costs. | Cost of soil sampling and analysis. |
| c. Plant winter cover crops to take up excess nitrogen left over after crops are harvested. | Takes up extra nitrogen and limits potential for leaching into ground water. | Stores extra nitrogen in plant matter for later release when cover crop is incorporated into the soil. | Cost of seed and fuel to plant cover crop. Note: this can be offset by a reduction in fertilizer. |
| d. Properly maintain irrigation systems to prevent over-irrigation. | Prevents leaching of excess nitrogen past the root zone. | Uniform irrigation application and save producer money on nitrogen costs. Reduce plant mortality due to overwatering. | Replacement nozzles at least every four years is recommended. |

| Practice | Resource Concerns Addressed | Benefits to Producer | Costs to Producer |
|---|---|---|---|
| e. Monitor soil water content and adjust irrigation schedules to maintain soil water content in an appropriate range in the root zone. | Prevents over-irrigation and leaching of excess nitrogen past the root zone. | Allows accurate irrigation application and keeps nutrients available to crops. Protects drinking water. | Soil monitoring equipment and time to evaluate soil water content. |
| f. Schedule irrigation applications based on expected evapotranspiration rates. | Prevents over-irrigation and leaching of excess nitrogen past the root zone. | Allows accurate irrigation application and keeps nutrients available to crops. Reduce plant mortality due to overwatering. | Time to evaluate expected evapotranspiration rates. |

(This page is blank)

# Chapter 3: Implementation Strategies

## Goal

Prevent and control water pollution from agricultural activities and soil erosion, and achieve applicable water quality standards.

To achieve the Area Plan goals, the following water quality related objectives are established:

- Streamside vegetation along streams on agricultural properties provides streambank stability, filtration of overland flow, and moderation of solar heating.
- No visible sediment loss from cropland through precipitation or irrigation induced erosion (this objective is laudable but difficult to achieve).
- No significant bare areas due to livestock overgrazing within 50 feet of streams on pasturelands and/or rangelands.
- Active gullies have healed or do not exist on pasturelands.
- Livestock manure is stored under cover and in a location that minimizes risk to surface and groundwater.
- Livestock manure applied annually at agronomic rates.

## LAC Mission

The mission of the Area Plan is to ensure that water quality goals are met while promoting the flexibility and economic viability of agriculture. The Area Plan is designed to achieve applicable chemical, physical, and biological water quality standards.

## 3.1 Measurable Objectives and Strategic Initiatives

Measurable objectives allow the Ag Water Quality Program to evaluate progress toward meeting water quality standards and TMDL load allocations. Any measurable objectives are stated here. Progress is reported in Chapter 4.

### 3.1.1 Management Area

ODA is working with SWCDs and LACs throughout Oregon to establish long-term measurable objectives to achieve desired conditions. Focus Areas and SIAs are being used to show progress in this Management Area. The current Focus Areas and SIAs are described below.

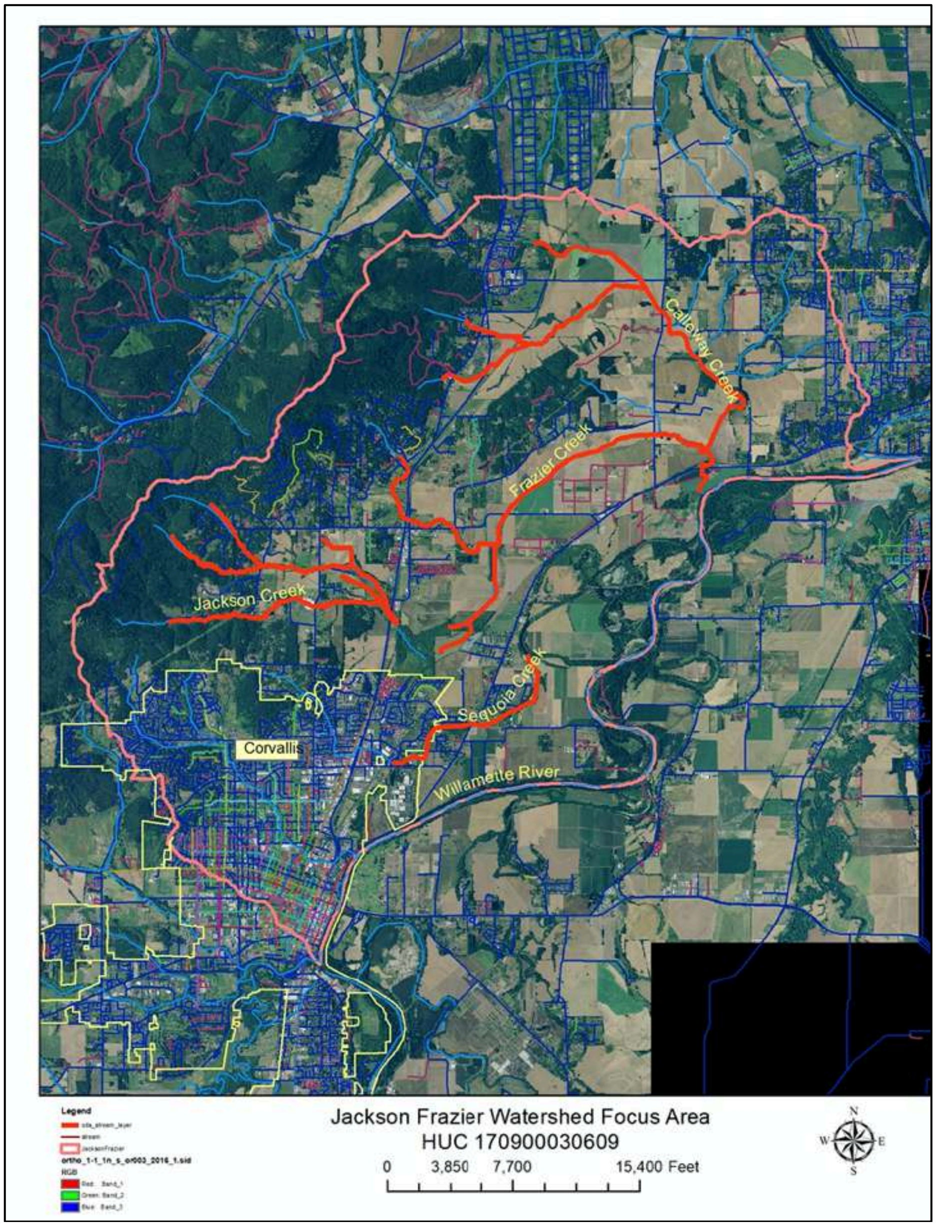
### 3.1.2 Focus Areas

Benton SWCD plans to keep the Jackson-Frazier Focus Area open to continue monitoring progress, while also starting work in a new focus area in the Benton County portion of the GWMA.

### 3.1.2.1 Jackson-Frazier Focus Area

Benton SWCD began work in this Focus Area in 2013 (Figure 3.1.2.1). The basis for selection included demographics, water quality assessments, land use, and existing momentum with watershed restoration partners. Primary water quality issues are temperature and nutrients. The watershed is approximately 3700 acres with 45 percent in Exclusive Farm Use and 65 percent in agricultural use. Primary commodities include grass seed production, pasture, hay, Christmas trees, hazelnuts and various row crops.

**Figure 3.1.2.1 Map of the Jackson-Frazier Focus Area**



Assessment Method: Streamside vegetation was evaluated with ODA's Streamside Vegetation Assessment (SVA) to characterize the type of ground cover within 35 feet of the stream. The metric is the number of acres of different types of land cover viewed on aerial photographs. Categories are: agricultural infrastructure; water; and bare ground, grass, shrubs, and trees (designated as agricultural or not).

Measurable Objectives and Associated Milestones:
By June 30, 2019, increase trees + shrubs by 10 acres and reduce undesirable vegetation (bare ag + grass ag) by 10 acres.

