Middle Deschutes Agricultural Water Quality Management Area Plan

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Developed by the

Oregon Department of Agriculture

Middle Deschutes Local Advisory Committee

With support from the

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Acronyms and Terms Used in this Document

Ag Water Quality Program – Agricultural Water Quality Management Program
Area Plan – Agricultural Water Quality Management Area Plan
Area Rules – Agricultural Water Quality Management Area Rules
BLM – Bureau of Land Management
CAFO – Confined Animal Feeding Operation
cfs – cubic feet per second
CREP – Conservation Reserve Enhancement Program
CRP – Conservation Reserve Program
CWA – Clean Water Act
DEQ – Oregon Department of Environmental Quality
DMA – Designated Management Agency
DSL – Oregon Department of State Lands
EQIP – Environmental Quality Incentives Program
GWMA – Groundwater Management Area
HABs – Harmful Algal Blooms
HUC – Hydrologic Unit Code
IPM – Integrated Pest Management
LAC – Local Advisory Committee
LMA – Local Management Agency
Management Area – Agricultural Water Quality Management Area
MOA – Memorandum of Agreement
NOAA – National Oceanic and Atmospheric Administration
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
ODFW – Oregon Department of Fish and Wildlife
OHA – Oregon Health Authority
ORS – Oregon Revised Statute
OSU – Oregon State University
OWEB – Oregon Watershed Enhancement Board
PMP – Pesticides Management Plan
PSP – Pesticides Stewardship Partnership
RCA – Required Corrective Action
RUSLE – Revised Universal Soil Loss Equation
SIA – Strategic Implementation Area
SVAP – Streamside Vegetation Assessment Protocol
SWCD – Soil and Water Conservation District
T – Soil Loss Tolerance Factor
TMDL – Total Maximum Daily Load
USDA – United States Department of Agriculture
US EPA – United States Environmental Protection Agency
USFS – United States Forest Service
WPCF – Water Pollution Control Facility
WQPMT – Water Quality Pesticides Management Team

Foreword

This Agricultural Water Quality Management 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 through a combination of outreach programs, suggested land treatments, management activities, compliance, and monitoring.

The Area Plan is neither regulatory nor enforceable (Oregon Revised Statute (ORS) 568.912(1)). It references associated Agricultural Water Quality Management Area Rules (Area Rules), which are Oregon Administrative Rules (OARs) 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 state and federal law (OAR 603-090-0030(1)). At a minimum, an Area Plan must:

- Describe the geographical area and physical setting of the Management Area.
- List water quality issues of concern.
- List impaired beneficial uses.
- State that the goal of the Area Plan is to prevent and control water pollution from agricultural activities and soil erosion and to achieve applicable water quality standards.
- Include water quality objectives.
- Describe pollution prevention and control measures deemed necessary by ODA to achieve the goal.
- Include an implementation schedule for measures needed to meet applicable dates established by law.
- Include guidelines for public participation.
- Describe a strategy for ensuring that the necessary measures are implemented.

Plan Content

Chapter 1: Agricultural Water Quality Management Program Purpose and Background. The purpose is to have 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 available practices to address water quality issues.

Chapter 3: Implementation Strategies. Presents goal(s), measurable objectives, timelines, and strategies to achieve these goal(s) and objectives.

Chapter 4: Implementation, Monitoring, and Adaptive Management. ODA and the Local Advisory Committee (LAC) will work with knowledgeable sources to summarize land condition and water quality status and trends to assess progress toward the goals and objectives in Chapter 3.

Chapter 1: Agricultural Water Quality Management Program Purpose and Background

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

As part of Oregon's Agricultural Water Quality Management 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 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 developed to implement the Area Plan, 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 603-095-1600). The Ag Water Quality Program's general rules guide the Ag Water Quality Program, and the Area Rules for the Management Area are the regulations that landowners are required to follow. Landowners will be encouraged through outreach and education to implement conservation 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 a few 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 lands in Oregon is regulated by DEQ and on Tribal Trust lands by the respective tribe, with oversight by the United States Environmental Protection Agency (US EPA).

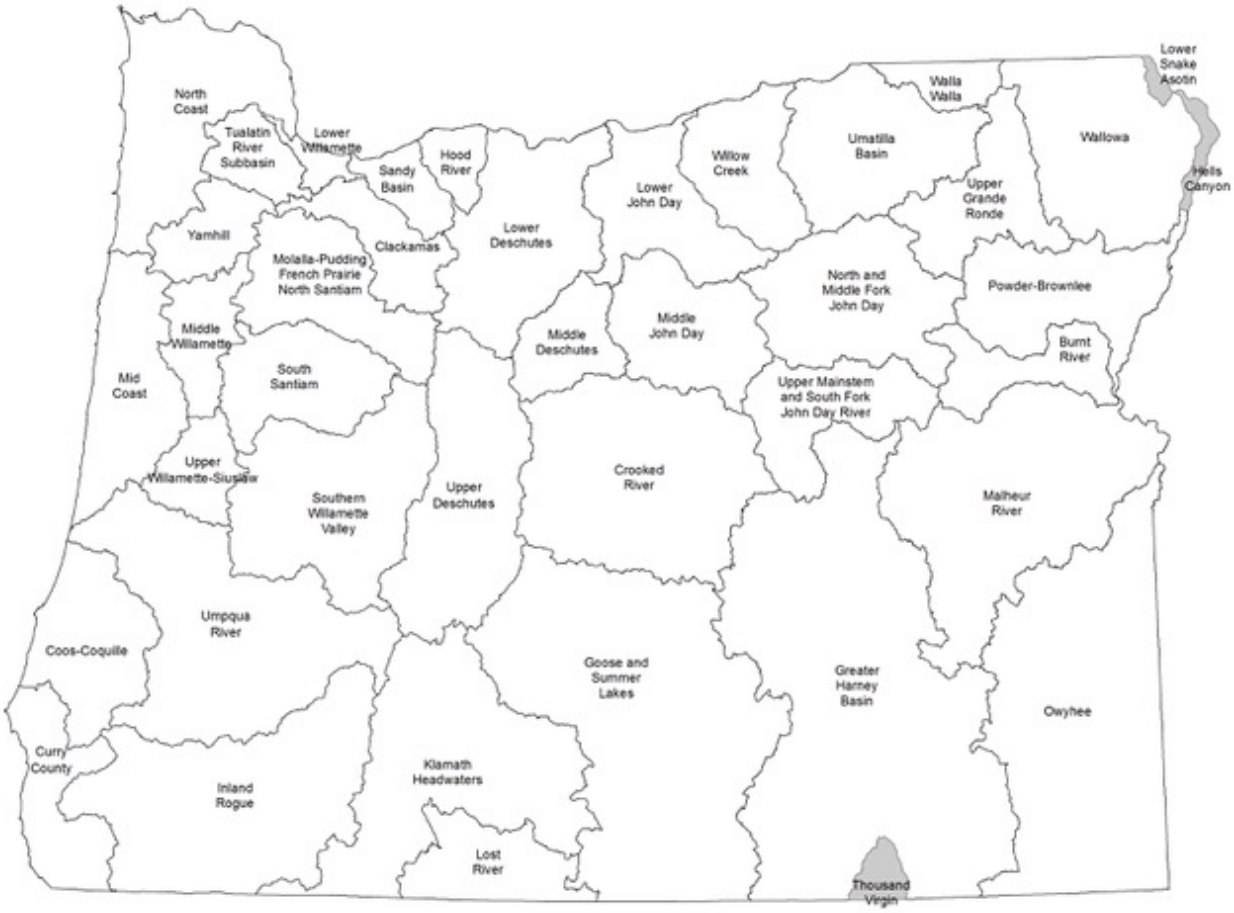
1.2 History of the Ag Water Quality Program

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, to achieve water quality standards, and to adopt rules as necessary (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). The Area Plan and Area Rules were developed and subsequently revised pursuant to these statutes.

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). 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: Map of 38 Agricultural Water Quality Management Areas
Grey areas are not incorporated into Ag Water Quality Management Areas



1.3 Roles and Responsibilities

1.3.1 Oregon Department of Agriculture

The Oregon Department of Agriculture 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 carry out a water quality management plan 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).

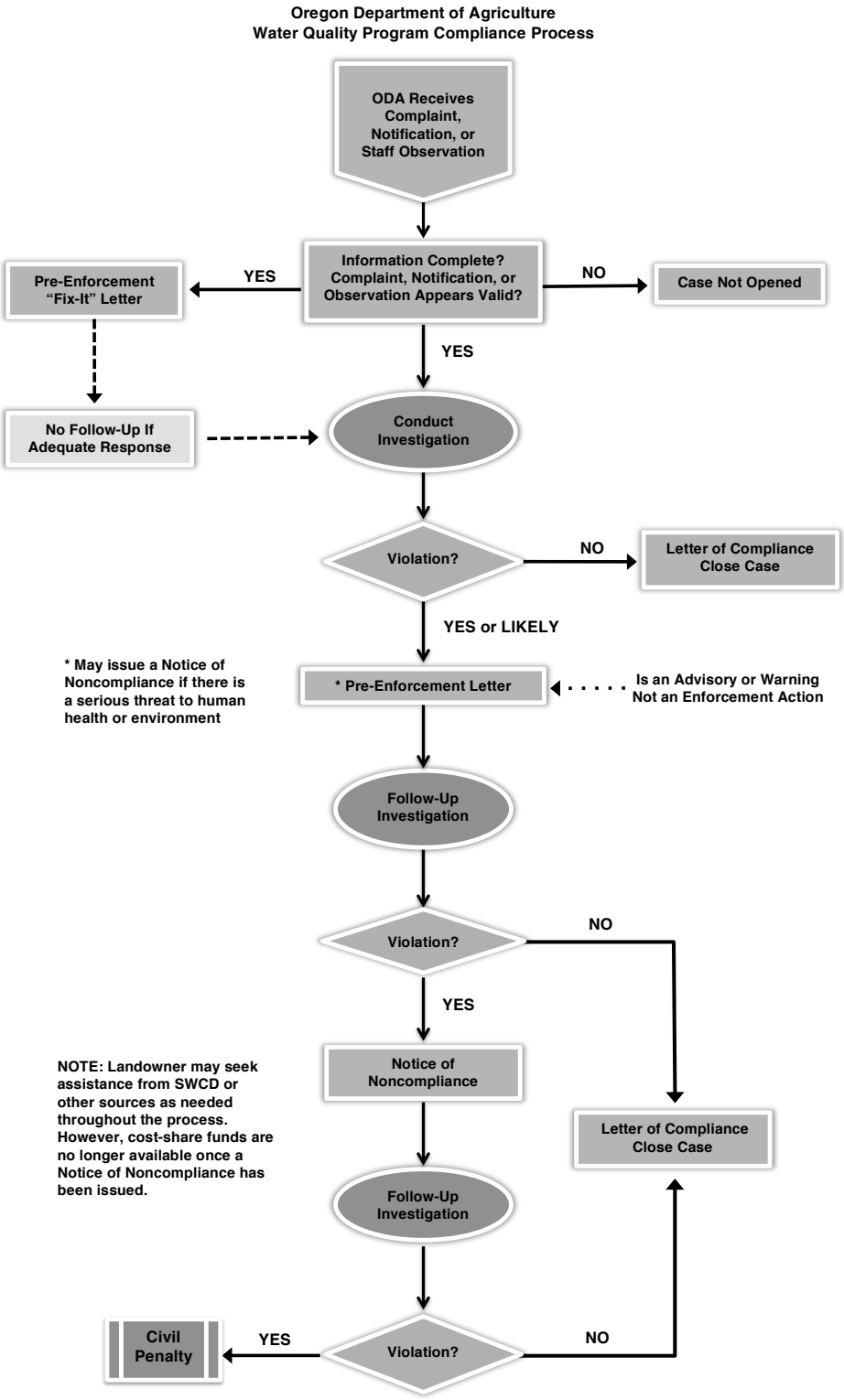
- Approved management measures for Coastal Zone Act Reauthorization Amendments (CZARA).
- Agricultural activities detailed in a Groundwater Management Area (GWMA) Action Plan (if DEQ has established a GWMA and an Action Plan has been developed).

The Oregon Department of Agriculture has the legal authority to develop and implement Area Plans and Area Rules for the prevention and control of water pollution from agricultural activities and soil erosion, where such plans are required by state or federal law (ORS 568.909 and ORS 568.912). 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. 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 gain compliance with Area Rules. Figure 2 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 the condition through required corrective actions (RCAs) 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 RCAs, ODA may assess civil penalties for continued violation of the 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.

Any member of the public may file a complaint, and any public agency may file a notification of a violation of an Area Rule. As a result, ODA may initiate an investigation (See Figure 2).

Figure 2: Compliance Flow Chart



1.3.2 Local Management Agency

A Local Management Agency (LMA) is an organization that ODA designated to assist with the implementation of an Area Plan (OAR 603-090-0010). The Oregon Legislature's intent is for SWCDs to 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 as many as 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 provide advice and direction to 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 their responsibilities, which include but are not limited to:

- Participate in the development and subsequent revisions of the Area Plan.
- Participate in the development and subsequent revisions of the 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. However, 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 a suite of measures to protect water quality. 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 also may 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:

- Conditions resulting from unusual weather events.

- Hot springs, glacial melt water, extreme or unforeseen 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

The public was encouraged to participate when ODA, LACs, and SWCDs initially developed the Area Plan and Area Rules. In each Management Area, ODA and the LAC held public information meetings, a formal public comment period, and a formal public hearing. ODA and the LACs modified the Area Plan and Area Rules, as needed, to address comments received. The director of ODA adopted the Area Plan and Area Rules in consultation with the Board of Agriculture.

The Oregon Department of Agriculture, the LACs, and the SWCDs 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 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. Significant 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 many are regulated under ODA's CAFO Program. Pesticide applications in, over, or within three feet of water also are regulated as point sources. Irrigation water flows from agricultural fields may be at a defined outlet but they do not currently require a permit.

Nonpoint 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 in OARs for each basin. They may include: public and private domestic water supply, industrial water supply, irrigation, livestock watering, fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, aesthetic quality,

hydropower, and commercial navigation and transportation. 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. Many of these waterbodies have established water quality management plans that document needed pollutant reductions. The most common water quality concerns related to agricultural activities are temperature, bacteria, biological criteria, sediment and turbidity, phosphorous, algae, pH, dissolved oxygen, harmful algal blooms (HABs), nitrates, pesticides, and mercury. Water quality impairments vary by Management Area and are summarized in Chapter 2.

1.4.3 Impaired Water Bodies and Total Maximum Daily Loads

Every two years, DEQ is required by the CWA to assess water quality in Oregon. CWA Section 303(d) requires DEQ to identify a list of waters that do not meet water quality standards. The resulting list is commonly referred to as the 303(d) list. In accordance with the CWA, DEQ must establish TMDLs for pollutants that led to the placement of a waterbody on the 303(d) list.