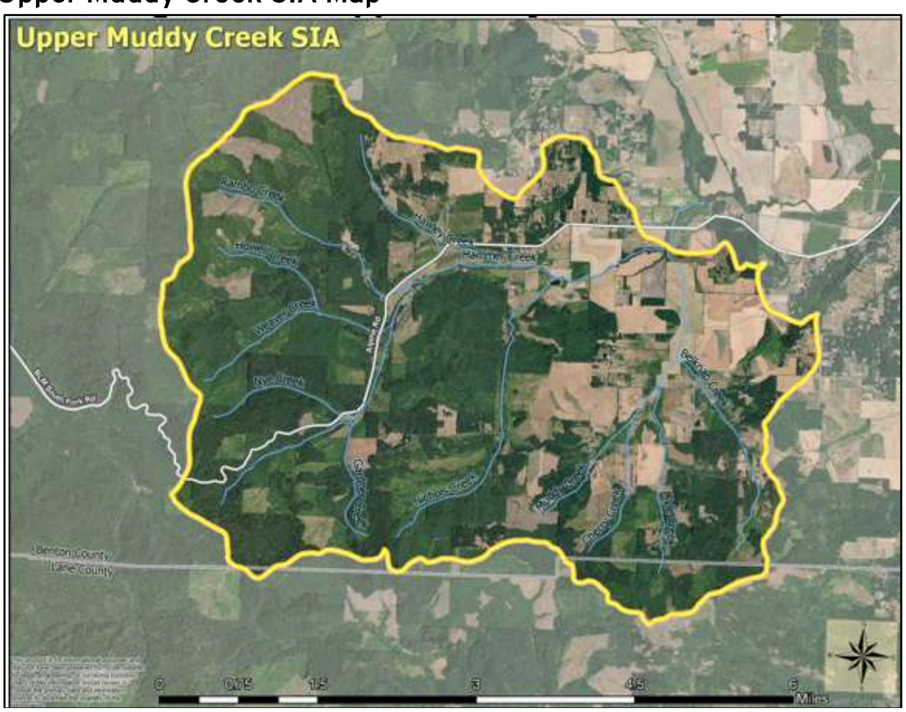
**Current Results**

| | Ag Infra-structure | Bare | Bare Ag | Grass | Grass Ag | Not Ag | Shrub | Shrub Ag | Tree | Tree Ag | Water | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | 6.8 | 0 | 22.9 | 0 | 61.1 | 25.3 | 23.4 | 0 | 92.4 | 0 | .9 | 232.8 |

### 3.1.3 Strategic Implementation Area(s)

*Description*
ODA selected the Upper Muddy Creek watershed as an SIA in 2018 (Figure 3.1.3). The watershed consists of approximately 13,728 acres. It is west of Monroe and includes part of the city of Alpine. ODA assessed approximately 5,700 agricultural acres during the remote and field evaluations for impacts of agricultural activities to water quality. Agriculture consists mostly of vineyards, hay, grass seed, filberts, berries, and equestrian. According to DEQ's 2012 Integrated Report, water temperature is a concern.

**Figure 3.1.3 Upper Muddy Creek SIA Map**



Assessment Method:
ODA completed a compliance evaluation of agricultural activities and potential concerns related to surface and ground water. The evaluation considered the condition of streamside vegetation, bare ground, and potential livestock impacts (including manure piles). The process involved both a remote evaluation and field verification from publicly accessible areas.

Categories for evaluation include:

- **Limited Opportunity for Improvement:** ODA identified no likely regulatory concerns, but there may be an opportunity for improvement (uplift) to reach the ecological goals of the Area Plan,
- **Low Opportunity for Improvement:** ODA identified no likely regulatory concerns, but there may be an opportunity for improvement (uplift) to reach the ecological goals of the Area Plan,
- **Opportunity for Improvement:** ODA identified that agricultural activities may be impairing water quality, or evaluation was inconclusive using remote and field verification,
- **Potential Violation:** ODA identified during the remote evaluation and verified during the field evaluation from a publicly accessible location that there is a potential violation of the Area Plan Rules.

**Table 3.1.3 Upper Muddy SIA Pre-Assessment Results**

| **Objectives** |
|---|
| ODA Measurable Objective: By 2022, 100% of evaluated agricultural tax lots will be in compliance with the streamside vegetation and waste rules. |
| **SWCD Objectives** |
| SWCD Objective: All interested landowners have received technical assistance and an opportunity to seek potential funding to help with projects to improve water quality.<br>• Objective 1: Provide outreach to 75 landowners<br>• Objective 2: Conduct site visits to interested landowners<br>• Objective 3: Develop conservation plans which address limiting water quality concerns<br>• Objective 4: Implement conservation practices<br>• Objective 5: Develop a monitoring plan to assess before and after practice implementation |

## 3.2 Proposed Activities

ODA, the LAC, the LMA, and other partners identified the following priority activities to track progress toward meeting the goal and objectives of the Area Plan (Table 3.2). COVID restrictions are limiting the ability to do some activities. Polk SWCD is currently focusing more of their efforts in the Yamhill Agricultural Water Quality Management Area.

**Table 3.2 Planned Activities for 2020-2023 throughout the Management Area.**

| Activity | Benton SWCD | Polk SWCD | Description |
|---|---|---|---|
| **Community and Landowner Engagement** | | | |
| # active events that target landowners/managers (workshops, demonstrations, tours) | 12 | 2 | Three to four presentations/workshops and 1 tour per year |
| # landowners/managers participating in active events | 180 | 75 | |
| **Technical Assistance (TA)** | | | |
| # landowners/managers provided with TA (via phone/walk-in/email/site visit) | 250 | 40 | |
| # site visits | 150 | 15 | |
| # conservation plans written* | 1 | 1 | |
| **On-the-ground Project Funding** | | | |
| # funding applications submitted | 6 | -- | |
| * Definition: any written management plan to address agricultural water quality. Can include NRCS-level plans. Can include: nutrients, soil health, grazing, riparian planting, forest thinning to improve upland pastures to reduce livestock pressure on riparian areas, etc. Cannot include projects with no or weak connection to agricultural water quality (weed eradication not for riparian restoration, fuels reduction, alternative energy, rain gardens/rain harvesting, non-agricultural culvert replacement, and instream habitat enhancement that does not also improve water quality) | | | |

## 3.3 Water Quality and Land Condition Monitoring

### 3.3.1 Water Quality

DEQ monitors seven sites in the Management Area as part of their ambient monitoring network (Long Tom River at Monroe; Luckiamute River at Buena Vista Road; Marys River at Corvallis; Muddy Creek south of Corvallis; and Willamette River at Albany, Corvallis, and Salem).

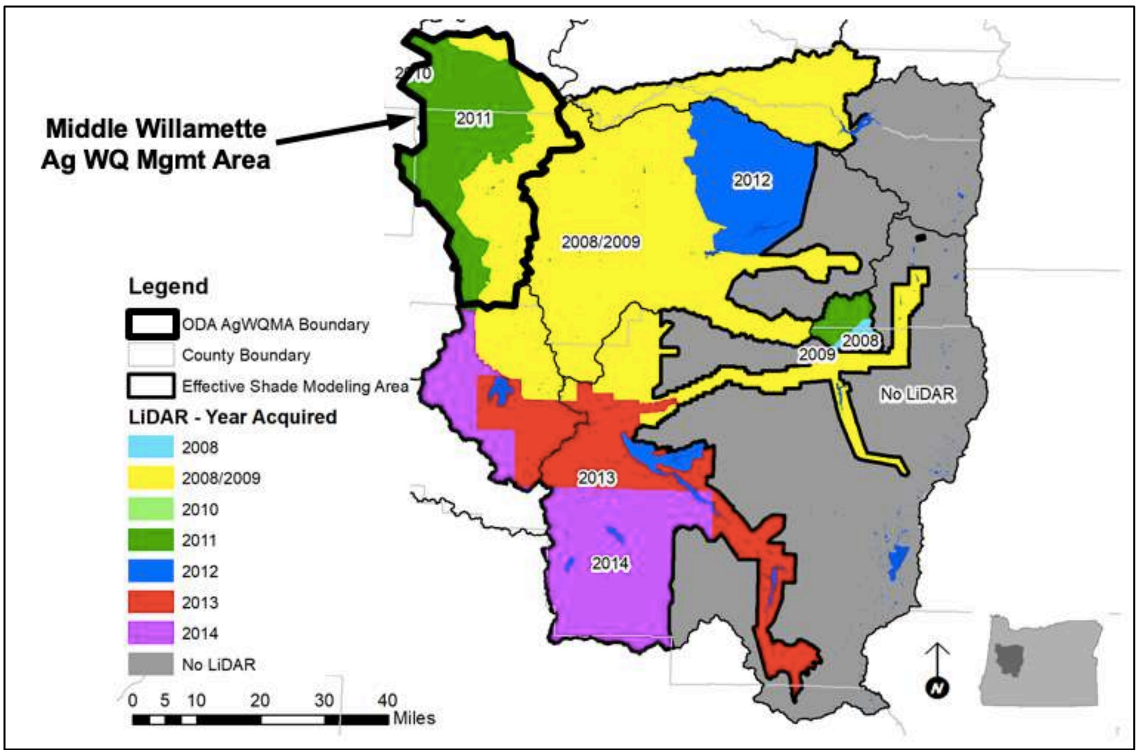
DEQ's Drinking Water Protection Program synthesizes and summarizes available data on potential sources of contamination and contaminant detections that could impact, or are impacting, public drinking water sources. For more details, please contact the DEQ Drinking Water Protection Program.