A TMDL includes an assessment of water quality data and current conditions and describes a plan to achieve conditions so that water bodies will meet water quality standards. TMDLs specify the daily amount of pollution a waterbody can receive and still meet water quality standards. In the TMDL, point sources are allocated pollution limits as "waste load allocations" that are then incorporated in National Pollutant Discharge Elimination System (NPDES) waste discharge permits, while a "load allocation" is established for nonpoint sources (agriculture, forestry, and urban). The agricultural sector is responsible for helping achieve the pollution limit by achieving the load allocation assigned to agriculture specifically, or to nonpoint sources in general, depending on how the TMDL was written.

Total Maximum Daily Loads generally apply to an entire basin or subbasin, not just to an individual waterbody on the 303(d) list. Water bodies will be listed as achieving water quality standards when data show the standards have been attained.

As part of the TMDL process, DEQ identifies the Designated Management Agency (DMA) or parties responsible for submitting TMDL implementation plans. TMDLs designate the local Area Plan 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.

For more general and specific information about Oregon's TMDLs, see: www.oregon.gov/deq/wq/tmdls/Pages/default.aspx. The list of impaired water bodies (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 ORS 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 of the Area Rules.

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 to prevent and control water pollution from agriculture activities and to prevent and control soil erosion. Streamside vegetation can provide three primary water quality functions: shade for cool stream temperatures, 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.

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

- Streamside vegetation can improve water quality related to multiple pollutants, including: temperature (heat), sediment, bacteria, nutrients, and toxics (e.g., pesticides, heavy metals, etc.).
- Streamside vegetation provides fish and wildlife habitat.
- Landowners can improve streamside vegetation in ways that are compatible with their operation.
- Streamside vegetation condition is measurable and can be used to track progress in achieving desired site conditions.

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. Site-capable vegetation is the 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 vegetation consistent with site capability 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 for 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 recognizes removal as a good conservation activity and encourages landowners to remove these plants. Voluntary programs through SWCDs and watershed councils provide technical assistance and financial incentives for weed control and restoration projects. In addition, the Oregon State Weed Board identifies invasive plants that can negatively impact watersheds. Public and private landowners are responsible for eliminating or intensively controlling noxious weeds as may be provided by state and local law enacted for that purpose. For further information, visit www.oregon.gov/ODA/programs/weeds.

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

The Oregon Department of Agriculture is the lead state agency for the CAFO Program. The CAFO Program was developed to ensure that operators do not contaminate ground or surface water with animal manure or process wastewater. Since the early 1980s, CAFOs in Oregon have been registered to a general Water Pollution Control Facility (WPCF) permit designed to protect water quality. A properly maintained CAFO must implement a site-specific suite of structural and management practices to protect ground and surface water. To assure continued protection of ground and surface water, the 2001 Oregon State Legislature directed ODA to convert the CAFO Program from a WPCF permit program to a federal NPDES program. ODA and DEQ jointly issue the NPDES CAFO permit, which complies with all CWA requirements for CAFOs. In 2015, ODA and DEQ jointly issued a WPCF general CAFO permit as an alternative for CAFOs that are not subject to the federal NPDES CAFO permit requirements. Currently, ODA can register CAFOs to either the WPCF or NPDES CAFO permit.

Both of the Oregon CAFO 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 about the CAFO program, go to www.oregon.gov/ODA/programs/NaturalResources/Pages/CAFO.aspx.

1.5.2 Groundwater Management Areas

Groundwater Management Areas are designated by DEQ where groundwater has elevated contaminant concentrations resulting, at least in part, from nonpoint sources. After the GWMA is declared, a local groundwater management committee comprised of affected and interested parties is formed. The committee works with and advises the state agencies that are required to develop an action plan that will reduce groundwater contamination in the area.

Oregon 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.

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

The ODA 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, the interagency Water Quality Pesticide Management Team (WQPMT) was formed to expand efforts to improve water quality in Oregon related to pesticide use. The WQPMT includes representation from ODA, Oregon Department of Forestry (ODF), DEQ, and Oregon Health Authority (OHA). 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 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.

The Oregon Department of Agriculture 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 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 see: 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 Oregon to implement the federal CWA in our state. DEQ is the lead state agency with overall authority to implement the CWA in Oregon. DEQ coordinates with other state agencies, including ODA and 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, Source Water Protection, the CWA Section 401 Water Quality Certification, and GWMAs. DEQ also coordinates with ODA to help ensure successful implementation of Area Plans.

A Memorandum of Agreement (MOA) between DEQ and ODA recognizes that ODA is the state agency responsible for implementing the Ag Water Quality Program. ODA and DEQ updated the MOA in 2012.

The MOA includes the following commitments:

- ODA will develop and implement a monitoring strategy, as resources allow, in consultation with DEQ.

- ODA will evaluate the effectiveness of Area Plans and Area Rules in collaboration with DEQ:
    - ODA will determine the percentage of lands achieving compliance with Area Rules.
    - ODA will determine whether the target percentages of lands meeting the desired land conditions, as outlined in the goals and objectives of the Area Plans, are being achieved.
- ODA and DEQ will review and evaluate existing information to determine:
    - Whether additional data are needed to conduct an adequate evaluation.
    - Whether existing strategies have been effective in achieving the goals and objectives of the Area Plans.
    - Whether the rate of progress is adequate to achieve the goals of the Area Plans.

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

Oregon Department of Agriculture and SWCDs work in close partnership with local, state, and federal agencies and organizations, including: DEQ (as indicated 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 effective 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 needed to achieve the measurable objective.

The AgWQ 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 implemented through focused work in small geographic areas (section 1.7.3), with a long-term goal of developing measurable objectives and monitoring methods at the Management Area scale.

The State of Oregon continues to improve its ability to use technology to measure current streamside vegetation conditions and compare it to the vegetation needed to meet stream shade targets to keep surface waters cooler. 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 incentive programs.

At each biennial review, ODA and its partners will evaluate progress toward the most recent 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 achieving the measurable objective(s) and will revise strategies to address obstacles and challenges.

The measurable objectives and associated milestones for the Area Plan are in Chapter 3 and progress toward achieving the measurable objectives and milestones 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, streamside vegetation generally is used as a surrogate for water temperature, because shade blocks solar radiation from warming the stream. In addition, sediment can be used as a surrogate for pesticides and phosphorus because they 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.
- Reductions in water quality 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 cost-prohibitive and could fail to 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 less likely to document the short-term effects of changing land conditions on water quality parameters such as temperature, bacteria, nutrients, sediment, and pesticides.

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 in the Focus Area. A key component of this approach 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 and is supported by a large body of scientific research (e.g. Council for Agricultural Science and Technology, 2012. Assessing the Health of Streams in Agricultural Landscapes: The Impacts of Land Management Change on Water Quality. Special Publication No. 31. Ames, Iowa).

Systematic implementation in Focus Areas provides the following advantages:

- Measuring progress is easier in a small watershed than across an entire Management Area.

- Water quality improvement may be faster since small watersheds generally respond more rapidly.
- A proactive approach can address the most significant water quality concerns.
- Partners can coordinate and align technical and financial resources.
- Partners can coordinate and identify appropriate conservation practices and demonstrate their effectiveness.
- A higher density of projects allows neighbors to learn from neighbors.
- A higher density of projects leads to opportunities for increasing the connectivity of projects.
- Limited resources can be used more effectively and efficiently.
- Work in one Focus Area, followed by other Focus Areas; will eventually cover the entire Management Area.

Soil and Water Conservation Districts select a Focus Area in cooperation with ODA and other partners. The scale of the Focus Area matches the SWCD's capacity to deliver concentrated outreach, technical assistance, and to complete projects. The current Focus Area for this Management Area is described in Chapter 3. The SWCD will also continue to provide outreach and technical assistance to the entire Management Area.

Strategic Implementation Areas

Strategic Implementation Areas (SIAs) are small watersheds selected by ODA, in cooperation 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. 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 made in the watershed. Chapter 3 describes any SIAs in this Management Area.

1.8 Monitoring, Evaluation, and Adaptive Management

The Oregon Department of Agriculture, the LAC, and the LMA will assess the effectiveness of the Area Plan and Area Rules by evaluating the status and trends in agricultural land conditions and water quality (Chapter 4). This assessment will include an evaluation of progress toward measurable objectives. ODA will utilize other agencies' and organizations' local monitoring data when available. ODA, DEQ, SWCDs, and LACs will examine these results during the biennial review and will revise the goal(s), measurable objectives, and strategies in Chapter 3 as needed.

1.8.1 Agricultural Water Quality Monitoring

As part of monitoring water quality status and trends, DEQ regularly collects water samples 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). DEQ collects water quality samples every other month throughout the year to represent a snapshot of water quality conditions. Parameters consistently measured include alkalinity, biochemical oxygen demand (BOD), chlorophyll a, specific conductance, dissolved oxygen (DO), DO percent saturation, *E. coli*, ammonia, nitrate and nitrite, pH, total phosphorus, total solids, temperature, and turbidity.

At each biennial review, DEQ assesses the status and trends of water quality in relation to water quality standards. Parameters included in the analysis are temperature, pH, and bacteria. DEQ will add additional parameters as the data become available, depending on the water quality concerns of each Management Area. ODA will continue to work with DEQ to cooperatively summarize the data results and how they apply to agricultural activities.

Water quality monitoring is described in Chapter 3, and the data are presented in Chapter 4.

1.8.2 Biennial Reviews and Adaptive Management

All Area Plans and Area Rules around the state undergo biennial reviews by ODA and the LAC. As part of each biennial review, ODA, DEQ, SWCDs, and the LAC discuss and evaluate the progress on implementation of the Area Plan and Area Rules. This evaluation includes discussion of enforcement actions, land condition, water quality monitoring, strategic initiatives, and outreach efforts over the past biennium. ODA and partners evaluate progress toward achieving measurable objectives and milestones, and revise implementation strategies as needed. The LAC submits a report to the Board of Agriculture and the director of ODA describing progress and impediments to implementation, and recommendations for modifications to the Area Plan or Area Rules necessary to achieve the goal of the Area Plan. ODA and partners will use the results of this evaluation to update the measurable objectives and implementation strategies in Chapter 3.

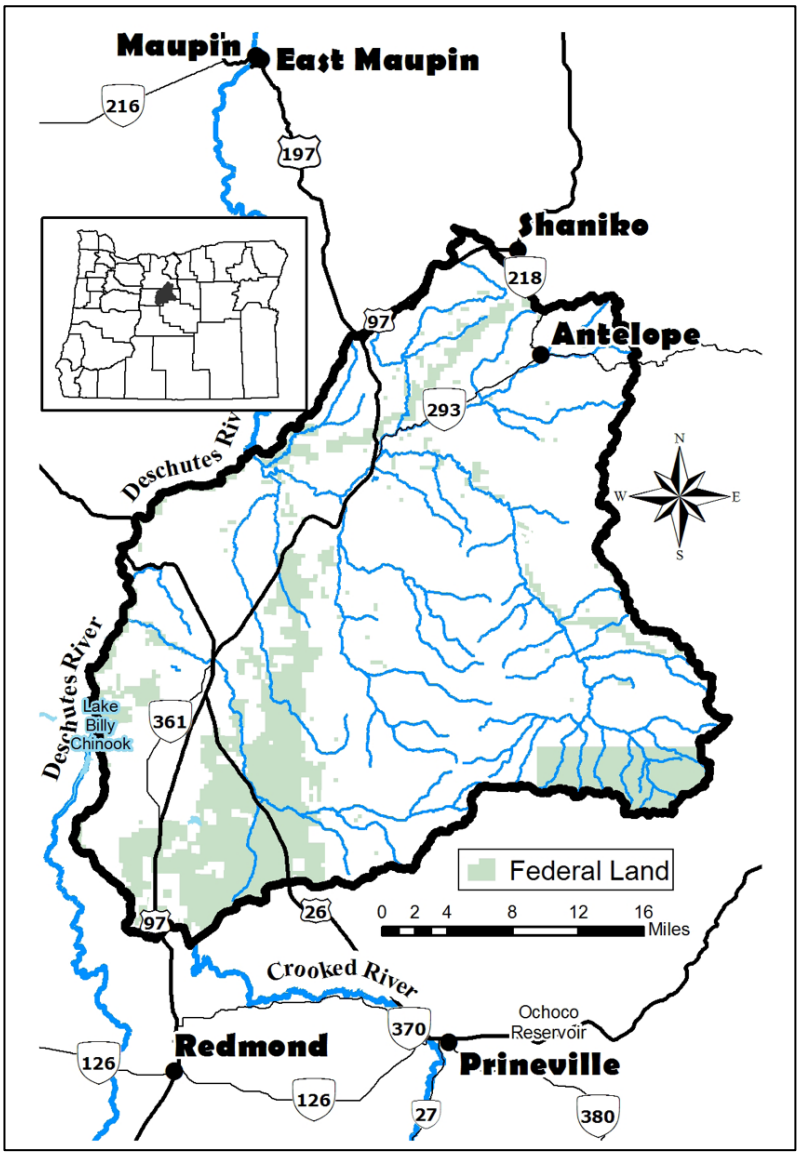
Chapter 2: Local Background

The Management Area includes the Trout Creek and Willow Creek drainages, the area along the eastern side of the Deschutes River between Trout Creek and Crooked River, and the area east of Crooked River between its confluence with the Deschutes River to the north and Sherwood Canyon to the south. This includes the entire North Unit Irrigation District (NUID).

Principal water bodies include:

- Trout Creek
- Willow Creek
- Deschutes River from confluence with Trout Creek upstream to confluence with the Crooked River (approx. 25 miles)
- Crooked River from mouth to just north of Smith Rock (approx. 21½ miles)

Figure 3. Map of Management Area



2.1 Local Roles

2.1.1 Local Advisory Committee

The Middle Deschutes Local Advisory Committee (LAC) was convened by ODA in 1998 and has been assisted by the Jefferson County Soil and Water Conservation District (SWCD). LAC members represent the interests of local landowners, producer groups, irrigation districts, private timberlands, watershed council, biologists, and the Jefferson County SWCD. Members are:

Table 1. Current Local Advisory Committee (LAC) members.	
Roy Hyder, **Chair**: Metolius, landowner	Brad Klann: Madras, row crops
Lowell Forman, **Vice-Chair**: Antelope, ranching	Evan Thomas: Culver, row crops
Mike Britten: North Unit Irrigation District	Rob Galyen: Agency Plains, row crops
Lori Campbell: Portland General Electric, biologist	Chase Duncan: ODF, Unit Forester
Lloyd Forman: Antelope, livestock and hay	
Mickey Killingsworth: Madras, sheep	Alternate: Kirk Holcomb (North Unit Irrigation District)

The LAC receives additional technical support from the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS); USDA Farm Service Agency; United States Forest Service; Oregon Departments of: Agriculture, Fish and Wildlife, Forestry, and Environmental Quality; Oregon State University Cooperative Extension Service; Central Oregon Agricultural Research Center; and others.

2.1.2 Local Management Agency

Implementation of the Area Plan is accomplished through an Intergovernmental Grant Agreement(s) between ODA and the Jefferson County SWCD. This Intergovernmental Grant Agreement defines the SWCD(s) as the LMA(s) for implementation of the Ag Water Quality Program in this Management Area. The SWCD(s) was/were also involved in development of the Area Plan and Area Rules.

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

2.1.3 Middle Deschutes Watershed Council

The Middle Deschutes Watershed Council is composed of a diverse group of landowners, residents, government agencies, and organizations working together to enhance the natural resources of the Trout Creek and Willow Creek watersheds. It collaborates with the community at large, including landowners and partner organizations, to foster an understanding of watershed resources and to improve watershed health through voluntary restoration actions. To accomplish this, it works with the community to identify and design projects with objectives that address the Area Plan goals, and then follows with securing funding to implement projects.

2.2 Area Plan and Area Rules: Development and History

The Area Plan and Area Rules were approved by the director of ODA in 2001.

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

2.3.1 Geography

Location

The Middle Deschutes Agricultural Water Quality Management Area encompasses just over 1,000 square miles in central Oregon and includes the towns of Madras, Culver, Metolius, Antelope, and Ashwood. The Management Area includes most of the eastern half of Jefferson County and portions of Wasco and Crook counties. Elevation above sea level ranges from 1,250 to 5,940 feet and averages 2,400 feet around Madras. Typical summers are dry and hot (temperatures up to 100°F), and winters tend to be wet and cold (temperatures down to -10° F).[1] Summer maximum temperatures average 87°F (July and August); winter minimum temperatures average 33°F (December-January).[2] Extreme temperatures in the last 40 years are 106°F and -31°F. Average annual precipitation ranges from 9 to 25 inches.[1] Almost all the precipitation falls between November and April, and in the highest elevations, more than half of it falls as snow.

Soils and Geology

The Management Area constitutes the far western corner of the John Day Ecological Province.[1] This rugged province is characterized by extensive, geologically eroded, steeply dissected hills of thick, ancient sedimentary materials interspersed with buttes and plateaus capped with basalt or tuffaceous rock. The area around Madras also includes flat to slightly rolling farmlands.

During the last 60 million years, Central Oregon has experienced major episodes of volcanic activity interspersed by periods of sedimentation.[1] In the Trout Creek watershed, soils on the north and east facing slopes consist mostly of volcanic ash and loess over or mixed with colluvium of fine to medium textured volcanic ash. The rock content in the soil profile is high. Productivity varies greatly between shallow and deep soils. Plateau tops, upper south-facing slopes, and ridge-tops have very shallow soils and have lower productivity. Lower slopes and drainages, sideslopes and swales offer better vegetative growth and regeneration potential. The ash soils in this area potentially can produce large amounts of sediment from accelerated runoff when exposed, compacted, or channeled.

Most soils used for irrigated crops, hay, and pastures are in the *Madras-Agency-Cullius Association*. This consists of moderately deep, well-drained soils on upland terraces and plateaus.[3] Slopes range from 0 to 15 percent. These soils formed in medium-textured windblown deposits and are underlain by gravels and basalt of the Deschutes Formation. The soils are fine loamy and depth to basalt or tuff bedrock is 10 to 40 inches. Wind erosion is a concern if the soils are left unprotected. Sediment from runoff due to over-irrigation or storm events may be moderate to high on slopes greater than 10 percent. *Era* soils are sandy loam with a cobbly substratum, 0-3 percent slopes, and with a depth of over 60-inches to bedrock. They are well drained and occur on mountains. Water erosion is a potential hazard.

The *Caphealy-Reute*r complex occurs in rolling hills and supports rangeland, dryland grain, and pasture[3]. *Caphealy* consists of loamy well-drained soils and has a depth of 20-40 inches to bedrock. *Reuter* soil is 10-20 inches to bedrock and is loamy and well drained. This association is limited by slope, wind erosion, and low available water capacity. Wind erosion is a concern if the soils are left unprotected. The soils are very sensitive to overgrazing and recovery rates can be slow. The very low available water capacity and the shallow depth of the Reuter soil limit the choice of species for range seeding to those that are drought-tolerant. The very low available water capacity and moderately rapid permeability should be considered in irrigation water management. Sediment from runoff due to over irrigation or storm events may be moderate to high on slopes greater than 10 percent.

Willowdale-Rail soils are used for irrigated hay and pastureland.[3] Slopes range from 0 to 2 percent. Soils are 40 to 60-inches deep. Willowdale soils are well drained; Rail soils are not. This association is limited

by high water table and prone to flooding. Shallow excavations are limited due to water table. Runoff is slow and hazard from erosion is slight. Streambank erosion is high when flooding events occur or when riparian or vegetation condition is poor.

Vegetation

Three general vegetation types occur in the Management Area.[4] The upper Trout and Willow Creek watersheds near the Jefferson/Crook County line consist of coniferous forest dominated by ponderosa pine, Douglas fir, or grand fir. Middle elevations consist primarily of juniper savanna interspersed with treeless grassland (now mostly converted to dryland cropping in the Wasco County portion of the Management Area). Irrigated croplands cover the lower elevation areas known locally as Mud Springs, Gateway, Little Agency Plains, Agency Plains, Culver, Henderson Flat, and Trail Crossing. Irrigated crops include: grass seed, alfalfa, seed potatoes, carrot seed, grains, flower seed, hay, nursery crops, herbs, mint, onion seed, garlic, and some vegetable crops. Non-irrigated crops include hay, small grains, pasture, and perennial vegetation planted under the Conservation Reserve Program (CRP).

Juniper density has increased dramatically over the past 90 years[4]. The increase in juniper has reduced the uplands' ability to collect and store precipitation.[5,6] The potential for recovering rangeland vegetative cover exists if practical ways can be found to control soil erosion and plants such as juniper.[1]

Noxious weeds include yellow starthistle; Scotch and Canada thistle; Dalmatian toadflax; spotted, diffuse, and Russian knapweed; whitetop; kochia; and teasel.[4] Weeds can affect water quality by providing inadequate soil cover and root mass, which can induce upland and streambank erosion.[7]

2.3.2 Hydrology

The Management Area incorporates two distinct drainages (Trout and Willow creeks) and the area irrigated by the NUID. NUID provides water to 58,860 acres from Gateway (mouth of Trout Creek) to Trail Crossing (Smith Rock). These NUID irrigated lands drain primarily into the Crooked River, Deschutes River, Mud Springs Creek, and Willow Creek.

Trout Creek[4]

Trout Creek drains approximately 700 square miles. Its headwaters are in the Ochoco National Forest in the Ochoco Mountains. These headwaters are forested; however, most of the watershed consists of juniper/sagebrush rolling hills. Mud Springs Creek drains irrigated croplands.

Seasonal precipitation patterns result in flows in Trout Creek that peak in winter and early spring and rapidly diminishes to low flows in summer. The NRCS estimates that current peak flows in some stream segments are two to three times greater than under pre-settlement conditions (Trout Creek Assessment, pages 8 and 12). Changes in vegetative cover appear to be most responsible for this increase in flow volume.

The annual flows of Trout Creek at Ashwood between 1966 and 1991 averaged 26.3 cfs. Annual means during this period range from 1.0 (1977) to 62.9 cfs (1982). The highest daily mean measured was 1,510 cfs (February 23, 1986).

Willow Creek[8]

Willow Creek drains approximately 180 square miles and flows from the Crook/Jefferson County line northwest through Madras to the Deschutes River. It drains the northwestern portion of the Ochoco Mountains and flows through several miles of the Crooked River National Grasslands.

Willow Creek is typical of the high desert region. High flows occur during winter in unusually wet periods or when rain falls on snow, which melts the existing snow and sends large quantities of water down the drainage. In the summer, the remaining small flows are typically diverted for irrigation of hay fields and pasture throughout the drainage. An unusual occurrence of groundwater springs discharge in the lower 1.5 miles of Willow Creek, which increases the flow substantially at the mouth above what flows through the town of Madras. Temperature measurements on these springs ranged from 54°F to 70°F, and a flow measurement on a collection of seven springs yielded 1.25 cfs.

Streamflow above the town of Grizzly between October 1967 and December 1978 averaged 1.51 cfs with long periods of no flow. The flow peaked at 52 cfs on April 26, 1978. Most of the flow occurred during the months of February, March, April, and May.

1964 Flood[4]

A large accumulation of snow, over frozen ground in some areas, followed by rapid warming and heavy rains caused widespread flooding through eastern Oregon in December 1964. Trout Creek completely inundated the Willowdale valley and dropped the streambed over 10 feet in places due to headcutting and channel widening. Many of these cut banks are still visible today. Major channelization by the Army Corps of Engineers followed the 1964 flood and the resultant berms have interfered with stream function by disconnecting streams from their floodplain.

North Unit Irrigation District (NUID)[9,10]

The NUID supplies water to 92 square miles (58,860 acres) of irrigable farmland that stretch from Gateway (mouth of Trout Creek) throughout the Agency Plains, Madras, and Culver areas, around Juniper Butte, and to Trail Crossing (just northwest of Smith Rock). Water is obtained from Wickiup Reservoir south of Bend, with supplemental water pumped from the Crooked River. Haystack Reservoir, east of Culver, provides off-stream storage and serves as a re-regulating reservoir; it was constructed to drastically reduce seasonal canal transmissions and spill losses. There was a three-day lag time between "turnout" from Wickiup Reservoir and "on-farm delivery." Haystack Reservoir reduced this time lag considerably. Substantial seepage losses occur between Bend and Crooked River crossing. As a result, NUID has adjusted their operation, management, and on-farm delivery over many years to match water availability. In the last 20 years, NUID has lined 12.5 miles of the Main Canal between Bend and Redmond thereby reducing seepage losses and increasing on-farm deliveries. NUID is also quite active in piping laterals to improve water quality and quantity, operations, and reduce seepage.

The NUID system consists of 65 miles of main canal and 235 miles of laterals. No on-farm tailwater is returned to the main canal or the laterals. The distribution system has an average conveyance efficiency of approximately 52 percent. Flow is intensively measured throughout the system. All water at the main diversion points from the Deschutes River and Crooked River, all laterals receiving water from main canals, and all points of delivery (on-farm) are accurately measured.

Average annual available deliveries usually do not exceed 2.25 acre-feet per acre. This delivery is inadequate to fully meet all crop water needs for all the irrigated farmland. Agricultural operators frequently direct water to high-value crops, sometimes leaving inadequate water for full growth of lower value crops.

Estimated on-farm irrigation efficiency is 60-65 percent, with a low of approximately 50 percent on flood-irrigated land to a high of 80 percent on late-model center pivot systems. There is also a trend toward installation of micro or drip irrigation systems on high value crops.

Landowners are delivered water out of the canals, pump out of drain ditches, or combine water from both sources in a pond and then pump out of that; drainage water is reused up to five or six times on land that

is flood irrigated. There is little to no runoff from sprinkler-irrigated lands. NUID has three emergency spills (at the Crooked River, Juniper Butte, and Willow Creek) that are rarely used and three regular drains (at Culver, Campbell Creek, and Mud Springs Creek). Most water in the Culver and Campbell Creek is used up by landowners at the "end of the line" before the water can exit the natural drainage ways into the Deschutes River.

Water Rights[4,8]

The earliest priority date for Antelope and Trout creeks is 1870; most of the water rights of Trout Creek and its tributaries are dated prior to 1909. The earliest groundwater right on Trout Creek has a priority date of 1953. Most of the groundwater rights were developed in the 1960s and 1970s.

Water withdrawals are allowed year-round from Trout Creek. In 1980, the Oregon Water Resources Commission withdrew all unappropriated waters of Trout Creek and its tributaries, except for Mud Springs Creek, to protect fish spawning. This withdrawal still allows human and livestock consumption and allows waters to be legally stored and released from storage.

The oldest water right on Willow Creek dates back to 1875 for the irrigation of 25 acres from the North Side Ditch. The primary use of water on Willow Creek is for irrigation. There is an instream water right with a 1990 date for Willow Creek for the reach from Coon Creek to the mouth.

2.3.3 Land Use

Historical[4]

Before the treaty of 1855, with the Tribes of Middle Oregon (now the Confederated Tribes of the Warm Springs Reservation), native peoples frequented the area for seasonal fishing, hunting, and subsistence food gathering.

Hay Creek saw the first permanent white settlement in Central Oregon. During the 1860s and early 1870s, stockmen settled the area and water from Trout Creek was first used for cropping in 1877. Logging of the forested headwaters of Trout and Willow creeks began around this time.

Current

The Management Area is characterized by rural land ownership. Less than 20 percent of the lands are in Federal ownership, managed by the US Forest Service and the Bureau of Land Management (BLM). The Ochoco National Forest includes the headwaters of Trout Creek; the Crooked River National Grasslands (managed by the Forest Service) include juniper/sage lands around Madras. BLM lands primarily line the Deschutes River and include the ridge between Antelope and Ward creeks. Forest Service and BLM lands have grazing leases.

Most of the range and forestlands are used for beef cattle production.[4] The beef industry is made up primarily of cow/calf operations with most calves being sold in late fall or early winter. A small number of yearlings are purchased from the outside area and grazed in the watershed.

Trout Creek has little cropping, consisting primarily of non-irrigated small-grain/fallow, with other dryland cropping systems including grass or grass/alfalfa in rotation with grains.[4] Some fields adjacent to streams are flood-irrigated from diversions; others have been enrolled in CRP, which keeps lands under perennial vegetation.

Gentle upland slopes in the north central Trout Creek watershed have been converted from native vegetation to dry farming.[4] Also, some larger bottoms or low terraces along major streams are now irrigated fields. Rangeland throughout the watershed is generally in fair condition. However, most highly

accessible low-elevation range near water is in poor condition, while steeper rangeland or more remote areas are still in good condition. Riparian areas have been altered by grazing from livestock and big game animals, logging, and fire suppression. Increased runoff peaks have overloaded and exceeded the capacity of the natural flood plains in some places. Consequently, many streambanks and most riparian areas are in low ecological condition.

The Willow Creek watershed is approximately 10 percent forested, 65 percent rangeland, and 25 percent cropped. Seventy percent of the cropland is irrigated.[8] Irrigated crops include: grass seed, alfalfa, seed potatoes, carrot seed, grains, flower seed, hay, nursery crops, herbs, mint, sugar beets, onion seed, and garlic. Non-irrigated crops include hay, small grains, CRP, and pasture. Sixty-five percent of the irrigated land is watered by sprinkler and 35 percent by flood. Sixty percent of the cropland (15,000 acres) is classified as Highly Erodible Land.

Most of Willow Creek's 85,000 acres of grazed forestland and rangeland have poor livestock distribution[8]. Approximately 10 percent of the rangeland is overstocked with juniper. Juniper numbers have increased dramatically on many areas of historically open juniper/grassland savanna.

Landowners voluntarily have undertaken many projects to improve the watershed health of Trout and Willow creeks. These include juniper cutting, spring improvements, riparian plantings, streambank stabilization, riparian fencing, conversion from flood to sprinkler irrigation; installation of instream structures for fish habitat, infiltration galleries, and sediment control basins; and changes in irrigation and livestock management.