### 3.3.2 Land Conditions: DEQ Assessment of Stream Shading

The following section describes the process DEQ used to assess streamside vegetation and shade conditions in the Southern Willamette Basin. Results of the assessment are summarized in Section 4.3.2 of this Area Plan. The results show where conditions may be sufficient, as well as where ODA and partners should focus efforts to improve conditions in the future.

In 2019, DEQ hosted a Willamette TMDL implementation workshop, which included a presentation, "Assessing the Status of Riparian Restoration, Protection, and Shading in the Southern Willamette Basin" (presentation and results are posted at: www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-Willamette-Basin.aspx#implementation). In this study, DEQ assessed nonpoint source solar heating along streams in the southern half of the Willamette Basin (including most of this Management Area; Figure 3.3.2a), to compare current conditions to targets established in the TMDL. DEQ assessed current levels of "effective shade" (shade), which measures the percent of a stream that is shaded by streamside vegetation plus topography. Shade helps reduce the rate of stream warming from solar radiation.

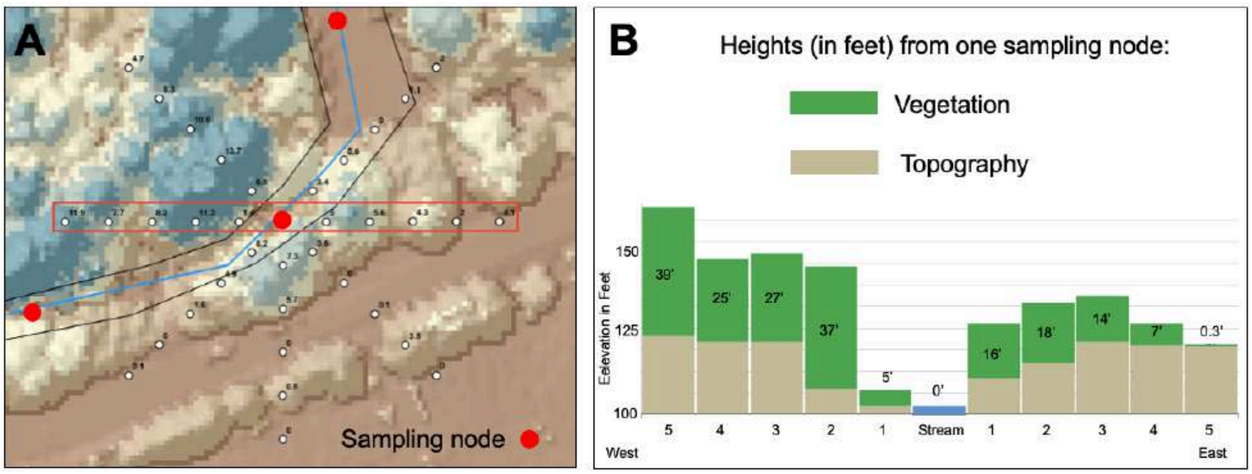
***Figure 3.3.2a: Southern Willamette study area; Middle Willamette Management Area is shown***




DEQ assessed shade along perennial and intermittent streams in the U.S. Geological Survey's National Hydrography Dataset (NHD). DEQ included all NHD streams because of known inaccuracies in stream flow classification. Many streams classified as intermittent streams are actually fish-bearing, with aquatic life using residual pools in the dry season. When and where more accurate stream classification is provided, DEQ could revise the shade assessment. DEQ recommends using the methods described by EPA in 2015 (www.epa.gov/measurements-modeling/streamflow-duration-assessment-method-pacific-northwest) to determine stream flow duration.

DEQ used Lidar data, computer mapping, and computer modeling to calculate shade levels as of the date Lidar was acquired, which ranges from 2009 to 2011 in this Management Area (Figure 3.3.2a). Lidar data were acquired by planes flying 3,000 to 4,600 feet above ground. DEQ set up sampling nodes to model shade every 656 feet (200 meters) along streams (red dots in Figure 3.3.2b). For each sampling node, DEQ used the Heat Source model to calculate effective shade (amount of sun blocked) throughout a mid-summer day, using vegetation and topographic heights from Lidar.

***Figure 3.3.2b: A - Background shows Lidar imagery, color-coded by vegetation height; for each sampling node (red dot), DEQ calculated vegetation and topographic heights in seven directions (white dots), out to a distance of 246 feet (75 meters); B - Cross section, west and east of the sampling node, shows vegetation and topographic heights at 49 foot (15 meter) intervals.***



# Chapter 4: Progress and Adaptive Management

## 4.1 Measurable Objectives and Strategic Initiatives

### 4.1.1 Management Area

ODA is working with SWCDs and LACs throughout Oregon towards establishing long-term measurable objectives to achieve desired conditions. Currently, ODA and the Benton SWCD are using Focus Area measurable objectives and the Upper Muddy Creek SIA to show progress in this Management Area.

### 4.1.2 Focus Areas in Small Watersheds

**Table 4.1.2.1 Jackson-Frazier Focus Area**

| | |
|---|---|
| **Measurable Objective** | |
| A measurable objective was not determined for this Focus Area. | |
| **Milestones** | |
| **Focus Area Milestone for 2017-2019**<br>• Increase Trees and Shrubs by 10 acres<br>• Decrease Bare Ag and Grass Ag by 10 acres | |
| **Current Conditions** | |
| **Progress Toward Measurable Objectives and Milestones**<br>• Grass Ag was decreased by 1.0 acre and Tree was increased by 1.0 acre. No other categories changed. | |
| Assessment Results: Number of acres | |
| **Activities and Accomplishments** | |
| **Community and Landowner Engagement** | |
| # active events that target landowners/ operators | **4** |
| # landowners/operators participating in active events | **140** |
| **Technical Assistance (TA)** | |
| # landowners/operators provided with TA | **19** |
| # site visits | **16** |
| # conservation plans written | **0** |
| **Ag Water Quality Practices Implemented in the Focus Area** | |
| Riparian Buffer | **0.5 ac** |
| Composting Facility | **1** |
| Heavy Use Area | **4000 ft$^2$** |
| Hedgerow | **.2 ac** |
| Brush Management | **50 ac** |
| Wetland Restoration | **40 ac** |
| **Adaptive Management Discussion** | |
| Outreach and site visits with landowners encouraged them, however people did not follow through with projects. Workshops with native plants were very popular and drew lots of people outside the watershed. Landowners in the Focus Area received information about the Area Plan and Rules. The SWCD is in the process of choosing a new focus area for the 2019-2021 biennium. | |

Assessment Results: Number of acres

| | Trees + Shrubs | Bare Ag + Grass Ag |
|---|---|---|
| 2017 | 153.5 | 84 |
| 2019 | 154.5 | 83 |

### 4.1.3 Strategic Implementation Area(s)

**Table 4.1.3 Upper Muddy SIA Progress**

| **Objectives** | | | | | |
|---|---|---|---|---|---|
| Objective 1: Provide outreach to 75 landowners concerns<br>This objective was met. | | | | | |
| Objective 2: Conduct site visits to interested landowners<br>This objective is underway with:<br>▪ 10 acres provided technical assistance<br>▪ 1 landowner site visit completed | | | | | |
| Objective 3: Develop conservation plans that address limiting water quality<br>This objective is underway. | | | | | |
| Objective 4: Implement conservation practices<br>1 project completed. | | | | | |
| Objective 5: Develop a monitoring plan to assess before and after practice implementation<br>A local monitoring team was formed and a draft monitoring plan submitted for approval. | | | | | |
| **Current Conditions** | | | | | |
| Tax Lots | Tax Lots Evaluated | Limited Opportunity | Low Opportunity | Opportunity for Improvement | Potential Violations |
| 454 | 274 | 247 | 13 | 14 | 0 |
| ODA identified water quality concerns on 27 (10%) of evaluated tax lots. This is not necessarily a discrepancy with the 51% shade gap identified by DEQ. The total number of evaluated tax lots includes many small tax lots near Alpine, and the tax lots with water quality concerns were some of the larger tax lots in the SIA. Therefore the 27 tax lots include much more than 10% of the agricultural stream miles. In addition, the DEQ evaluation looked more closely at intermittent streams than the ODA evaluation likely did, and may have identified more issues on those streams. | | | | | |

## 4.2 Activities and Accomplishments

ODA, the LAC, the LMA, and other partners identified the following priority activities to track progress toward meeting the goal and objectives of the Area Plan. ODA will review the four-year results and then provide a report at the end of the 2021-2023 Biennium.