2.4 Agricultural Water Quality

2.4.1 Water Quality Issues

In September 2011, DEQ published the Deschutes Basin Water Quality Status and Action Plan. It discussed water quality concerns and emphasized the following actions related to agriculture in the Management Area:

1. Surface Water Actions

- Reduce temperatures, improve flow volume and patterns, and improve habitat through:
    - Better land management and conservation
    - Increasing native, streamside vegetation
    - Improved water conservation
    - Increased instream flows
    - Channel restoration
    - Juniper reduction
    - Combating invasive weeds
- Reduce erosion and nutrient and pesticide levels in water through better land and crop management.

2. Groundwater Actions

- Minimize nitrate contamination from agriculture and other sources.
- Assess effects of groundwater pumping and irrigation efficiency projects on stream flows.
- Assess cause, extent and magnitude of risks associated with bacteria in groundwater.

2.4.2 Beneficial Uses

Water quality standards have been developed to protect the following beneficial uses in the Deschutes Basin (OAR 340-41-0130, Table 130A): public and private domestic water supply, industrial water

supply, irrigation, livestock watering, fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, and aesthetic quality. In addition, hydropower is identified as a beneficial use for the Deschutes River from the Pelton Regulating Dam upstream to the Bend diversion dam and for the Crooked River. In practice, water quality standards are set at a level to protect the most sensitive beneficial uses.

The beneficial uses which are most sensitive to water quality impairment are typically fish and aquatic life, public and private drinking water supply (both groundwater and surface water), and water contact recreation. Temperature, dissolved oxygen, pH, sediment and pesticides are examples of pollutants which directly affect fish and aquatic life. Bacteria, turbidity and toxics are examples of pollutants which directly affect human health.

2.4.2.1 Most Sensitive Beneficial Use: Salmonids

Steelhead and bull trout in this area are listed as Threatened under the Federal Endangered Species Act.

Location

1. The Deschutes River from Trout Creek to the Reregulation Dam (River Mile 87 to 101) has several fish species, which are present year-round: fall Chinook, summer steelhead, bull trout, and resident rainbow "redband" trout. All species with the exception of bull trout spawn and rear year-round in this section.

2. Trout Creek has summer steelhead and resident redband. These species are present in the system all year. Both steelhead and redband spawn and rear in Trout Creek.

3. Willow Creek has resident redband that are present all year. Redband spawn and rear in certain upper and lower reaches. There is seasonal use in areas around the city of Madras.

4. Lake Billy Chinook and Lake Simtustus have bull trout, redband trout, and kokanee. These three species all rear in the lake, and various age groups are present all year.

5. The Crooked River has resident redband, which spawn and rear and are present year-round.

6. Corresponding to completion of a fish transfer facility in Lake Billy Chinook, a full- scale fish reintroduction plan began in 2009 in the Crooked, Deschutes, and Metolius River basins. Steelhead and Chinook fry were released in tributaries to the Crooked and Deschutes rivers; only Chinook were released into the Metolius.

Habitat Requirements

Steelhead spawn during March to May in areas with good gravel, usually downstream of pools. From fertilization to when the fry swim up from the gravel takes about 60 days. The fry rear in the stream for one to three years and, on average, smolt in the second year. In the spring, fry begin to smolt and migrate to the ocean between March and June. After one to three years in the ocean, the adults begin their return to their natal stream to repeat the cycle.

Redband trout exhibit similar characteristics to steelhead except they don't migrate to the ocean. Adult redband in headwater reaches and in small tributaries can be as small as five inches.

Steelhead and redbands require cool water with varied habitat that includes diversity within pools and riffles aided by overhanging banks and vegetation, boulders, root wads, and large woody debris.

Kokanee salmon rear and mature in Lake Billy Chinook. These fish feed on zooplankton in deep areas of the lake. Most kokanee spawn in the Metolius River system with a few spawning in the Deschutes River above Lake Billy Chinook.

Bull trout rear and mature in both the lakes and in the Deschutes and Metolius rivers; they are fish-eaters and need cold water. Diverse habitat provides cover and ambush areas to feed from. The eggs for this species generally need water colder than 50·F.

2.4.3 WQ Parameters and 303(d) list

Table 2 consists of water quality limited streams from DEQ's 2012 303(d) list.

Table 2. Location and seasonality of exceedances of Oregon's Water Quality Criteria in the Middle Deschutes Area, from DEQ's 2012-303(d) list[12]. Current information on the 303(d) list can be found at *http://www.deq.state.or.us/wq/assessment/rpt2012/search.asp*

Stream Segment	Water Quality Parameters						
	Sediment	Temperature	pH	Dissolved Oxygen	Chlorophyll *a*	*E. coli*	Biological Criteria
Trout Creek	X	X					X
Trout Creek tributaries: Auger, Big Log, Bull, Cartwright, Dick, Dutchman, & Potlid	X	X					
Trout Creek tributary: Mud Springs Creek and unnamed trib to Mud Springs Creek			X				
Trout Creek tributary: Tenmile Creek		X					
Trout Creek tributary: Antelope Creek							X
Willow Creek		X					
Lake Simtustus and Lake Billy Chinook			X		X		
Deschutes River (below Reregulation Dam)		X	X	X			
Crooked River		X	X	X		X	X

The 303(d)-listed parameters indicate problems for fish and humans.

- Sediment fills in the gravels needed for salmonid spawning and clouds up water, thereby reducing aquatic productivity.

- Lethal temperatures for adult salmonids vary according to a variety of factors but generally are reported in the range of 70° to 77°F. Salmonid eggs and juveniles are much more sensitive to high temperatures. Generally, water temperatures above 55°F inhibit salmonid spawning, egg incubation and fry emergence from the gravel. However, salmonids have successfully survived in some areas where natural water temperatures are higher. Egg development and the subsequent timing of emergence are closely associated with stream temperatures. Juvenile rearing and growth may be impaired by temperatures greater than 64°F. Optimal water temperature for juvenile bull trout is less than 50°F. Temperature criteria, which are applied to streams in the Management Area, can be found in Figures 130A and B referred to in OAR 340-041-0028(4) and can be accessed at *http://www.oregon.gov/deq/Regulations/Pages/OARDiv41.aspx*

- High pH and low dissolved oxygen generally result from excessive plant growth (chlorophyll *a*), which is stimulated by high nutrient concentrations in the water and warm water temperatures. When plants die, they drop to the stream bottom and are broken down by bacteria, which use up oxygen in the process. The breakdown of aquatic plants can use up large amounts of the oxygen needed by other aquatic life for survival.

- Bacteria are used to determine the safety for "human contact recreation." High levels of *E. coli* bacteria can cause severe gastric illness and even death. *E. coli* are also indicators of other pathogens. Bacteria are not believed to be a problem in groundwater in the Management Area; *E. coli* were detected in only one out of nine sampled wells based on data in Oregon's Real Estate Transaction database.

- Biological criteria listings indicate waters that do not adequately support aquatic insects and other invertebrates (benthic macroinvertebrates). These organisms are important as the basis of the food chain and are very sensitive to changes in water quality. To assess a stream's ecological health, the community of benthic macroinvertebrates is sampled and compared to a reference community (community of organisms expected to be present in a healthy stream). If there is a significant difference, the stream is listed as water quality limited. This designation does not identify the actual limiting factor, although sediment and temperature are two of the likely causes.

Three additional water quality concerns are not on the 303(d) list:

- Nitrate levels above 10 mg/L can cause blue-baby syndrome and other issues in humans. High nitrate levels can also contribute to algae blooms. Groundwater north and west of Madras contains nitrate levels of 3-8 mg/L.

- Habitat modification refers primarily to riparian areas that have been so modified that they no longer provide sufficient habitat to sustain aquatic life. Examples include: denuded streambanks, lack of large woody debris, and insufficient pools and riffles.

- Flow modification refers to reduced streamflow. Reduced streamflow can result in warmer water temperatures. Slower flows can also lead to lower concentrations of dissolved oxygen because the slow-moving water does not pick up oxygen as readily from the air.

2.4.4 Basin TMDLs and Agricultural Load Allocations

Currently, there are no Basin TMDLs and Agricultural Load Allocations developed for the Management Area. TMDL development work has not yet been scheduled for the Middle Deschutes Management Area.

2.4.5 Potential Contributors to Pollutions

Potential contributors to pollution in the Management Area include runoff and erosion from agricultural and forest lands, leaching of pollutants to groundwater, eroding streambanks, runoff from roads and urban areas, and waste discharges from pipes. Rerouting of runoff via road building, construction, and land surfacing such as parking areas can lead to excessive erosion or pollutant transport. Pollutants can be carried to the surface water or groundwater through the actions of rainfall, snowmelt, irrigation, and leaching. Increased heat input due to vegetation removal, seasonal flow reduction, changes in channel shape, and floodplain alteration is a major source of water quality impairment. Channelization and bank instability may alter gradient, width/depth ratio, and sinuosity, thereby causing undesirable changes in sediment transport regime, erosional and depositional characteristics, and stream temperature.

Land conditions associated with the following agricultural activities were identified as sources of water quality impairment through their effects on streambank stability, soil erosion, vegetation on uplands and

along streams, and the amount and content of runoff to ground or surface water:

1. Use of streambanks and uplands.
2. Livestock grazing and areas of concentrated livestock.
3. Irrigation water use and drainage.
4. Application and storage of crop nutrients and farm chemicals.

The following non-agricultural sources likely contribute to water quality issues in the Management Area: the city of Madras, urban and suburban developments, sewage treatment plants, municipal sludge spread on fields, off-road vehicles, railroad beds, hydroelectric dams on the Crooked and Deschutes rivers, activities on federal lands, and high concentrations of deer, elk, antelope, and feral swine. In addition, the Deschutes and Crooked rivers drain huge areas upstream of the Management Area; the Deschutes and Crooked rivers will show cumulative effects from upstream sources.

2.5 Management Intent, Voluntary and Regulatory Measures

Water quality is maintained or enhanced through a combination of landowner education and implementation of appropriate Management Measures. Management Measures include both voluntary management practices and regulatory requirements.

Voluntary efforts are the primary means to prevent and control agricultural sources of pollution. Local, state, and federal agencies and organizations provide information and technical and financial assistance. The Jefferson and Wasco County SWCDs are the main support agencies at the local level.

Regulations complement the voluntary strategies. ODA pursues enforcement to gain compliance with the requirements only when reasonable attempts at a voluntary solution have failed.

Landowners have flexibility in choosing management approaches and practices to address water quality issues on their lands. Landowners may choose to develop management systems to address problems on their own, or they may choose to develop a voluntary conservation plan to address applicable resource issues. Landowners may seek planning and financial assistance from any agency or a consultant.

To help achieve water quality standards in the Management Area, an effective strategy:

- Maintains adequate riparian vegetation.
- Minimizes streambank erosion.
- Minimizes runoff that contains potential pollutants.

2.5.1 Management Intent

1. Maintain Adequate Riparian Vegetation along Surface Waters

   Riparian vegetation consists of plants that depend on or tolerate the presence of water near the ground surface for at least part of the year.

   Adequate riparian vegetation helps:

   - Minimize streambank erosion by increasing the cohesiveness and structural strength of streambanks and by reducing flow velocities.[13,14,15]
   - Reduce increases in summer water temperature.[16,17]
   - Maintain late season flows by increasing the ability of the adjacent soils to store water during runoff seasons.[18,19,20]
   - Moderate winter stream temperatures through the inflows of relatively warmer groundwater from adjacent soils.[21]

- Filter out and process excess nutrients, bacteria, and sediment in runoff that could pollute adjacent streams.[22,23,24,25]

Adequate riparian vegetation should:

- Include a variety of plant species and ages.
- Include plants that have root masses capable of withstanding high stream flows.
- Provide adequate cover to protect the streambank and dissipate energy during high flows.
- Include sufficient ground cover to filter out excess sediment or nutrients in overland flows.
- Provide shade, where allowed by site capability.

Adequate vegetation includes:

- Visible ongoing renewal of riparian vegetation, vigorous growth, and the maintenance of a majority of each year's new growth of woody vegetation (trees and shrubs).
- Noxious weeds are undesirable as they generally provide less shade, filtering capacity, and stabilizing root mass than the plants they replace.
- Native vegetation is preferred where practical due to its integral role within the ecosystem.

- As riparian vegetation matures, stream channels are expected to narrow and deepen. These stream channels will have less water surface area exposed to solar radiation (thereby reducing heating rates during summer) and will be more connected to their floodplain. Better floodplain connectivity has the added benefit of increasing storm water storage and reducing storm water velocities. These streams will also meander more, which will reduce flow velocities and damage from flooding.

2. Minimize Streambank Erosion[26]
   Streambanks naturally change in form or location over time. Some bank instability usually occurs in undisturbed streams, and human activities can increase the speed and amount of streambank erosion. Adequate vegetation can significantly increase streambank stability.

Bank stability can be an important indicator of watershed condition and can directly affect several beneficial uses. Unstable banks contribute to:

- Sediment in the stream channel caused by slumps and surface erosion,
- Fine sediment in the water,
- Wider channels, which increases exposure of water to solar radiation,
- Decreasing stream depth and alteration of fish habitat.

3. Minimize Runoff that Contains Potential Pollutants
   Potential pollution is reduced by having less runoff and fewer possible pollutants (sediment, nutrients, bacteria, toxics) in the runoff.

   Sediments can enter from overland flow or gullies on croplands, rangelands, farmsteads, and roads. Reduction in sediment 1) reduces nutrient concentrations in streams, since many nutrients, especially phosphorus, attach to soil particles; and 2) increases dissolved oxygen due to a reduction in sediment oxygen demand.[27,28]

2.5.2 Voluntary Measures

The following Recommended Management Practices address the objectives of the Area Plan and generally are accepted as effective, economical, practical, and they protect water quality. They are not required. Widespread adoption of these practices addresses the water quality parameters of concern in the Management Area. These practices should also maintain the economic viability of agriculture in the area.

Appropriate management practices for individual farms and ranches may vary with the specific cropping, topographical, environmental, and economic conditions that exist at a given site. Because of these variables it is not possible to recommend uniform management practices for all farms or ranches in the Management Area.

The Natural Resources Conservation Service's *Field Office Technical Guide* contains extensive lists of management practices as well. NRCS offices are in The Dalles and Redmond. The Jefferson and Wasco County SWCDs, Cooperative Extension Agents, and Oregon Department of Fish and Wildlife biologists can also recommend practices.

Streamside Management:
Objectives: achieve adequate riparian vegetation, increase streambank stability, and filter out pollutants

- Minimize channelization,
- Stabilize streambanks without confining the channel over any significant length,
- Maintain vegetative buffer: CRP, Conservation Reserve Enhancement Program (CREP), riparian buffers, control weeds,
- Manage livestock (see below),
- Properly place, design, and maintain roads, culverts, bridges, and crossings.

Cropland Management:
Objectives: reduce soil erosion, reduce and capture runoff, reduce potential pollutants in runoff

- Use conservation tillage: reduced tillage, direct seeding, subsoiling, and chemical fallow,
- Plant annual and perennial cover crops,
- Farm on the contour: strip cropping, divided slopes, terraces, contour tillage,
- Select crops that hold soil in place and enhance a crop rotation,
- Seed early or double in critical areas,
- Create and maintain sediment basins and vegetative buffer strips: riparian buffers, filter strips, grassed waterways, field borders, contour buffer strips, and interception ditches,
- Control weeds.

Upland Management:
Objectives: reduce soil erosion, improve infiltration of water into soil, and capture runoff

- Manage livestock (see below),
- Encourage vegetation that provides good ground cover and enhances water capture. Practices include: prescribed burning, range plantings, juniper control, weed control,
- Use sediment retention basins,
- Roads: close seasonally; properly maintain, design, and place.

Livestock Management:
Objectives: reduce soil erosion, manage manure, and achieve adequate riparian vegetation

- Manage grazing: livestock distribution; grazing intensity, duration, frequency, and season,
- Improve riparian buffers,
- Install fencing: temporary, cross, exclosure,
- Control livestock watering through spring developments and off-stream water,
- Provide salt, minerals, and shade away from streams,
- Install adequate waste management systems: clean water diversions; waste collection, storage, and utilization; properly operate and maintain facilities,
- Control runoff from concentrated feeding areas and irrigated pastures.

Irrigation Management:
Objectives: reduce runoff, minimize potential pollutants, reduce soil erosion, improve fish habitat

- Schedule irrigation based on crop needs, soil type, climate, topography, and infiltration rates,
- Improve irrigation efficiency,
- Pipe or line mainline and delivery systems,
- Select, locate, maintain, and operate diversions to minimize effects on water quality; install fish screens. [Infiltration galleries have the potential to take more water out of streams during low flows than is taken via conventional methods. The LAC recommends that infiltration galleries be designed following the guidelines in the NRCS' *Infiltration Galleries of the Deschutes Basin*; June 1999.],
- Minimize return flows through the use of cover crops, straw mulch, and grass filter strips,
- Install backflow devices,
- Grade and slope property to retain runoff whenever possible.

Crop Nutrient and Farm Chemical Management:
Objectives: reduce potential for pollution, reduce runoff

- Develop nutrient budgets based on water and soil testing, tissue testing, plant needs,
- Apply appropriate amounts at proper times; dispose of containers properly,
- Potential spills: have a cleanup plan, store tanks away from streams, check the valves on delivery trucks,
- Manage tail water,
- Use Integrated Pest Management,
- Municipal sludge: keep on site and out of waters of the state. Preferably don't apply on agricultural lands at all.

Ditch Management:
Objectives: reduce erosion, filter out potential pollutants

- Manage vegetation: burning, chemical, clipping, and critical area planting,
- Stabilize banks (structural and bioengineering),
- Install outfall protection to reduce erosion at culverts,
- Pipe or line ditches,
- Construct offstream or headwater storage,
- Develop wetlands at end of line to filter and process drain water,
- Size ditches appropriately to handle maximum flows.

2.5.3 Regulatory Measures

In addition to the voluntary strategies, regulations (OAR 603-095-1600 through 603-095-1660) are included as an implementation strategy.

Landowners in the Middle Deschutes Management Area are required to manage:

- Riparian vegetation,
- Irrigation water diversions,
- Manure and other wastes,
- Sediment in irrigation tail water,
- Application of crop nutrients.

Healthy riparian systems are expected to withstand a 25-year flood with minimal damage. Structural conservation practices generally are designed to withstand different levels of storms or floods. For instance, terraces and waterways typically are designed for a 10-year, 24-hour storm, while drop structures, streambank protection, and larger dams are designed for at least a 25-year flood. Most agronomic practices can withstand a two to five-year flood event.

OAR 603-095-1640

(1) Landowners must comply with OAR 603-095-1640(2) through (6) within the following limitations:

(a) A landowner is responsible for only those conditions resulting from activities controlled by the landowner. A landowner is not responsible for conditions resulting from activities by landowners on other lands. A landowner is not responsible for conditions that: are natural, could not have been reasonably anticipated, or that result from unusual weather events or other exceptional circumstances.

Some regulations may become more specific over time, as additional information becomes available on land conditions and water quality.

Streamside Area: OAR 603-095-1640(2)

(a) By January 1, 2005, activities must allow the establishment and development of riparian vegetation, consistent with site capability, for streambank stability and stream shading.

(b) By January 1, 2005, activities must allow the establishment and development of vegetation or the presence of an equally effective erosion control device or practice for filtering out sediments before they enter perennial streams.

The streamside area requirements address stream temperature, sediment, nutrients, bacteria, and habitat modification. The LAC encourages ODA to 1) develop a map that reflects general vegetative site capability; and 2) determine targets for adequate vegetation to provide root mass for bank stability and herbaceous vegetation to reduce heat inputs to surface water. ODA will include this as part of their compliance evaluation process.

Streambanks are the usual boundaries of a stream channel and do not extend to the flood boundaries. Banks of *perennial* streams (streams that flow continuously and are named on a US Geological Survey quadrangle map) include the area up to the ordinary high-water mark (OAR 603-095-0010(32) and (46)).

Riparian vegetation means plant communities consisting of plants dependent upon or tolerant of the presence of water near the ground surface for at least part of the year (OAR 603-095-0010(36)).

Site capability is the highest ecological status (vegetation) an area can attain given political, social, or economic constraints. Common constraints include the presence of a bridge, water gap, building, or highway. Natural factors determining site capability include: channel morphology, climate, elevation, and soil parent material (Process for Assessing Proper Functioning Condition. Bureau of Land Management. TR 1737-9. 1995).

Rule (a) requires activities that prevent vegetation from developing to cease. Reasonable rates of recovery include 50 percent retention in annual vegetative growth within 15 to 25 feet of the stream. The rule does not specify any activities that must cease and does not require any particular activity to take place. Landowners are not responsible for wildlife browsing and grazing use.

Rule (b) requires activities that keep vegetation from developing or that inhibit the presence of an equally effective erosion control device to cease. This rule refers to the filtration of sediment caused by human activities, not sediment resulting from natural processes. This rule does not require that the vegetation be riparian; any type of vegetation other than noxious weeds, such as a grassed filter strip, may be used to filter out sediment. Different types of vegetated buffers (riparian, forest, grass, etc.) have different NRCS standards. Sufficient vegetation to filter out sediment also helps reduce the number of bacteria and nutrients entering streams; nutrients can bind to sediments and can be carried into waterways in greater proportions than by water flow without sediments.

Instream Structures: OAR 603-095-1640(3)

(a) Effective on rule adoption, temporary irrigation diversions must:

(A) Be constructed and operated only during periods of irrigation.

(B) Not hinder channel carrying capacity between November 1 and March 1 to accommodate anticipated or expected seasonal streamflow.

(C) Not increase instream turbidity during operation by more than 10%, compared to a point just upstream of the diversion.

(b) By January 1, 2007, temporary irrigation diversions must not contribute to channel instability.

This rule addresses stream temperature, sediment, and habitat modification.

Temporary irrigation diversions can reduce water quality and impede fish passage. This rule addresses water quality concerns related to temporary irrigation diversions of less than 50 cubic yards of fill. Larger diversions require Oregon Fill and Removal Permits and must be managed to minimize water quality impairments as provided by ORS 196.800 through 196.990. State law, as provided by ORS 498.351, requires that all artificial stream structures allow fish passage. The intention on Trout Creek (which has a year-round irrigation season) is that landowners breach their temporary diversions when no longer in use (and remove the fill or spread it so it isn't likely to erode), instead of allowing winter and spring floodwaters to blow through the dams. This reduces the possible damage from flooding. Additionally, instream structures in use during a winter irrigation season should allow sufficient carrying capacity to withstand expected, seasonal high flows. The '10 percent increase' is based on the current state water quality standard for turbidity.

The later date for channel instability will give landowners time to develop appropriate structural or agronomic alternatives. Also, instream work is only feasible during certain times of the year.

Waste Management: OAR 603-095-1640(4)

(a) Effective on rule adoption, no person subject to these rules shall violate any provision of ORS 468B.025 or ORS 468B.050.

This rule ensures that concentrated nutrient concentrations, pathogens associated with high animal density areas, high sediment concentrations in run-off, toxics, or other potential pollutants are not readily transported to waters of the state.

Wastes associated with livestock operations can include manure from seasonal feeding and birthing areas, gathering pastures and corrals, rangelands and pasture, and any other situations not already covered by Oregon's Confined Animal Feeding Operation laws. Potential indicators of noncompliance include 1) runoff flowing through areas of high livestock usage and entering waters of the state; 2) livestock waste located in drainage ditches or areas of flooding; and 3) fecal coliform counts that exceed state water quality standards. Livestock grazing is allowed to the extent it does not violate state water quality standards and complies with the regulations. Livestock facilities located near streams should employ an adequate runoff control and waste management system. Compliance with the streamside area rule will help keep wastes from being carried into waters of the state. Landowners can contact the NRCS and SWCD for assistance with complying with this rule.

Wastes also include excess sediment discharges. Landowners who, based on visible erosion scars and/or sediment-laden runoff, are discharging significant quantities of sediment, may be in violation of this rule.

Irrigation Tailwater: OAR 603-095-1640(5)
(a) Effective on rule adoption, irrigation tailwater must not increase the turbidity of the perennial stream into which it drains by more than 10%, compared to a point just upstream of the tailwater discharge.

This rule helps reduce sediment and nutrients entering perennial streams. It reflects current state water quality standards and applies both to irrigated lands watered directly from perennial streams and to lands served by the NUID. The NUID system is fairly complex (see NUID in Section 1). On lands served by the NUID, individual landowners are responsible for the water quality of return flows from their lands to both NUID and private drains. If a shared drain violates the above rule, each landowner contributing to that drain water is expected to take appropriate action to reduce turbidity. ODA will consider each individual's proportional contribution to the problem when deciding on actions to take. The Jefferson County SWCD assists landowners with plans for improved sediment control where necessary.

Nutrients: OAR 603-095-1640(6)
(a) Effective on rule adoption, nutrient application rates and timing must not exceed specific crop requirements. Crop nutrients will be based on recommendations from the best available data applicable to a specific site.

Fertilizers (both chemical and manure) can contribute nutrients to streams. By requiring that nutrients be applied at appropriate rates, the amounts of nitrates and phosphates that can enter streams will be reduced. Careful application of manure also reduces the amount of bacteria that could enter streams. Nutrients already present in the soil and irrigation water should be accounted for when calculating application rates.

2.5.4 Area Rule Enforcement

In addition to the voluntary strategies, regulations (OAR 603-095-1600 through 603-095-1660) are included as an implementation strategy. The following regulations provide for resolution of complaints.

OAR 603-095-1660

(1) When the department receives notice of an apparent occurrence of agricultural pollution through a written complaint, its own observation, through notification by another agency, or by other means, the department may conduct an investigation. The department may, at its discretion, coordinate inspection activities with the appropriate Local Management Agency.

(2) Each notice of an alleged occurrence of agricultural pollution will be evaluated in accordance with the criteria in ORS 568.900 to 568.933 or any rules adopted thereunder to determine whether an investigation is warranted.

(3) Any person allegedly being damaged or otherwise adversely affected by agricultural pollution or alleging any violation of ORS 568.900 to 568.933 or any rules adopted thereunder may file a complaint with the department.

(4) The department will evaluate or investigate a complaint filed by a person under section OAR 603-095-1660(3) if the complaint is in writing, signed and dated by the complainant and indicates the location and description of:

(a) The waters of the state allegedly being damaged or impacted; and

(b) The property allegedly being managed under conditions violating criteria described in ORS 568.900 to 568.933 or any rules adopted thereunder.

(5) As used in section OAR 603-095-1660(4), "person" does not include any local, state or federal agency.

(6) Notwithstanding OAR 603-095-1660, the department may investigate at any time any complaint if the department determines that the violation alleged in the complaint may present an immediate threat to the public health or safety.

(7) If the department determines that a violation of ORS 568.900 to 568.933 or any rules adopted thereunder has occurred, the landowner may be subject to the enforcement procedures of the department outlined in OARs 603-090-0060 through 603-090-0120.

Chapter 3: Implementation Strategies

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

The LAC recognizes that certain water quality improvement projects may be prohibitively expensive for many landowners. In some cases, it is reasonable to expect that the expense may be disproportionate towards the overall benefits to water quality. In either case, the LAC recognizes that the landowner would be accountable for the improvement of water quality within the constraints of economic feasibility. The LAC expects that funding will be available from private and public sources to assist landowners with implementing projects.

This Area Plan will minimize agriculture's contribution to the following water quality concerns, while acknowledging that these parameters are present at some natural level:

- Sediment: keep soil on the land and out of streams (minimize soil erosion and amount of soil-laden runoff; maintain adequate riparian and upland vegetation).
- Nutrients: keep nutrients on site and out of streams and groundwater (apply at appropriate rates; minimize amount of nutrient-laden runoff and percolation to groundwater).
- Toxics: keep toxics, such as pesticides and municipal sludge on site and out of streams and groundwater (apply pesticides and municipal sludge at appropriate rates; prevent runoff).
- Temperature: maintain adequate riparian vegetation based on site capability and enhance channel morphology.
- Bacteria: keep livestock waste and municipal sludge on the land and out of streams.
- Dissolved oxygen: reduce agriculture's contribution to high temperatures, low flows, high nutrients, organic carbon and sediment.
- Habitat modification: maintain adequate riparian and upland vegetation; enhance channel morphology; minimize impacts of irrigation diversions.
- Flow modification: encourage efficient irrigation; improve the ability of uplands to capture, store, and beneficially release water.

3.1 Measurable Objectives

3.1.1 Management Area

At the 2020 biennial review, ODA will provide the following information:

1. Percentage of perennial stream miles in the Management Area likely in compliance with the Streamside Area Rule.
2. Percentage of agricultural lands in the Management Area likely in compliance with the Waste Rule.

At the 2018 biennial review, ODA presented the methodology for a Land Condition Assessment. The Land Condition Assessment is an assessment that will help the LAC develop measureable objectives based on the percentage of agricultural lands that are likely in compliance with the Riparian and Waste Rules. ODA will complete the Land Condition Assessment during the 2018-2020 Biennium. Results will be presented at the 2020 Biennial Review.

With that information, the LAC can start developing dates and milestones for:

1. 90% of streamside in compliance with the streamside area regulation.

2. 90% of streams provide water quality functions (shade and streambank stability) to the extent allowed by site capability.
3. 90% of agricultural lands in compliance with the Area regulations.

Ideally, vegetation along at least 90 percent of agricultural stream miles in the Management Area will support water quality functions as described earlier in this document. This will take some years to achieve due to management changes and landowner turnover. The LAC does not have enough information yet to develop timelines for the Management Area.