Future Area Plans will compare results and targets in Table 4.2a.

**Table 4.2a Activities conducted in 2018-2020 by SWCDs throughout Management Area.**

| Activity | Benton SWCD | Polk SWCD | Description |
|---|---|---|---|
| **Community and Landowner Engagement** | | | |
| # active events that target landowners/ managers (workshops, demonstrations, tours) | 20 | 10 | |
| # landowners/managers participating in active events | 850 | 304 | |
| **Technical Assistance (TA)** | | | |

| | | | |
|---|---|---|---|
| # landowners/managers provided with TA (via phone/ walk-in/email/site visit | 350 | 44 | |
| # site visits | 63 | 44 | |
| # conservation plans written* | 6 | 18 | |
| **On-the-ground Project Funding** | | | |
| # funding applications submitted | 7 | 9 CREP | |
| # funding applications awarded | 7 | 9 CREP | |
| * Definition: any written management plan to address agricultural water quality. Can include NRCS-level plans or simpler plans. Can include: nutrients, soil health, water quality, irrigation, grazing, riparian planting, forest thinning to improve upland pastures to reduce livestock pressure on riparian areas, etc. Cannot include projects with no or weak connection to ag water quality (weed eradication that is not for riparian restoration, fuels reduction, alternative energy, non-ag rain gardens/rain harvesting, non-ag culvert replacement, and instream habitat enhancement that does not also improve water quality) | | | |

Table 4.2b and 4.2c summarize information from the OWRI on restoration project funding and accomplishments on agricultural lands in the Management Area. The majority of OWRI entries represent voluntary actions of private landowners who have worked in partnership with federal, state, and local groups to improve aquatic habitat and water quality conditions.

**Table 4.2b Implementation funding (cash and in-kind) for projects on agricultural lands reported 1997-2018 (**OWRI data include most, but not all projects, implemented in the Management Area).

| Landowners | OWEB | DEQ | NRCS | County | Federal | Local Business | All other sources* | TOTAL |
|---|---|---|---|---|---|---|---|---|
| $450,683 | $3,537,375 | $57,523 | $1,151,737 | $64,448 | $1,069,193 | $450,683 | $505,587 | $7,287,229 |

*Includes city, county, tribal, other state/federal programs, and non-profit organizations. There were too many entities to list.

**Table 4.2c Miles and acres treated on agricultural lands reported 1997-2018** (OWRI data include most, but not all projects, implemented in the Management Area).

| Activity Type | Miles | Acres | Count* | Activity Description |
|---|---|---|---|---|
| **Riparian** | 647 | 307 | | Planting streamside vegetation, channel modification such as creation of side channels or alcoves, fencing, streambank stabilization and invasive plant treatment |
| **Fish Passage** | 206 | | 267 | Replacing structures to provide fish passage such as culverts, bridges, fish ladders and screening diversions |
| **Instream** | 120 | | | Placing large wood and beaver introduction |
| **Instream Flow** | 34 | | | Water conservation such as irrigation improvements |
| **Wetland** | | 9 | | Wetland enhancement or previously filled or drained wetlands, |
| **Road** | 246 | | 1,012 | |
| **Upland** | | 440 | | Livestock manure management, grazing management, implementing erosion control practices, invasive plant treatment, |
| **TOTAL** | 1,254 | 756 | 1,279 | |

* # of hardened crossings, culverts, etc.

## 4.3 Water Quality and Land Condition Monitoring

### 4.3.1 Water Quality

#### 4.3.1.1 DEQ Statewide Status and Trends Report

DEQ evaluated dissolved oxygen, *E. coli*, pH, temperature, total suspended solids and total phosphorus, and temperature data from 175 monitoring sites in the Management Area. Thirty-five stations had data from 2016-2019 (DEQ. Oregon Water Quality Status and Trends Analysis. 2020. https://www.oregon.gov/deq/wq/programs/Pages/wqstatustrends.aspx).

Nine stations had sufficient data to evaluate trends and recent attainment of water quality attainment standards. Table 4.3.1.1 summarizes water quality conditions at sites potentially influenced by agricultural land use.

**Table 4.3.1.1 Trends and Attainment of water quality standards from 2016 to 2019**

| Site Description | Site ID | Parameter | | | | | |
|---|---|---|---|---|---|---|---|
| | | ***E. coli*** | **pH** | **Dissolved Oxygen** | **Temperature** | **Total Phosphorus (mg/L)** | **Total Suspended Solids (mg/L)** |
| | | **Attainment Status and Trend** | | | | Median; maximum[1] | Median; maximum[2] |
| *Stations with ≥20% Agriculture or ≥40% combined agriculture/range per the Status and Trends Report. These stations had sufficient data to evaluate trends and recent attainment of water quality standards.* | | | | | | | |
| Mary's River at 99W (Corvallis) | 10373 | No | Yes | No ↑ | - | (0.06;0.13) | (7;36) |
| Long Tom River at Stow Pit Road (Monroe) | 11140 | No | Yes ↓ | No ↓ | - | (0.06;0.13) | (11;22) ↓ |
| Muddy Creek south of Corvallis at Airport Ave. | 36790 | No | Yes | No | - | (0.1;0.23) | (9;32) |
| Luckiamute River at Buena Vista Road | 36875 | Yes | Yes | No | - | (0.04;0.17) | (5;58) ↑ |
| *With the exception of 25989, these sites represent ≥16% agriculture or ≥34% combined agriculture/range per the Status and Trends Report. Site 25989 (River Mile 119) is near 10350 (River Mile 119.4).* | | | | | | | |
| Willamette River at Keizer, OR (USGS Site) | 14192 015 | - | - | - | No | - | - |
| Willamette River at Albany (eastbound Hwy 20 bridge) | 10350 | - | Yes | - | - | (0.05;0.13) ↑ | (6;24) |
| Willamette River at Albany, OR | 25989 | - | - | - | No ↑ | - | - |
| Willamette River at Old Hwy 34 Bridge (Corvallis) | 10352 | Yes | Yes | Yes | - | (0.045;0.1) ↑ | (5;20) |
| Willamette River at Marion Street (Salem) | 10555 | Yes | Yes | Yes ↑ | - | (0.04;0.14) ↑ | (4;40) |

[1] DEQ has no benchmark for total phosphorus in this Management Area; ODA benchmark for potential water quality concerns = 0.08 mg/L

[2] DEQ has no benchmark for total suspended solids in this Management Area

↑ Statistically significant improving trend

↓ Statistically significant degrading trend

Data indicate concerns with:

- Declining water quality at Long Tom River at Slow Pit Road. The site did not attain dissolved oxygen or *E. coli* standards. There was one *E. coli* excursion (six times the standard). The site had degrading trends for pH, dissolved oxygen, and total suspended solids.
- *E. coli* and dissolved oxygen at Mary's River at 99W (Corvallis). The site did not attain standards for either parameter, but dissolved oxygen has improved.
- *E. coli*, dissolved oxygen, and total phosphorus at Muddy Creek south of Corvallis at Airport Ave. The site did not attain *E. coli* and dissolved oxygen standards. At least half of total phosphorus values exceeded the ODA benchmark.
- Dissolved oxygen and temperature in the Luckiamute River watershed. The Luckiamute River at Buena Vista Road site did not attain dissolved oxygen standards. DEQ also assessed temperature attainment at twenty sites in the Luckiamute River watershed (not included in Table 4.3.1); seventeen sites, including a cluster in the Kings Valley area, did not attain the standard. Total suspended solids concentrations are improving, despite having the highest concentrations of all the sites included in this analysis.
- Temperature in the mainstem Willamette River. Temperature did not attain standards at Keizer or Albany. The Albany site had an improving temperature. Temperature is driven by flow in the Willamette River and is unlikely to be related to agricultural actifvities.

Data also indicate that, with exception of temperature, water quality at the mainstem Willamette sites are attaining *E. coli*, pH, and dissolved oxygen standards. Total phosphorus concentrations were above ODA benchmarks, but are statistically improving. Total suspended solids concentrations were near or below concentrations detected in tributaries. Unfortunately, these water quality data are insuficient to determine the source of the impairments and how much to attribute to agricultural activities.