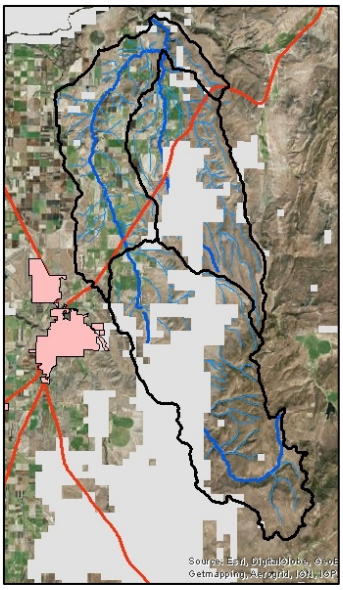
3.1.2 Focus Area

Each Focus Area will be assessed before, during, and after the focused work to show progress towards meeting water quality and land condition objectives. The SWCD and LAC will work together to develop measurable objectives for each Focus Area. Each Focus Area will have a monitoring plan.

Mud Springs is the current Focus Area. The SWCD is selecting Campbell Creek and Rattlesnake Canyon as their next Focus Areas, to be started in 2019.

Mud Springs Creek

Mud Springs Creek watershed (black outline) is north and east of Madras. Mud Springs flows into Trout Creek about two miles above its confluence with the Deschutes River. About 75 percent of the watershed is privately-owned; the rest is managed by the US Forest Service as a National Grassland (grey on map). The watershed is 95 square miles (75 percent range and 25 percent irrigated agriculture). Agriculture consists of beef cattle, hay, pasture, and seed crops.



Sagebrush Creek is the main tributary of Mud Springs Creek. The mainstems of Mud Springs and Sagebrush Creeks consist of 11.5 perennial stream miles and 3.5 subsurface miles. Another 207 miles of tributary streams are intermittent. There are also 41 miles of irrigation delivery ditches and canals in this sub watershed.

Mud Springs supports native steelhead. Steelhead currently inhabit the first 1.6 miles of Mud Springs Creek; historically, they lived in 7.3 miles *(2002, Trout Creek Watershed Assessment, pg 224)*.

An Oregon Water Resources gaging station at the mouth of Mud Springs indicates that average flow is around 10 cfs.

Water quality monitoring in 2006-2008 identified turbidity, *E. coli*, and nitrate as concerns. In addition, visual surveys identified lack of streamside vegetation in some areas, unlimited livestock access to streams and riparian areas, and irrigation-induced erosion as potential agricultural sources of these issues.

3.1.3 Focus Area Milestones and Measurable Objectives (Mud Springs Creek)

Jefferson County SWCD evaluated riparian conditions using three methods. One was the Streamside Vegetation Assessment (SVA) developed by ODA to characterize the type of ground cover within 35 feet of the stream. The metric is the percent of the different types of land cover (agricultural infrastructure, bare ground-bare due to agricultural activities, grass, agricultural grass, shrubs, trees, and water).

The other classified vegetation based on its ability to provide water quality functions, using surveys that followed the NRCS Streamside Vegetation Assessment Protocol (SVAP) (Table 3). For the latter, the SWCD used the riparian area quantity, riparian area quality, and canopy cover metrics.

Table 3. Mud Springs Riparian Condition Classification

Class	Description
I	Provides functions. SVAP = 9-10. Ag activities (grazing) were discontinued, vegetation is filling in the stream corridor and the riparian vegetation is sufficient to provide water quality function.
II	Not yet providing functions. SVAP = 5-8.9. Ag activities are not hampering water quality functions of riparian vegetation; however the vegetation is not sufficient to protect water quality.
III	Functions impeded by agricultural activity. SVAP < 5.
IV	Functions impeded by non-agricultural activities, e.g. the railroad bermed and relocated the stream channel.
V	Legacy agricultural issues that are not likely to change in the immediate future, for instance where Mud Springs Creek was piped under a field at the upper end of the watershed in the 1940s and has since been farmed over.

A third assessment is being completed in the Focus Area which evaluates all irrigated cropland, including those with seasonal or perennial streams or irrigation runoff, north of the Grasslands. The assessment is based on aerial photos, visual observations, proximity to stream, and knowledge of the farming practices on a particular property.

In addition, the SWCD used best professional judgement to evaluate properties for likelihood of contributing sediment or *E. coli* to Focus Area creeks (Table 4). Evaluations were based on 2006-2008 water quality monitoring, livestock presence, field verification, and aerial imagery.

Table 4. Mud Springs Irrigated Cropland Classification

Class	Description
I	Agricultural activity likely causing discharge of E. coli and sediment delivery to Mud Springs or Sagebrush Creek.
II	Agricultural activity not likely to cause E. coli or sediment to enter into to Mud Springs or Sagebrush Creek.
III	Agricultural property has no potential for delivery of E. coli or sediment to Mud Springs or Sagebrush Creek.

The milestones and measurable objective for the Mud Springs Focus Area SVAP are based on the reference site between the mouth of Mud Springs Creek and the first railroad crossing.

Conditions at beginning of Focus Area: 2015

- Riparian Streamside Vegetation Assessment: Tree + Shrub + Grass = 183 acres or 72%
- Riparian classification: Class III = 0.8 miles or 5%
- Irrigated cropland classification Class III = 1,021 acres or 7%

Current Conditions: 2017

- Riparian Streamside Vegetation Assessment: Tree + Shrub + Grass = 183 acres or 72%
- Riparian classification (lower 6 miles): Class III = 0.5 miles or 3%
- Irrigated cropland classification: Class III = 437 acres or 3%

Milestone: By June 30, 2019

- Riparian Streamside Vegetation Assessment: Tree + Shrub + Grass = 194 acres or 76%
- Riparian classification (lower 6 miles): Class III = 0.3 miles or 2%
- Irrigated cropland classification: Class III = 292 acres or 2%

Measurable Objectives: By June 30, 2021

- Riparian Streamside Vegetation Assessment: Tree + Shrub + Grass = 251 acres or 99%
- Riparian classification (lower 6 miles): Class III = 0.3 miles or 2%
- Irrigated cropland classification Class III = 200 acres or 1.3%

3.2 Strategies and Activities

The LAC, Jefferson County SWCD, and ODA:

- Develop strategies to provide landowners with information and technical and financial assistance.
- Work with others to develop and participate in a long-term monitoring plan that:
    - Characterizes baseline conditions,
    - Tracks Area Plan implementation,
    - Evaluates Area Plan effectiveness (improvements in water quality and land conditions),
    - Identifies priority areas,
    - Identifies annual and long-range strategies for Area Plan implementation.
- Continue to include the public in the development and implementation of the Area Plan and regulations.

To the greatest degree possible, prevention and control of agricultural pollution are encouraged in a cooperative spirit through the voluntary efforts of landowners, aided by information and technical and financial assistance from local, state, and federal agencies, and others.

The SWCD selected the highest priority watersheds for work based on the following criteria:

- Documented water quality concerns,
- A high percentage of agricultural land,
- Suspected water quality concerns,
- Waterways used by anadromous fish,
- A size that matches SWCD capacity to address resource issues in a reasonable time frame.

The highest priority watersheds were ranked from high to low:

1. Upper and Lower Trout Creek (documented high temperatures, 303(d) listing for biological criteria, anadromous fish).
2. Mud Springs (documented temperature and pesticide issues, concerns with bacteria and nutrients).
3. Rattlesnake Canyon (documented sediment and bacteria issues, concerns with bacteria and nutrients).
4. Campbell Creek (documented sediment, bacteria, pesticides, and nutrient issues).
5. Upper Willow Creek (concerns with temperature, bacteria, and nutrients).
6. Antelope Creek (concerns with bacteria and nutrients, bacteria, and temperature; anadromous).
7. Lower Willow Creek (concerns with nutrients).

Work is already being done in all of seven of these watersheds at some level.

Education is the key to the success of this Area Plan. The NRCS, Jefferson and Wasco County SWCDs, and the Middle Deschutes Watershed Council work together to provide farmers and ranchers in the Management Area with information about the goals, objectives, and requirements of the Area Plan and regulations.

The following strategies are used:

1. Improve water quality through planning and implementation of technically sound and economically feasible conservation practices that:

- Achieve riparian vegetation targets and sediment control,
- Stabilize streambanks, reduce high summer water temperatures, and restore and enhance wetlands and riparian areas, while avoiding adverse fish habitat modification,
- Improve irrigation water use and conveyance efficiency to reduce the impact of seasonal flow modifications on streams resulting from water withdrawals.

2. Create a high level of awareness and an understanding of water quality issues among the agricultural community and rural public, in a manner that minimizes conflict and encourages cooperative efforts, through education and technical assistance:
   - Incorporate Area Plan implementation as a priority element in the SWCDs' Annual Work Plans and Long-Range Plans, with support from partner organizations,
   - Inform landowners of the Area Plan and regulations and encourage landowners to make needed changes,
   - Showcase successful practices and systems; conduct tours for landowners and media,
   - Recognize successful projects and practices through appropriate media and newsletters,
   - Conduct educational programs to promote public awareness of water quality issues and their solutions,
   - Proactively offer and provide site evaluations on any lands within the Management Area to assess conditions that may affect water quality,
   - Prioritize sub-watersheds within the Management Area for targeting implementation strategies.

3. Encourage adequate funding and administration of the program to achieve Area Plan goals and objectives by systematic, long-range planning and focusing of coordinated efforts on full-scale, watershed-based approaches; identifying needs; developing projects; actively seeking funding; and ensuring successful implementation of funded projects.

3.3 Monitoring and Evaluation

Monitoring of water and land conditions in the Management Area is helping:

- Characterize baseline conditions,
- Track Area Plan implementation and compliance with the regulations,
- Evaluate Area Plan effectiveness (improvements in water quality and land conditions),
- Identify priority areas and annual and long-range strategies for Area Plan implementation.

The Middle Deschutes Watershed Council is in the process of developing a monitoring strategy for the entire watershed.

A 2003 study by Portland General Electric showed elevated levels of nitrates in springs flowing into Willow Creek, Campbell Creek, and Mud Springs Creek.[29] Analysis of the spring water suggested that the water in the springs is 10-40 years old; the younger water shows lower nitrate levels[30]. The most likely sources of the nitrates are: fertilizer from irrigated fields, leachate from wastewater ponds, dry wells, and/or septic systems, or soils naturally high in nitrates. The latter is unusual but there is evidence from soil samples and a 1932 USGS report (Nitrate deposits in the United States. United States Department of the Interior: Geologic Survey, Bulletin 838) this may be true in the Agency Plains area. Other possible sources may be leachate from wastewater ponds, dry wells, and/or septic systems.

In 2006-2008, the Jefferson County SWCD, ODA, CTWS, and others intensively monitored water quality in the Madras area.[31,32,33] Their analyses of irrigation delivery water, irrigation tailwater, streams, and ground water identified water quality issues, which resulted in prioritized conservation projects. Results demonstrate that nitrates are not a concern in irrigation surface runoff, but that sediment, phosphorus, and *E. coli* are concerns in the Campbell Creek and Mud Springs Creek drainages. While drains flowing

directly over the bluff into the Deschutes River are occasionally high in phosphorus and *E. coli*, the volume of water entering the Deschutes River from these drains is very low. Therefore, the 'bluff drains' deliver inconsequential amounts of nutrients and bacteria to the Deschutes River.

The monitoring clearly shows higher nitrates (3 - 8 mg/L) in groundwater, with the highest values near Gateway. It is unclear at this time whether the high nitrates are due to historical or current agricultural practices. Determining the ages of groundwater throughout the study area will help answer this question; as will additional monitoring of nutrients in groundwater and analyses of groundwater flow patterns.

The following monitoring activities are planned or in progress:

a. Potential Pesticide Stewardship Partnership (PSP)
   In 2014, four locations were sampled for pesticides in the Management Area to determine whether there was interest in creating a PSP. Water was collected between late March and early December from the mouth of Campbell Creek, mouth of Willow Creek, Mud Springs Creek at Gateway, and Trout Creek above Mud Springs Creek. A second round of sampling occurred during the spring and fall of 2017. Modifications were made to several of the sampling locations. Sites that were retained for 2017 were Campbell Creek at mouth, Mud Springs at Gateway and Trout Creek. Those added were Campbell Creek at Hwy 26 and Culver Drain at Crooked River Campground. Results are provided in Chapter 4.1. Please note that results for fall 2017 sampling were not yet available at the time of this report.

b. Nitrates
   The SWCD and ODA would like to know more about the source of nitrates in the Management Area. In the future, the SWCD and ODA may seek researchers/partners to conduct a study to evaluate nitrates that will answer two questions: 1) what is the source of the nitrates, and 2) are they diminishing over time in ground and surface water.

c. Turbidity
   The SWCD has monitored turbidity since 2015 in the Mud Springs, Rattlesnake, and Campbell Creek Drainages to measure sediment inputs from irrigation tail-water. Sediment in irrigation return flows to the Deschutes River has been a concern for many years and has resulted in the implementation of multiple sediment reduction and water conservation projects.

d. DEQ monitoring
   DEQ monitors two sites in the Management Area as part of their ambient monitoring network (Deschutes River @ Hwy 26 and Trout Creek below Mud Springs Creek). The site on the Deschutes is strongly influcenced by the Pelton-Round Butte Dam complex, not by agriculture. DEQ has completed a status and trends analysis for the Management Area (http://www.oregon.gov/deq/wq/programs/Pages/wqstatustrends.aspx). The report will be updated for future biennial reviews, and the LAC can make informed decisions on management activities within the coverage area.

For a description of monitoring and evaluation results, see Chapter 4.

Chapter 4: Implementation, Monitoring, and Adaptive Management

4.1 Progress Toward Measurable Objectives

4.1.1 Management Area

ODA presented the methodology for the management area wide assessment at the 2018 biennial review. ODA will provide results at the 2020 biennial review.

4.1.2 Focus Area

The SWCD tracked changes in the Mud Springs Focus Area. In the last three years, one mile of stream near the Gateway area improved from Class III due to changes in management. In addition, 1,000 acres of cropland are no longer likely contributing sediment and/or *E. coli* to Mud Springs Creek.

The NUID has been piping two laterals that were delivering excess water to Mud Springs Creek, a major tributary of Trout Creek. The piping of 58-9 consisted of 4.5 miles and has prevented 2 cfs of excess sediment-laden water from entering Mud Springs Creek. When completed in 2018, the piping of 58-11 will consist of 5 miles and save 3.7 cfs (1,617 acre-feet) of water instream. Water quality monitoring for turbidity by the Jefferson SWCD has showed significant improvements since these piping projects began in 2009. The landowners on these laterals have been able to hook up to pressurize water as well, which has reduced flood irrigation and allowed for multiple irrigation efficiency upgrades on-farm. By 2018, we expect to see little to no excess tailwater entering Mud Springs Creek.

In the last two years, the following activities reduced soil erosion and sediment and bacteria inputs into Mud Springs Creek:

58-11 piping project Phase 3 and 4:

- Irrigation Water Management 743.8 Acres
- Irrigation Pipelines 7,001 Feet
- Water Control Structures – 5

Assessment Results:

Table 5. Mud Springs Streamside Vegetation Assessment.

SVA Map Category	Pre-Assessment (2015)	Mid-Assessment (2017)	Post-Assessment (2019)	Change Notes
Ag Infrastructure	24.29	24.29		
Bare	1.60	1.60		
Bare Ag	5.19	5.19		
Grass	107.73	107.59		
Grass Ag	35.10	35.10		
Not Ag	73.40	73.40		
Shrub	36.93	36.93		
Shrub Ag	0	0.00		
Tree	36.97	37.11		
Tree Ag	0	0.00		
Water	2.62	2.62		
TOTAL ACRES	**323.84**	**323.84**		

Table 6. Mud Springs Riparian Conditions						
		Stream miles (total miles = 15.2)				
Class	**Description**	**2008**	**2012**	**2015**	**2017**	**2019**
I	Provides functions. SVAP = 9-10. Ag activities (grazing) were discontinued, vegetation is filling in the stream corridor and the riparian vegetation is sufficient to provide water quality function.	0	0	0.5	0.7	
II	Not yet providing functions. SVAP = 5-8.9. Ag activities are not hampering water quality functions of riparian vegetation; however, the vegetation is not sufficient to protect water quality.	**0**	**5.9**	6.4	6.5	
III	Functions impeded by agricultural activity. SVAP < 5.	**7.7**	**1.8**	**0.8**	**0.5**	
IV	Functions impeded by non-agricultural activities, e.g. the railroad bermed and relocated the stream channel.	2.5	2.5	2.5	2.5	
V	Legacy agricultural issues that are not likely to change in the immediate future, for instance where Mud Springs Creek was piped under a field at the upper end of the watershed in the 1940s and has since been farmed over.	5	5	5	5	

Table 7. Mud Springs Creek Focus Area: likelihood of runoff containing sediment or *E. coli*					
		Agricultural acreage (total = 14,580 acres)			
Class	**Description**	**2012**	**2015**	**2017**	**2019**
1	Agricultural properties have no potential for run-off of *E. coli* or sediment delivery to Mud Springs Creek.	5,686	5,686	5,686	
2	Agricultural activities are not likely to cause *E. coli* or sediment to enter into the stream.	6,686	7,873	8,457	
3	Agricultural activity likely causing discharges of *E.coli* and sediment delivery to the stream. This includes all agricultural tax lots, with seasonal or perennial streams or irrigation run off. If possible, agricultural use was verified through aerial photo analysis or field.	2,208	1,021	437	

From 2015-2017, Class 3 improved by more than 50 percent due to the installation of the 58-11 Pipeline (to be completed Winter 2018), which is increasing irrigation water efficiency through irrigation system improvements.

4.2 Activities and Accomplishments

Landowner assistance is primarily coordinated by the SWCD and the Middle Deschutes Watershed Council. Their efforts focus on providing technical assistance, coordinating financial assistance, and distributing water quality, and land management through various media.

Trout Creek

The SWCDs Trout Creek Watershed Restoration Project's primary goal is to increase the abundance of ESA listed Middle Columbia River DPS Summer Steelhead. The status of the summer steelhead population in Trout Creek, within the Deschutes River eastside DPS, is currently rated as a viable population (Oregon Mid-C Steelhead Recovery Plan, 2010). The confidence for making this population assessment "viable" is largely the result of the BPA funded programs associated with this project. Past project work, the continued maintenance and monitoring of this work, along with the proposed future habitat restoration to be completed in future years will hopefully put the MCR DPS up for consideration of de-listing.

This project satisfies the goals listed in the Deschutes River Sub-basin Summary (Nelson, 2001), the portion of the draft Deschutes Subbasin Plan (2004) that addresses Trout Creek, and the Trout Creek Watershed Assessment (2003). This project satisfies the objectives of Reasonable and Prudent Alternatives 34 and 35 of the 2008 FCRPS Biological Opinion calling for protection and improvement of tributary habitat-based on biological needs and prioritized actions. This project also follows the habitat strategies and actions found in the Oregon Middle Columbia (Mid-C) Steelhead Recovery Plan (2010).

Following the goals and objectives of the numerous plans and documents will ensure the viability of the summer steelhead that utilizes the Trout Creek Watershed. Continued work in this area will promote healthy populations of numerous species of fish and wildlife, while simultaneously promoting the use of sustainable agricultural practices on private land. Successful agriculture and extraordinary habitat can and does coexist in the Trout Creek Watershed and needs to continue well into the future for all parties involved if there is to be true "restoration." The work done here also has a huge impact on the region's financial income. The Deschutes River is one of the single largest recreational summer steelhead fisheries in the United States, with over 50,000 angler days per season, bringing millions of dollars annually to the region. Trout Creek accounts for approximately 25-33 percent of the entire run of wild summer steelhead found in the Lower Deschutes River Subbasin (ODFW). Sustaining, or better yet, improving this run of fish is critical to the economy of central and north-central Oregon.

The SWCD plans to accomplish these goals with the implementation of demonstration projects located throughout the Trout Creek Watershed on private lands. Priority areas have been identified in previous studies and assessments. We give preference to these areas when selecting projects to implement, but it should be noted that all of our work hinges on the permission and desire of the landowner. Some landowners are more willing than others. Since the inception of this project in 1998, there have been massive gains in trust and willingness throughout the watershed and we have recently gained access to numerous acres that were previously off limits to us and our work. This gain in trust is a huge benefit for all when it comes to the restoration of our habitat. The demonstration projects we plan to implement include: Habitat Improvement Projects that include in-stream work, riparian, and floodplain enhancements, fish passage improvements, upland vegetation management, spring developments and conservation easements such as the Conservation Reserve Enhancement Program (CREP). We have been very successful in the improvement of irrigation practices throughout the watershed and there are still more opportunities that exist in Trout Creek. Improving efficiencies of irrigation systems is critical to the overall reduction of water withdrawals. Also, improving individual points of diversion, not only aid the irrigator, but hugely benefit the species of concern - juvenile summer steelhead.

These demonstration projects should continue until all of the habitat, including upland, riparian, and in-stream, can sustain ample fish and wildlife populations and summer steelhead can become de-listed. This may take many years for all of this to come to fruition, however, we are making great strides in the right direction, and each and every year, we gain trust and access to habitats that were previously inaccessible.

Willow Creek

Previous and current restoration efforts have focused on addressing degraded riparian areas, treating upland juniper encroachment, stabilizing eroding banks, and planting native trees and shrubs. The Middle Deschutes Watershed Council and partners have launched a landowner outreach project targeting the Upper Willow Creek Watershed to address resource concerns identified in the Willow Creek Watershed Analysis (2000) and Proper Functioning Condition Assesment (2005). The MDWC and the US Forest Service partnered on a large juniper treatment on the Crooked River National Grasslands. The MDWC Environmental Education Program has been successful in achieving the objective of getting students outside to participate in hands-on restoration projects and activities.

Irrigated Lands draining to the Deschutes River

The SWCD has chosen to focus their efforts on lands draining to Rattlesnake Canyon and Campbell

Creek, located in Agency Plains north of Madras. Concerns have risen over the last several years about sediment-laden tailwater entering the Deschutes River from these two drainages. A 2014 study conducted on Rattlesnake Canyon recommended more irrigation upgrades, more tailwater ponds, pond cleaning, and soil bonding chemicals such as polyacrylamide. The SWCD and NRCS plan to work together to help reduce this sediment tailwater from flowing into the Deschutes River over the next several years. The Jefferson SWCD also has an ongoing stream restoration project on lower Campbell Creek that includes artificial beaver dam structures to help slow the tailwater flows and drop out sediments. The SWCD hopes to continue efforts to further reduce the issue throughout the next few years.

Table 8. Activities accomplished in the Management Area outside of the Focus Area since the last biennial review by the SWCD, Middle Deschutes Watershed Council, and NRCS			
	Outreach/Education	**Implementation outside Focus Areas**	**Monitoring**
Riparian vegetation	• Conducted 2 tours on Willow Creek with Forest Service and Culver high school to learn about natural resources associated with Willow Creek. • Conducted 10 education days at Trout Creek and Willow Creek with 600 students from Culver and Madras schools. • 2 Farm Fair presentations included riparian restoration in Trout Creek and Willow Creek. • A 2 year assessment was completed on ripiarian vegetation in Mud Springs Creek. • 23 landowners contacted and provided assistence on riparian areas • Several landowners contacted about CREP	• 3 landowners signed CREP re-ups for Trout Creek and Mud Springs. 10,000 plants were planted for a new CREP on Trout Creek. • Removed blackberries from 1,900 ft of riparian area along Campbell Creek in November of 2015 • Reconstructed 411 feet of Trout Creek, including relocating a bridge and road • Treated 27 acres of noxious weeds in the riparian areas. • 200 plants were planted on willow creek in Spring of 2017. • 2015-2016: Trout Creek Watershed Sprayed 466.50 Acres of Scotch Thistle, Knapweek and StarThistle. • 2015-2016 : Trout Creek Watershed Sprayed 340 Acres of Medusahead. • 2015-2016: Trout Creek Watershed Landowners sprayed 18.5 acres of Riparian Vegetation and 488 Acres of Upland. • Design Work on Trout Creek Channel Reconstruction. • 2016-2017: Trout Creek Watershed 1.35 miles of total channel reconstruction; 42 Habitat Structures, 32 pool structures and 10 riffle structures. • 2016-2017 89 Trout Creek Watershed: Foot long decked railcar Bridge Installed over Trout Creek eliminating a Ford. • 2016-2017: Trout Creek Watershed 5,000 trees planted with Hudraulic Stinger to ensure rootes will be in groud water; 5,000 trees planted by hand. • Irrigation Water Management 200.3 Acres • Sprinkler System Upgrade 180.7 Acres • Pumping Plant 3 Total • Water Control Structures 2 Total • Irrigation Pipeline 2,474 Feet	• Turbidity monitored at least once per month in Mud Springs, Trout Creek, Campbell Creek and Rattlesnake Creek • Pesticide stewardship monitoring for Spring and Fall of 2017
Irrigation water improvem ents	• 1 tour was conducted for new pivot technology in the Madras area with the Hay Growers association. • 1 Agency Plains landowner meeting to disscuss irrigation water improvement opportunities. • 2 Farm Fair presentations included several irrigation projects	• Agency Plains/Culver Areas implemented 2 ditch to pipe projects (2,500 ft), 2 pond expansions/sealing (2 acres), and 4 irrigation Water Management plans (200 acres)	N/A

	throughout Culver, Madras, and Agency Plains. • 75 landowners contacted and provided with technical assistance for irrigation water management improvements.		
Uplands	• 1 tour with the Forest Service on an 2,200 acre juniper treatment site on Willow Creek. • 1 tour with parners on Upper Willow Creek Watershed. • Uplands disscussed at 2 Farm Fairs. • 25 landowners contacted and provided technical assistance for upland improvements.	• Treated juniper on 1,969 acres at 3 locations: Ashwood, Blizzard Ridge, and Willow Creek. • Treated 2,200 acres of juniper on Crooked River National Grasslands. • Range seeded 4 acres on Cambell Creek. • Installed 3.2 miles of fence on a burned area of Ashwood, OR. Landowners sprayed 488 Acres of Upland in 2015-2016. • 2016-2017: Trout Creek Watershed over 1,000 juniper trees removed and transported to Channel Reconstruction Project. • 2016-2017: Trout Creek Watershed focused our efforts on early spring weeds such as Scotch Thistle, Whitetop and diffuse Knapweed. Locations that were treated were areas that we have treated the past 6 years, which include past restoration sites as well as important steelhead production corridors. These include remote, rugged areas with little access. These include Degner Canyon along Trout Creek as well as the Ward Creek drainage, the primary tributary to Antelope Creek.	N/A

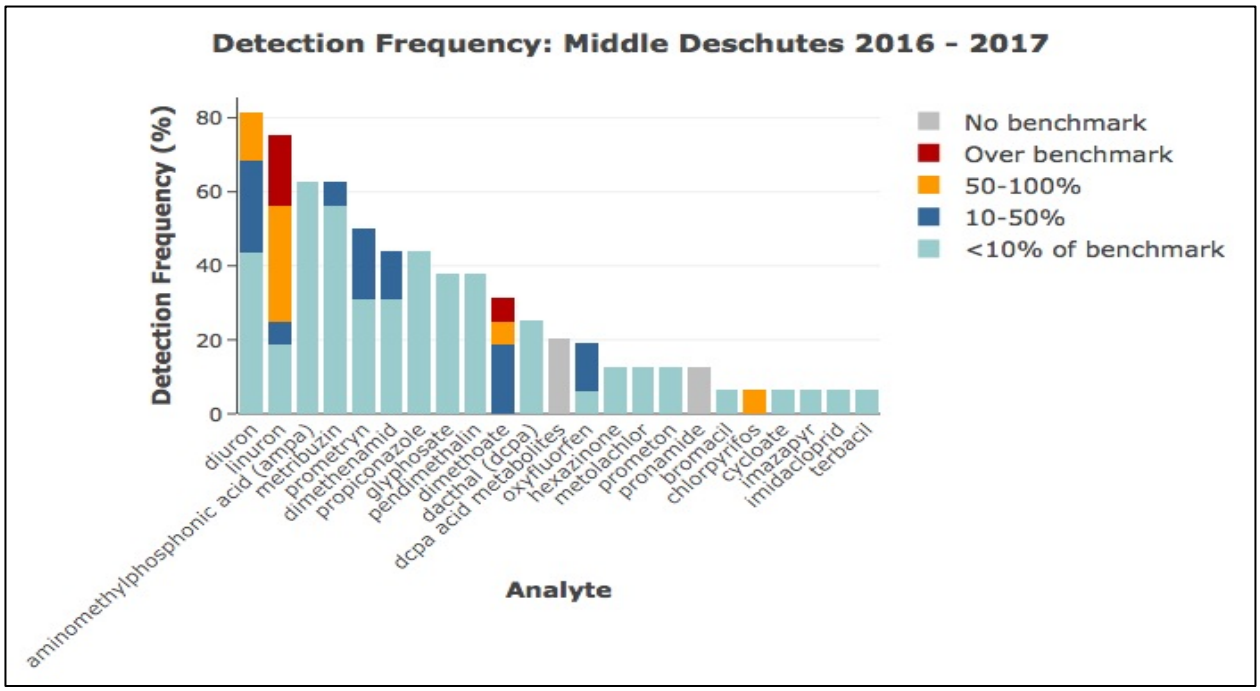
4.3 Monitoring—Status and Trends

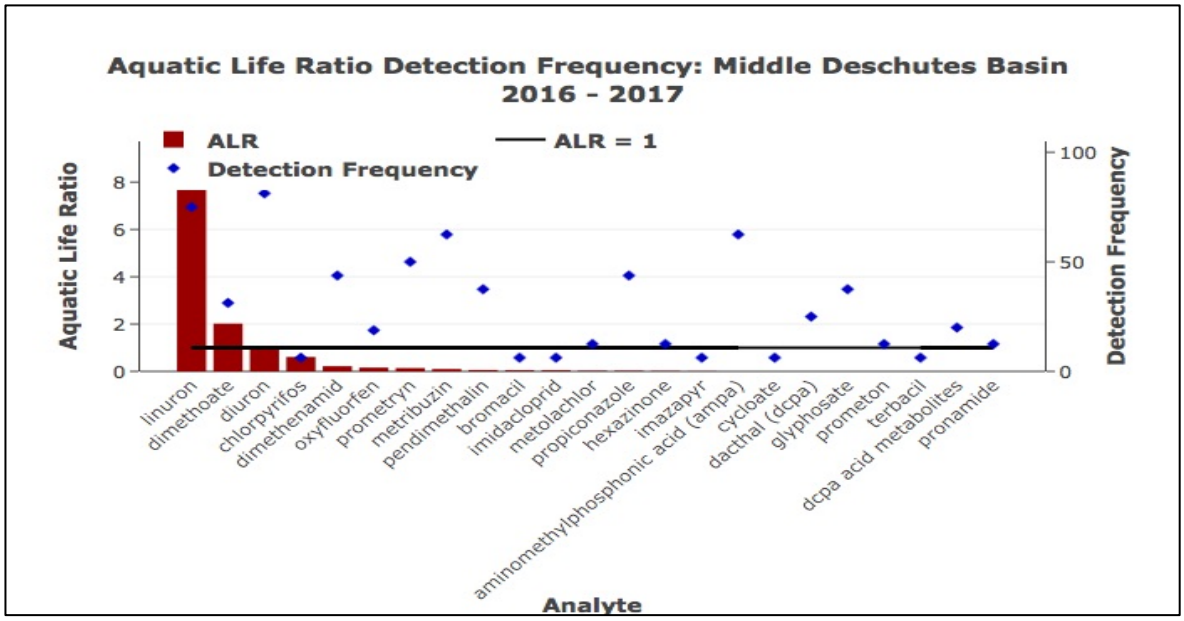
4.3.1 Water Quality

a. Pesticide Stewardship Partnership (PSP)
The 2017 PSP pesticide sampling results have raised the level of concern above that indicated for 2014 results. At most sampling locations, multiple pesticides were detected thus raising concern regarding potential synergistic effects from multiple pesticides at low/medium concentrations present at the same time.