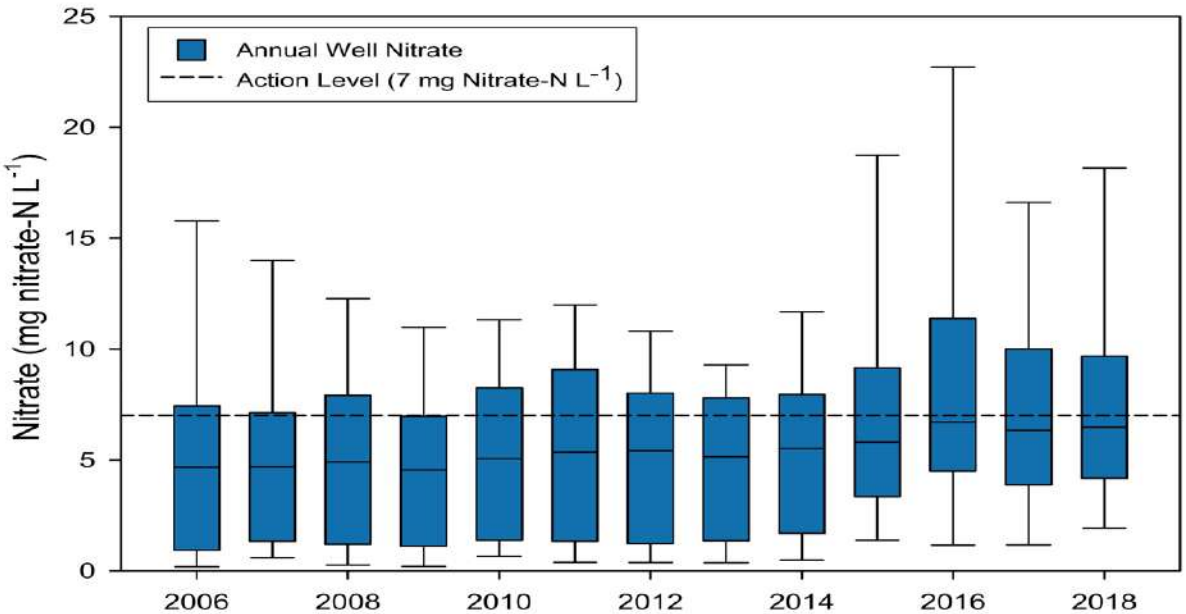
#### 4.3.1.2 SWV GWMA

Actions completed by the SWCDs over the biennium can be found in Appendix B.

**Status and trends from DEQ long-term groundwater monitoring sites in the SWV GWMA (Based on Piscitelli, 2019)**

From 2006 to 2019, 33 percent of the mean well concentrations in the SWV GWMA exceeded Oregon's 7 mg/L nitrate-N Action Level, and 12 percent exceeded EPA's Maximum Contaminant Level (MCL) of 10 mg/L nitrate-N. Approximately 57 percent of the wells showed an increase in nitrate throughout the total study period (2006-2011 mean = 5.41 mg/L; 2012-2019 = 6.28). The findings indicate an increase in groundwater nitrate concentrations over the last 14 years despite greater public awareness of the issue in the SWV GWMA,. Statistical analyses identified confined animal feeding operations, well recharge source, and surface nitrogen fertilizer inputs to be significant drivers of nitrate concentrations. It is not clear why the nitrate concentrations are increasing. To address this nitrate contamination problem, future efforts may need to find new and different approaches to improve drinking water quality in the SWV GWMA.

**Figure 4.1.5.** Nitrate concentrations in 34 well water monitoring sites over time in the SWV GWMA. The box represents the 25th to the 75th percentile of the data, while the whiskers represent the 5th and 95th percentile. The horizontal line is the median concentration, which has increased over time. (From Piscitelli, 2019).




## <u>4.3.2 Land Conditions: DEQ Assessment of Stream Shading</u>

The following section describes the results of DEQ's assessment of streamside vegetation and shade in the Southern Willamette Basin. The assessment shows that conditions are sufficient in some areas, and highlights where ODA and partners should focus efforts in the future.

In the 2019 presentation, "Assessing the Status of Riparian Restoration, Protection, and Shading in the Southern Willamette Basin", DEQ summarized stream shading within 246 feet (75 m) of perennial and intermittent streams in the southern half of the Willamette Basin. The presentation and results are posted at: www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-Willamette-Basin.aspx#implementation.

For all land uses in the Southern Willamette study area, the average current shade is 66%, and the average target shade in the TMDL is 92%. The difference between the current shade and the target shade, or "shade gap" (additional shade needed to achieve the target) is 26%.

For agricultural streams in the Southern Willamette study area, the average current shade is 33%, the average target shade in the TMDL is 82%, and the shade gap (additional shade needed to achieve the target) is 49%.

Figure 4.3.2a shows the model results for current shade (blue) and target shade (gray) for agricultural streams only: for the entire study area, for this Management Area, and for the four watersheds in this Management Area. The shade gap on agricultural streams in this Management Area is somewhat smaller (41%) than for the entire DEQ study area (49%). The shade gap on agricultural streams in the four watersheds varies from 35% to 50%.

***Figure 4.3.2a: Shade results for agricultural lands, across the entire study area, this Management Area, and the four watersheds in this Management Area***

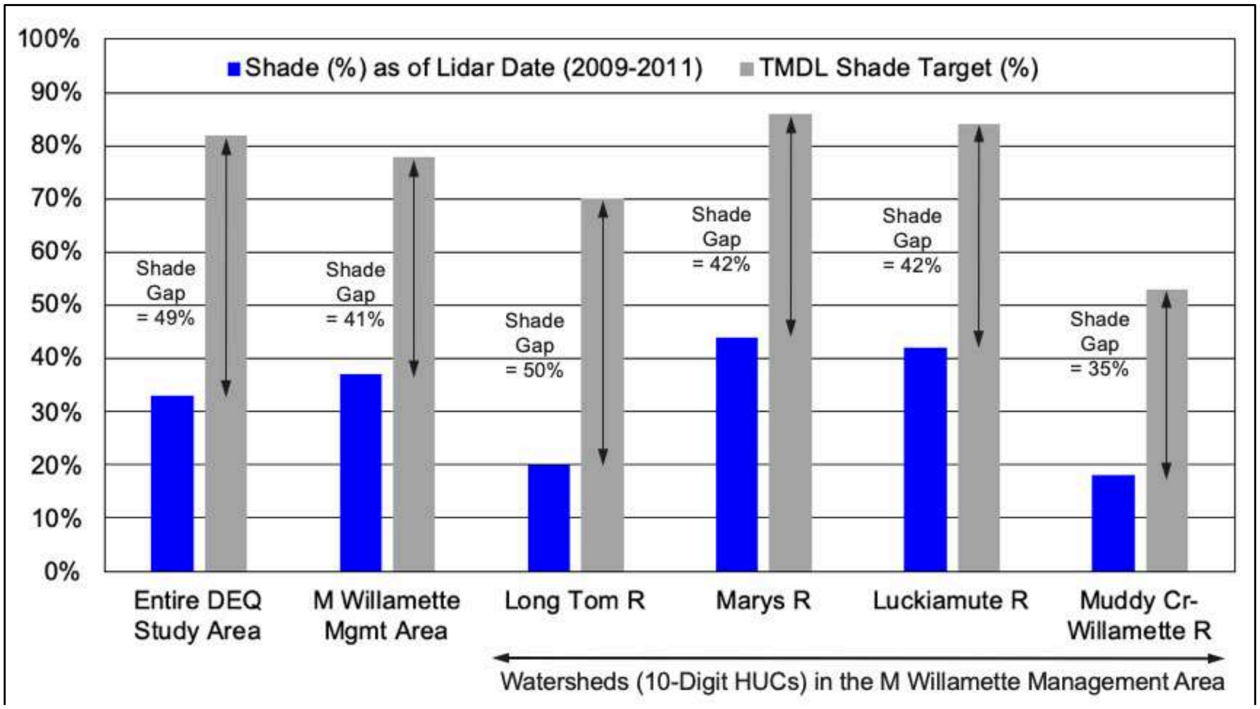
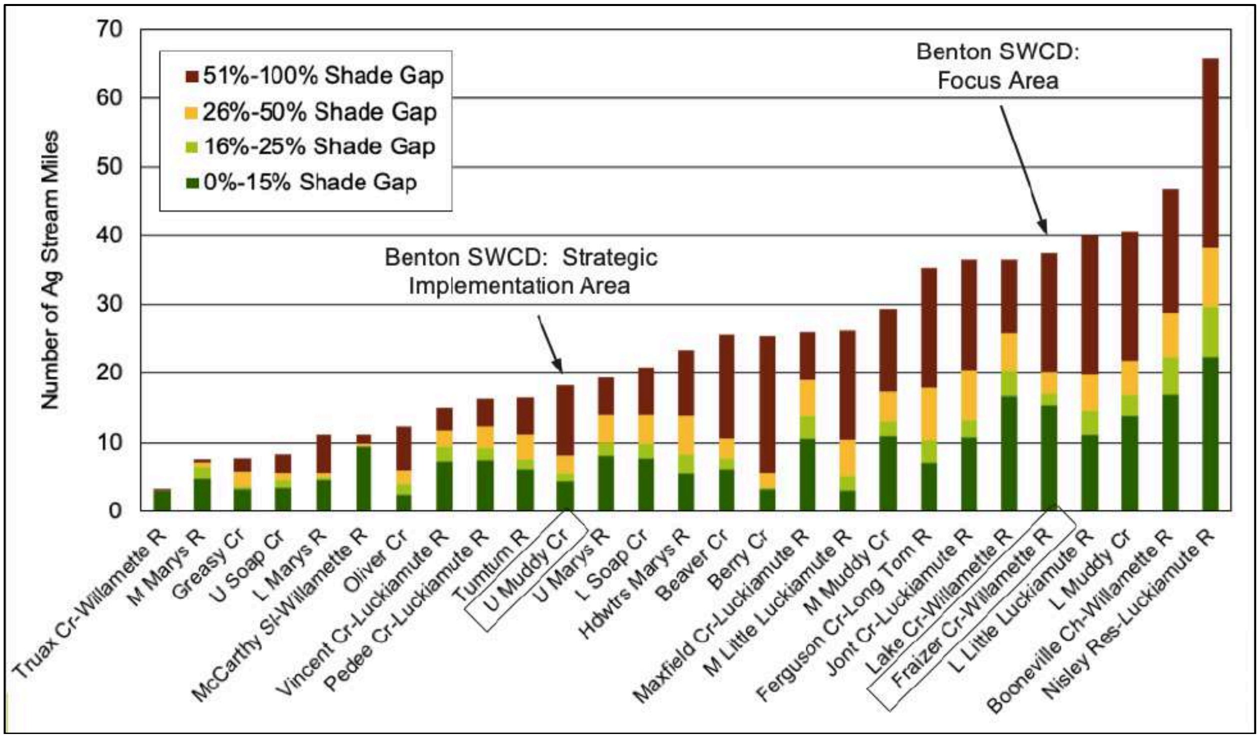



Figure 4.3.2b shows the model results for the number of agricultural stream miles in each of the 27 smaller watersheds in this Management Area, and the number of stream miles that have lesser to greater shade gaps. The shade gaps on agricultural lands vary considerably in these watersheds, from 6% in the Middle Marys River sub-watershed to 68% in the Berry Creek sub-watershed. Figure 4.3.2b also identifies Benton SWCD's current SIA and Focus Area, which were selected before ODA had access to the DEQ shade results. Polk SWCD's SIA and Focus Area are located outside of the DEQ study area. The results by smaller watershed can be used to help prioritize future implementation, e.g. to select future SIAs or Focus Areas.

*Figure 4.3.2b: Number of stream miles on agricultural lands with lesser to greater shade gaps for each smaller watershed in this Management Area; watersheds are arranged by number of agricultural stream miles (lowest to left, highest to right)*




Completed streamside vegetation restoration projects in this Management Area (Table 4.2c) have contributed to current shade levels, and as the vegetation grows, it will contribute additional shade over time. Instream restoration projects that add channel complexity also help to reduce stream temperatures.

ODA and partners plan to use the information from the DEQ shade assessment to identify where to focus work in the future. The assessment also helps ODA and partners to understand how changes to land conditions improve water quality, and how much remains to be done. This will help ODA and partners to set objectives for future improvements. ODA, DEQ, the LMA, and the LAC recognize that TMDL implementation is a community effort that may take decades. DEQ is interested in calculating updated shade levels within the next few years, to document additional progress.

## 4.4 Biennial Reviews and Adaptive Management

ODA, the LAC, the LMA, and other partners met on October 21, 2020 to review implementation of the Area Plan and provided recommendations for the future (Tables 4.4a and 4.4b).

**Table 4.4a Summary of biennial review discussion**

| **Summary of Progress and Impediments** |
|---|
| Progress<br>1. SWCDs are doing a great job of outreach. They are confident about meeting ambitious goals.<br>2. Research/monitoring studies are providing more information now on which to base decision-making<br>3. Research in the Management Area is being carefully done. Great to use OSU students.<br>Impediments<br>1. Lack of data on condition of riparian vegetation throughout the Management Area, especially invasives, beyond just shade.<br>2. WQ data are inadequate to identify which WQ issues are related to human activities (ag and non-ag) and which ones are natural.<br>3. Lack of data about how management strategies have affected land conditions (riparian and uplands) and WQ.<br>4. Beaver numbers are increasing. Beavers benefit the health of riparian areas, but also kill trees that could provide shade.<br>5. Hard to show improvements in stream temperature when it takes 20 years for a tree to grow large enough to provide shade.<br>6. Inadequate time and money for research on riparian vegetation and water quality and how they are being affected by ag practices over time.<br>7. ODA keeps changing the focus of the LAC meetings and Area Plan, for instance asking for different things to be addressed. |
| **Recommended Modifications and Adaptive Management** |
| 1. Develop monitoring project to establish baseline and track riparian vegetation conditions (this is a challenging request).<br>2. Develop more monitoring projects that track project implementation in conjunction with land condition/water quality (in addition to Focus Areas and SIAs).<br>3. Develop WQ monitoring project that can measure trends and identify sources.<br>4. Track beaver activity as part of monitoring riparian vegetation conditions<br>5. Track weather as part of tracking riparian vegetation/WQ over time.<br>6. Track economic variables (e.g. price of fertilizer or grass seed) as part of tracking riparian vegetation/WQ over time to better dynamics of implementation of practices.<br>7. Keep the LAC focused over time on addressing specific items, e.g. SWV GWMA and monitoring possibilities.<br>8. Implement more creative ways to provide landowners with technical and financial assistance to meet WQ goals. |

**Table 4.4b Number of compliance actions in 2015-2018.**

| Actions | Letter of Compliance | Pre-Enforcement Notification | Notice of Noncompliance | Civil Penalty |
|---|---|---|---|---|
| Compliance Actions Outside SIA(s) | 3 | 0 | 0 | 0 |
| Compliance Actions Within SIA(s) | 0 | 0 | 0 | 0 |

The Letters of Compliance cases concerned riparian and sediment issues. One case related to a Department of State Lands Removal Fill Law issue. ODA identified no potential violations in the SIA.

# Literature Cited


Benton County Geographic Information Systems, personal communication, March 2001.

Beschta, R.L. 1997. Riparian shade and stream temperature: an alternative perspective. Rangelands 19:25-28.

Bilby, R.E. 1984. Characteristics and frequency of cool-water areas in a western Washington stream. Journal of Freshwater Ecology 2:593-602.

Brown, G.W. 1969. Predicting stream temperatures of small streams. Water Resources Research 5:68-75.

Budeau, D. Personal communication, February, 2001.

Center for Population Studies. 2013. Population estimates for Oregon cities. Portland State University, Portland, Oregon.

Chen, D.Y., R.F. Carsel, S.C. McCutcheon, and W.L. Nutter. 1998. Stream temperature simulation of forested riparian areas. Journal of Environmental Engineering 124:316-328.

Clark, A. 1998. Landscape variables affecting livestock impacts on water quality in the humid temperate zone. Canadian Journal of Plant Science 78:181-190.

Knezevich, C. 1975. Soil survey of Benton County, Oregon. United States Department of Agriculture, Washington, D.C.

Knezevich, C. 1982. Soil survey of Polk County, Oregon. United States Department of Agriculture, Washington, D.C.

Krueger, W.C., T.K. Stringham, and C.E. Kelley. 1999. Environmental and management impacts on stream temperature. Final report. Department of Rangeland Resources. Oregon State University, Corvallis, Oregon.

Larson, L.L. and S.L. Larson. 1996. Riparian shade and stream temperature: A perspective. Rangelands 18:149-152.