- Seventeen pesticides were detected at the mouth of Campbell Creek,
- Fourteen pesticides were detected at the Campbell Creek Hwy 26 site,
- Seven pesticides were detected at the Mud Springs (Gateway) location,
- Three pesticides were detected at the Culver Drain location,
- One pesticide detection occurred at the Trout Creek site,
- The overall detection frequency across sites exceeded 50 percent from several pesticides including, diuron, linuron, ampa, metribuzin and prometryn, (See Graph below)
- The presence of dacthal at both of the Campbell Creek locations is of concern due to the potential for groundwater contamination from one of its degradates,

- EPA benchmarks were exceeded on several occasions, for both Dimethoate and Linuron in Campbell Creek,
- Detections of numerous pesticides including Diuron, Metribuzin, Prometry Dimethenamid, Oxyfluorfen were between 50 and 100 percent of the lowest benchmark; the rest of the pesticides were all less than 50 percent of the lowest EPA benchmark concentration.





b. <u>Nitrates</u>

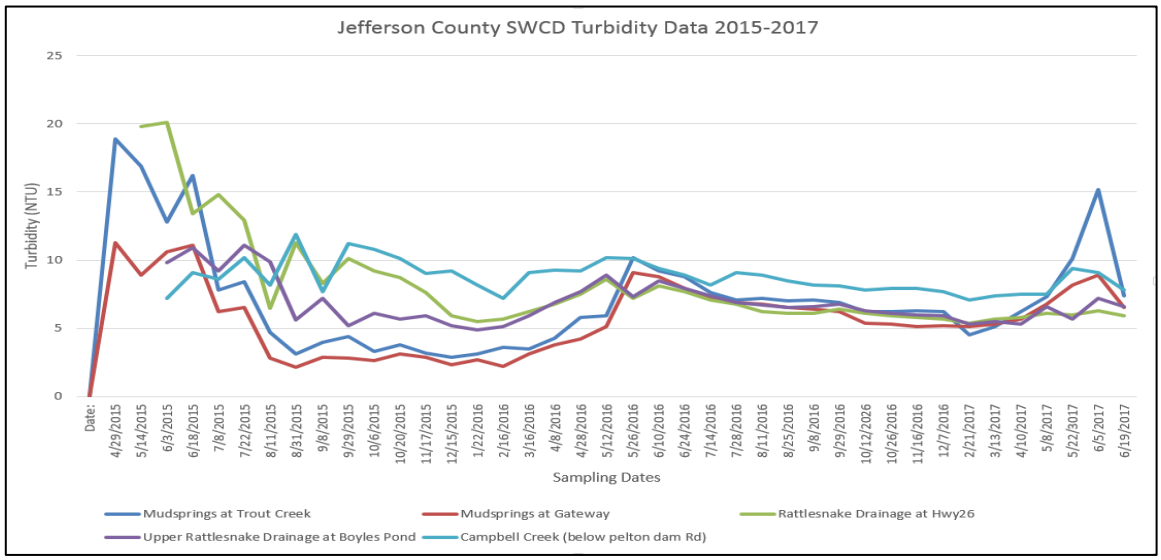
The SWCD and ODA would like to know more about the source of nitrates in the Management Area. In the future, the SWCD and ODA may seek researchers/partners to conduct a study to

evaluate nitrates that will answer two questions: 1) what is the source of the nitrates? and 2) are they diminishing over time in ground and surface water?

c. Turbidity

Turbidity is a measure of the clarity of the water and reflects both suspended sediment and organic matter. But, turbidty is often used as a surrogate suspended sediment due to the ease of measuring it. A value of <25-30 NTUs is generally considered beneficial for fish.

The SWCD measured turbidity at five sites from January through October in 2015-2017.

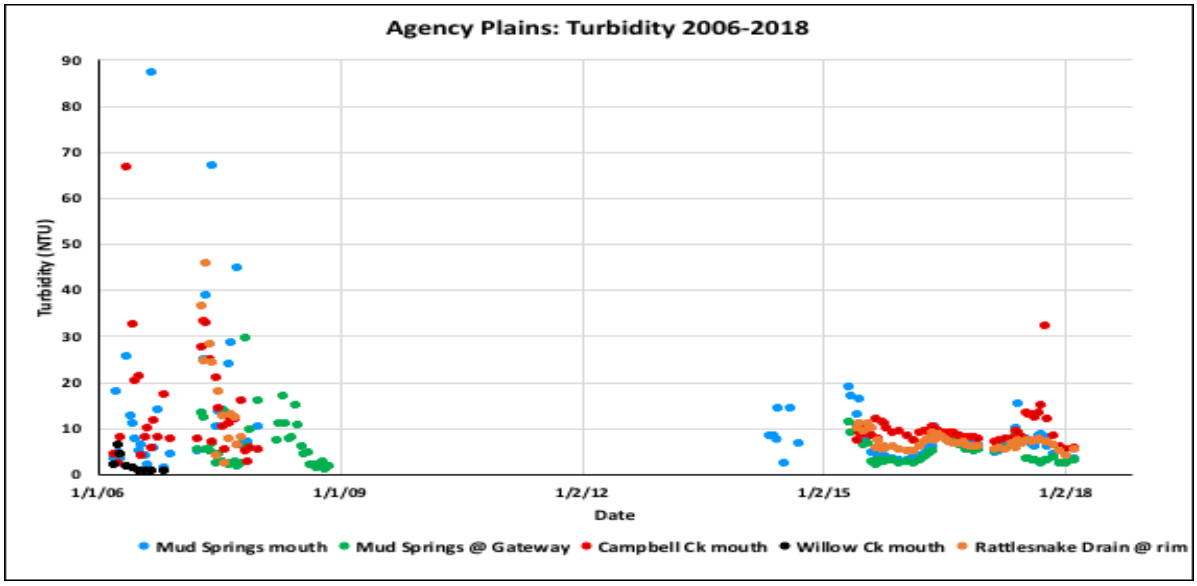


Mud Springs: Both sites peaked annually in May and June, likely due to storms and irrigation water flushing from the NUID system. The 2017 peak at the mouth was due to a blowout on the 58-11 Lateral pipeline that contributed sediment to the creek. NUID fixed this problem and values decreased. Turbidity at the mouth generally mirrors that at Gateway, indicating that most of the sediment enters Mud Springs above Gateway. This reflects the change from mostly row crops above Gateway to rangeland cattle grazing below.

Rattlesnake Drain: In 2015, turbidity at the mouth was generally higher than at the rim, probably due to erosion of the bluff as the water flowed to the Deschutes River. After 2015, the levels are almost identical, likely due to reduced volume of water flowing over the rim and causing less erosion. Both locations showed improvements since 2015, likely due to landowner awareness from the 2014-2015 SWCD Rattlesnake Canyon study and implementaiton of multiple irrigation improvement projects. Also, the landowner at the edge of the rim improved his sediment pond to more effectively capture sediment.

Campbell Creek: This is a small, heavily rowcropped drainage, with a steep fall above the sampling location near the mouth. Campbell Creek generally had the highest turbidity of all sites tested, but never exceeded 12 NTU. Turbidity has improved slightly since 2015.

Turbidity values have become more consistent in the last few years and appear to be generally lower than those measured in 2006-2008.

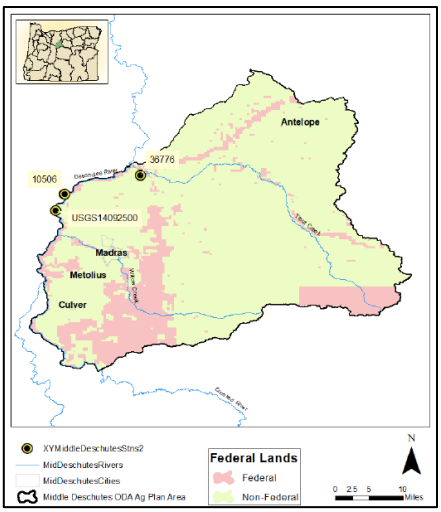


d. <u>DEQ</u>

For this biennial review, DEQ reviewed data from forty sites, of which three had sufficient data for status and trends analysis.[39] Data from the two sites on the Deschutes River are not presented in this Area Plan as they are below a series of dams and do not represent water quality influenced by agriculture in the Management Area. Based on the data below, water quality at the Trout Creek site is fairly good.

Site ID	Site Description	*E. coli*	pH	Temperature	Dissolved Oxygen	Total Suspended Solids	Total Phosphorus
		# exceeding standard/N*				# >25 mg/L**/N*	median***/N*
36776	**Trout Creek below Mud Springs Creek**	7/33	6/38	-	5/38	3/35	~0.12/38

*N = # of observations
**25 NTU = OWEB target
***Total Phosphorus ≤0.07 mg/L is generally considered from 'natural' sources



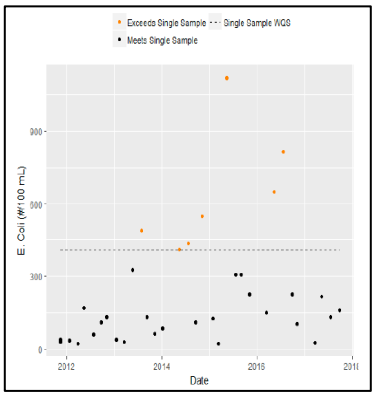
During the summer, Mud Springs contributes almost the entire flow of Trout Creek at the sampling site because Trout Creek is almost completely dewatered by upstream irrigation. Trout Creek drains mostly forest, rangeland, and streamside irrigated pastures; Mud Springs drains primarily irrigated row crops and pasture. Peak values of pollutants during the irrigation season are likely related to agricultural activities in the Mud Springs drainage. It is believed by many that the Central Oregon volcanic soils are naturally high in phosphorus and also contribute to a higher pH in local waters.

All but one of the *E. coli* exceedances were measured during the irrigation season, when concentrations can increase due to low flows.

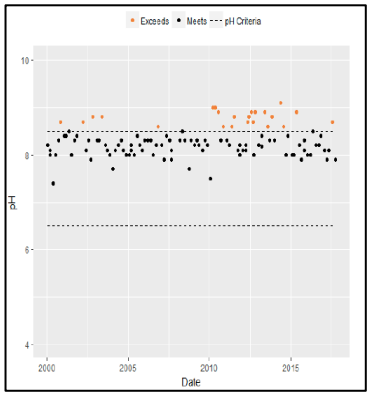
Most of the pH values measured in the Deschutes River and Trout Creek met the standard, although most of the values were between 8 and 8.5 (close to the standard).

Dissolved oxygen exceeded the standard only at the end of the spawning season.

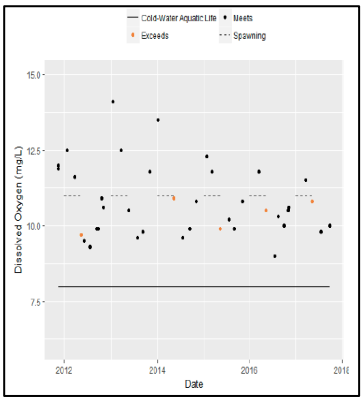
E. coli



pH

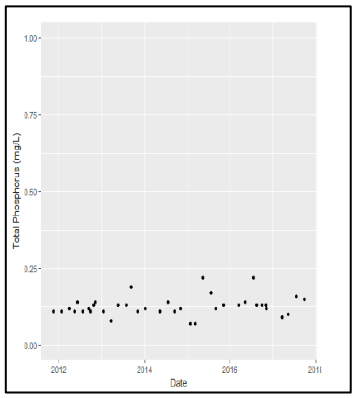


Dissolved Oxygen

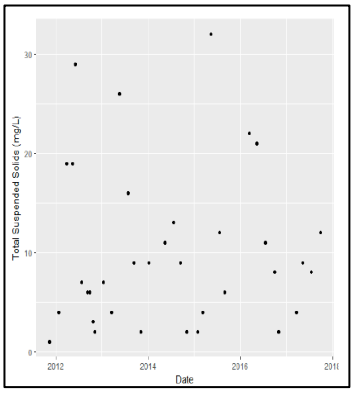


Total Phosphorus values exceed the 'natural' level, but even Deschutes River median is approximately 0.1 mg/L. It is believed by many that higher levels of phosphorus occur naturally in the volcanic soils of Central Oregon. Highest values of both total phosphorus and total suspended solids concentration are during the irrigation season.

Total Phosphorus



Total Suspended Solids



4.4 Biennial Reviews and Adaptive Management

The March 6, 2018, biennial review consisted of updating language in Chapters 3 and 4. ODA presented the program updates from the past two years. This included Focus Areas, Strategic Implementation Areas, examples of compliance cases, and ODA water quality monitoring program. ODA presented major edits of the Area Plan to the LAC, including a discussion regarding the Land Condition Assessment.

Compliance Cases: There were none in the Management Area since the last Biennial Review.

Recommendations from the LAC:

- Need baseline data to track improvements in riparian vegetation,
- Lack of funding for on farm management changes and irrigation improvements,
- Lack of adequately-designed and maintained sediment catch basins,
- Collect baseline riparian condition data,
- SWCD develop an outreach program concentrated on improved designs and maintenance of sediment catch basins,
- Find more funding for the improved sediment basins.

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