Mikkelsen, R.L., and J.W. Gilliam. 1995. Transport and losses of animal wastes in runoff from agricultural fields. p. 185–188. *In* C.C. Ross (ed.) Proceedings of the 7th International Symposium on Agricultural and Food Processing Wastes. ASAE, St. Joseph, MI.

Moore, J.A. and J.R. Miner. 1997. Stream temperatures: some basic considerations. Ext. Cir. EC-1489. Oregon State University Extension Service, Corvallis, Oregon.

Naiman, R.J. and H. Decamps. 1997. The ecology of interfaces: Riparian zones. Annual Review of Ecology and Systematics 28:621-658.

Oregon Department of Environmental Quality. 2007. Reducing Mercury Pollution in the Willamette River. Oregon Department of Environmental Quality, Portland Oregon.

Piscitelli, C.M., 2019. A Trend Analysis of Nitrate in the Southern Willamette Valley Groundwater Management Area (GWMA). M.S. Thesis. Oregon State University, Corvallis, OR.

Pojar, J. and A. MacKinnon. 1994. Plants of the Pacific Northwest Coast. Lone Pine Publishing,

Sherer, B.M., J.R. Miner, J.A. Moore, and J.C. Buckhouse. 1992. Indicator bacterial survival in streams and sediments. Journal of Environmental Quality 21:591–595.

Taylor, G. and Hannan. 1999. The climate of Oregon. Oregon State University Press, Corvallis, Oregon.

Terrell, C.R., and Perfetti, P.B. 1989. Water quality indicators guide: surface waters. Natural Resources Conservation Service, Washington, D.C.

Ward, J.V. 1985. Thermal characteristics of running waters. Hydrobiologia 125:31-46.

# Appendix A: References for Water Quality Improvement Practices

Below is a list of some selected references with more specific information on water quality and natural resources improvement practices. Copies of many of these publications are available from the local Oregon State University Extension office or local SWCD. Underlined publications are also available online on the publishing agency's website.

### General Water Quality Protection

Adams, E.B. 1992. Farming practices for groundwater protection. Washington State University, Spokane, Washington.

Hermanson, R.E. 1994. Care and feeding of septic tanks. Washington State University, Spokane, Washington.

Hirschi, M. et al. 1994. 50 ways farmers can protect their groundwater. University of Illinois, Urbana, Illinois.

Hirschi, M., et al. 1997. 60 ways farmers can protect surface water. University of Illinois, Urbana, Illinois.

Ko, L. 1999. Tips on land and water management for small acreages in Oregon. Oregon Association of Conservation Districts, Portland, Oregon.

U.S. Department of Agriculture Natural Resources Conservation Service. 1998. National Handbook of Conservation Practices. U.S. Department of Agriculture Natural Resources Conservation Service, Portland, Oregon.

**Riparian Areas and Streams**

Adams, E.B. 1994. Riparian Grazing. Washington State University, Spokane, Washington.

Darris, D. and S.M. Lambert. 1993. Native willow varieties for the Pacific Northwest. U.S. Department of Agriculture Soil Conservation Service, Corvallis Plant Materials Center, Corvallis, Oregon.

Nash, E. and T. Mikalsen, eds. 1994. Guidelines for streambank restoration. Georgia Soil and Water Commission, Atlanta, Georgia.

South Santiam Watershed Council. 1998. Guide for using Willamette Valley native plants along your stream. Linn Soil and Water Conservation District, Tangent, Oregon.

### Nutrient and Manure Management

Godwin, D. and J.A. Moore. 1997. Manure management in small farm livestock operations: protecting surface and groundwater. Oregon State University, Corvallis, Oregon.

Hart, J. 1995. How to take a soil sample…and why. Oregon State University, Corvallis, Oregon.

Hart, J. 1999. Analytical laboratories serving Oregon. Oregon State University, Corvallis, Oregon.

Marx, E.S., J. Hart, and R.G. Stevens. 1999. Soil Test Interpretation Guide. Oregon State University, Corvallis, Oregon.

Moore, J. and T. Willrich. 1993. Manure management practices to reduce water pollution. Oregon State University, Corvallis, Oregon.

Sattell, R. et al. 1999. Nitrogen scavenging: using cover crops to reduce nitrate leaching in western Oregon. Oregon State University, Corvallis, Oregon.

### Grazing and Pasture Management

Ursander, D. et al. 1997. Pastures for Profit: a guide to rotational grazing. University of Wisconsin, Madison, Wisconsin.

### Erosion and Sediment Control

Hansen, H. and W. Trimmer. 1997. Irrigation runoff control strategies. Oregon State University, Corvallis, Oregon.

Trimmer, W. and H. Hansen. 1994. Irrigation scheduling. Oregon State University, Corvallis, Oregon.

### Pesticide Management and Integrated Pest Management

Kerle, E.A., J.J. Jenkins, and P.A. Vogue. 1996. Understanding pesticide persistence and mobility for groundwater and surface water protection. Oregon State University, Corvallis, Oregon.

Menzies, G., C.B. MacConnell, and D. Havens. 1994. Integrated pest management: effective options for farmers.

# Appendix B: SWV GWMA Agricultural Action Plan and connection to this Area Plan

This table provides information about the Goals, Objectives and Actions identified in the SWV GWMA. These actions are carried out by many different partners. The second column indicates the actions implemented by ODA and Benton SWCD as part of the Area Plan.

| Goals for Agricultural Lands in the SWV GWMA | Connection to MWUS Area Plan |
|---|---|
| Goal 1: Prevent and control pollution of groundwater from agricultural activities and achieve applicable water quality standards that protect beneficial uses through voluntary management actions.<br>Goal 2: Reduce existing concentrations of nitrate and prevent further contamination from agricultural sources of groundwater in the GWMA. Identify: practices contributing to contamination, best management practices to prevent nitrogen inputs to groundwater, and a schedule for implementation of actions. | The goals of the GWMA and the Area Plan are very similar. The Area Plan goal is at the beginning of Chapter 3.<br><br>Practices related to GWMA Goal 2 are identified in Chapter 2.5 of this Plan. |
| **Objective 1: Education and Outreach**<br>Organize education and outreach efforts to increase the agricultural community's awareness of groundwater vulnerability and best management practices. | |
| Strategy 1.1 Within the GWMA, coordinate agricultural surface and groundwater pollution control efforts. Coordinate groundwater pollution control efforts among the various agriculture-related organizations and plans in the GWMA.<br>Actions<br>• Annually evaluate the Benton SWCD Scope of Work to include groundwater quality tasks. These tasks should focus on nitrogen use efficiency, irrigation use efficiency, and manure management.<br>• During biennial reviews of the Area Plan, update groundwater quality items in the Goals and Objectives. The Area Plans Goals and Objectives sections should include a focus on nitrogen use efficiency, irrigation efficiency, and manure management.<br>• Communicate to NRCS local work groups the priority of spending funds on nutrient use efficiency, irrigation efficiency, and manure management within the GWMA. | Benton SWCD's Scope of Work is reviewed quarterly as part of the OWEB Capacity Grant; it include tasks that relate to the SWV GWMA Action Plan.<br><br>The SWV GWMA Agricultural Actions are identified in Chapter 2.5, 3.2, 4.2 and in this Appendix.<br><br>ODA and Benton SWCD participate annually on NRCS Local Work Groups to advocate for funding for SWV GWMA implementation. |
| Strategy 1.2 Organize and deliver workshops and demonstration projects aimed at producers to show BMP implementation and increase BMP adoption. At the workshops, educate producers about groundwater conditions, populations at risk from high nitrate levels, federal assistance programs, and sustainable agriculture opportunities.<br>Actions<br>• Each SWCD develop one demonstration project showcasing successful BMPs and systems. | See Chapter 3.2 and 4.2 for targets and results.<br><br>A Joint LAC and GWMA Field Tour is being proposed for summer or fall of 2021. GWMA demonstrations projects are intended to be included in the tour. |

| | |
|---|---|
| • Organize one tour (field or virtual) of each demonstration project for agricultural managers and producers. Partner with agribusiness for tours of demo projects.<br>• Each year partners sponsor two small acreage resource management workshops that provide presentations (either as a stand-alone presentation or part of a broader presentation) on surface and groundwater quality issues.<br>• Include information on sustainable practices, incentive programs, and third-party certification at the workshops. The goal is to attract 100 producers annually to the demonstrations and workshops. | |
| Strategy 1.3 Write and publish articles to promote/improve the agricultural community's awareness of water quality issues in the GWMA.<br>Actions<br>• Once per year, provide an update on the status of the GWMA and associated water quality data in the Benton SWCD newsletter. The Linn and Upper Willamette SWCDs do not have a newsletter, and therefore, should provide an update to be included in a partner newsletter or other media source.<br>• Publish two media articles or public service announcements per year in the GWMA about successful agricultural resource management practices. | DEQ publishes a SWV GWMA newsletter that includes water quality status information and successful agricultural resource management practices.<br><br>The Benton SWCD began publishing a newsletter which provides an opportunity to include information about SWV GWMA status and associated water quality data as well as information about successful agricultural management practices. |
| Strategy 1.4 Share information and coordinate with agribusiness, producers, and producer groups to promote practices and conditions that protect and improve water quality.<br>Actions<br>• Follow-up meeting with agribusiness field representatives active in the GWMA to review the groundwater nitrate issue and share appropriate outreach materials. This should occur in 2012 and once every three years thereafter. Possible ways to meet with field representatives include:<br>  o Grower meetings<br>  o Individual company meetings<br>  o Oregon Agriculture Chemical and Fertilizer safety training workshops<br>• 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.<br>• SWCDs will make at least 100 contacts (total) with landowners about groundwater quality per year within the GWMA.<br>• Provide or develop outreach materials for producers that summarizes practical resource management for groundwater quality. | Table 3.2 indicates what the Benton SWCD plans to do over the next four years. Note that some of these actions are completed and some can be carried out on an ongoing basis.<br><br>Table 4.2 indicates what the Benton SWCD implemented over the past two years. |
| **Objective 2: Resource Management—Implement BMPs in the GWMA to improve groundwater quality.** | |

| | |
|---|---|
| Strategy 2.1 Work with agricultural producers in the GWMA to implement practices to improve groundwater quality.<br>Actions<br>• Provide technical assistance to producers in the GWMA. Each SWCD will have a minimum of ten contacts with producers within the GWMA annually promoting irrigation efficiency, and nutrient and manure management.<br>• Promote proper nutrient management, irrigation efficiencies, and manure management to reduce nitrogen loss to groundwater. Each SWCD will work with two producers within the GWMA annually to design and implement best management practices. | The Benton SWCD works with producers on an ongoing basis to provide technical assistance. See 3.2 and 4.2 for targets and results. |
| Strategy 2.2 Obtain sufficient financial assistance to support technical assistance to producers and implementation of resource management practices.<br>Actions<br>• Include tasks in the SWCDs Scopes of Work for technical assistance to producers and to seek funds for implementation of practices related to groundwater quality.<br>• Communicate to NRCS local work groups the priority of spending funds on nutrient use efficiency, irrigation efficiency, and manure management within the GWMA.<br>• Include the promotion and support of USDA programs such as the Environmental Quality Incentives Program and the Conservation Reserve Enhancement Program into SWCD work plans and Scopes of Work.<br>• Seek funds from USDA incentive based financial assistance programs to assist producers to implement groundwater protection practices.<br>• Seed DEQ 319 funds to assist with agricultural on-the-ground projects and management practices that minimize groundwater nitrate pollution. | SWCD Scopes of Work include tasks for providing technical assistance to producers and for seeking funding for the implementation of resource management practices.<br><br>The SWCD and ODA participate on annual NRCS Local Work Groups to communicate the need for SWV GWMA implementation consideration. |
| Strategy 2.3 Develop and target a priority area within the GWMA to evaluate progress related to implementation of the Agricultural Water Quality Plans and GWMA Action Plan. (The purpose of the priority area is to evaluate the area before and after targeting and demonstrate progress. Progress is a measurement of improvement of water quality parameters or surrogates.) As resources and time allows, multiple priority areas will be identified for targeting.<br>Actions<br>• Identify a priority area to target education, outreach, and other resources. This area should be identified by July 2013.<br>• Identify BMPs that will be promoted for improvement of groundwater quality. | ODA Focus Areas<br>Benton SWCD's Jackson-Frazier Focus Area provides an opportunity for the SWCD to provide targeted education, outreach and other resources to producers who manage lands within the Focus Area.<br>ODA Strategic Implementation Area<br>Benton SWCD's Upper Muddy SIA is just outside the SWV GWMA. Opportunities to provide GWMA |

| | |
|---|---|
| • Identify management practices or conditions that assure agricultural contributions of nitrate to groundwater are at acceptable levels.<br>• Measure soil nitrate levels at enough sites in the priority area to assess potential of nitrate leaching.<br>• Contact all landowners within the priority area with information on the GWMA and best management practices to reduce nitrate inputs.<br>• Develop targets and milestones specific to the priority area.<br>• Implement management practices with all willing landowners in the priority area. | related outreach occurs even though the SIA is not officially within the GWMA boundary.<br>Neighborhoods Project<br>In 2017 SWV GWMA partners identified an area within the GWMA where nitrates have been persistently high. ODA is working with producers in this area on an ongoing basis to identify potential practices to test ideas that may lead to reduced nitrates. |
| Strategy 2.4 Obtain adequate funding for implementation of desired practices within the priority area.<br>Actions<br>• Develop implementation and funding plan for the identified priority area.<br>• Work with producers in the priority area to determine interest in implementation of specific practices.<br>• Work with partners to submit funds proposals to cost-share implementation of practices. | An ODA fertilizer grant was sought for the Neighborhoods Project during 2019 but was not funded. |
| **Objective 3: Monitoring and Research**—Monitor groundwater quality in agricultural areas to evaluate the impacts of agricultural management practices. Research best management practice effectiveness, adoption of best management practices, and priority research needs. | |
| Strategy 3.1 Evaluate current domestic and monitoring wells to determine monitoring needs in agricultural areas.<br>Actions<br>• Coordinate with local, state, and federal partners to evaluate current surface and groundwater monitoring network and identify additional monitoring needs, by January 2013.<br>• Evaluate aquifer characteristics to determine whether the existing monitoring wells provide comprehensive data on nitrate concentrations or if additional wells are necessary to monitor nitrate levels in the GWMA.<br>• Evaluate LiDAR (light detection and ranging) data to understand connections between wells. | Completed (see SWV GWMA web page). |
| Strategy 3.2 Measure the success of BMPs implementation efforts.<br>Actions<br>• Measure producer (within the priority area from Strategy 2.3):<br>    o Awareness of groundwater quality issues,<br>    o Level of BMPs implementation,<br>    o Ease of implementing BMPs, and<br>    o Barriers to BMPs implementation. | See SWV GWMA web page.. |

| | |
|---|---|
| • This measurement should be completed in the fall of 2013 and repeated two years later to determine any changes. Target: 50% of the producers surveyed in 2013 using groundwater protection BMPs as identified by groundwater staff and agricultural partners. | |
| Strategy 3.3 Document groundwater related investigations and violations of Area Rules and CAFO permit conditions within the GWMA.<br>Actions<br>• Document the number, issue, validity, and outcome investigations regarding potential violations of Area Rules where the violations could impact groundwater.<br>• Document CAFO violations and outcomes. | See Table 4.4.b for a summary of water quality investigations and violations of the Area Rules. None of the violations within the biennium were related to ground water issues. |
| Strategy 3.4 Research, document and coordinate BMP effectiveness. Implement priority research identified at February 2010 researchers meeting.<br>Actions<br>• Follow-up to the February 2010 researchers meeting to track progress related to identified priority research and funding needs. Research needs identified include:<br>o Nitrogen budgets and BMPs for other and nontraditional crops (such as specialty seed crops)<br>o Nitrogen mineralization under different crop scenarios<br>o Bioreactors on tile lines<br>o Time of groundwater travel (data needs improved)<br>o No till vs. conventional (difference in cost and potential leaching)<br>o Study nitrate sources and how nitrate moves<br>o Impact of tile lines on nitrate concentration and movement<br>• Maintain a prioritized research plan and identified sources of funding.<br>• Work with OSU or other partners to design a nitrate leaching study to further characterize potential nitrate leaching from various agricultural sources in the GWMA.<br>• Implement research to measure BMP and systems effectiveness and identify factors affecting groundwater nitrate levels from agricultural practices.<br>• Research and document effectiveness and impacts of specific BMPs on nitrate leaching. | See SWV GWMA web page for research and monitoring results. |
| Strategy 3.5 Obtain sufficient funding to support priority research needs.<br>Actions<br>• Submit research grant applications to support high priority research needs. Potential grant sources include the DEQ 319 program, ODA's fertilizer research funds, EPA, the USDA, and other agencies and private organizations. | See SWV GWMA web page for information about funding.<br><br>An ODA fertilizer research grant was applied for to assist with the Neighborhoods Project, but was not funded. |