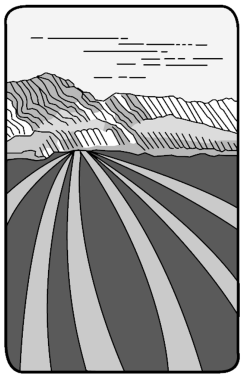


Oregon
Department
of Agriculture

Agricultural Water Quality Management Program

Monitoring Strategy

December 2017

Prepared by
Ellen Hammond
Oregon Department of Agriculture
Water Quality Program

Table of Contents

Acronyms and Abbreviations

AgWQ = Agricultural Water Quality
Area Plan = ODA Agricultural Water Quality Management Area Plan
Area Rules = ODA Agricultural Water Quality Management Area Rules
DEQ = Oregon Department of Environmental Quality
FA = Focus Area
LAC = Local Advisory Committee
Management Area = ODA Agricultural Water Quality Management Area
MOA = Memorandum of Agreement
NRCS = Natural Resources Conservation Service
ODA = Oregon Department of Agriculture
OWQI = Oregon Water Quality Index
ORS = Oregon Revised Statute
OWEB = Oregon Watershed Enhancement Board
Program = Agricultural Water Quality Management Program
SCV = Site-Capable Vegetation
SIA = Strategic Implementation Area
SVA = ODA Streamside Vegetation Assessment
SWCD = Soil and Water Conservation District
TMDL = Total Maximum Daily Load

Oregon Agricultural Water Quality Program: Monitoring Strategy

1. Introduction

The Oregon Department of Agriculture (ODA) is responsible for implementing Oregon's Agricultural Water Quality (AgWQ) Program (Program). Monitoring is needed to document agricultural land and water quality conditions, evaluate how those conditions change over time, and determine whether conditions and implementation strategies will achieve Oregon's water quality goals. ODA will use monitoring data as part of a broad effect to continually review and determine the effectiveness of Area Plans and proposed measures. ODA also needs monitoring data to help tell the story of agriculture's efforts to improve water quality to a broad audience.

This document describes both the monitoring questions that ODA needs to answer regarding Program effectiveness and the monitoring activities that ODA and partners have identified to answer those questions. ODA then provides this information to funders, policy makers, and policy influencers. Limited resources prevent ODA from developing monitoring activities to answer all the questions, so questions have been prioritized.

Monitoring needs have been identified to help ODA collaborate more effectively with other partners, including other state agencies, watershed councils, and Soil and Water Conservation Districts (SWCDs). ODA expects this document to facilitate ongoing dialogue with our partners about how best to use the Program's monitoring resources. ODA will update this document as we continue discussions with partners and stakeholders.

1.1 Oregon's Coordinated Streamside Management Partnership

The State of Oregon, working with federal and local partners, is implementing a coordinated approach to streamside management. The State believes this coordinated approach will improve water quality and make more habitat available for fish and stream-side dependent plants and animals. The State, with partners, will select areas in different geographic areas to maximize the potential for implementing on-the-ground work for conservation and monitoring activities.

Monitoring is an essential component of coordinated streamside management. Watershed-scale monitoring can show that landowner actions result in improved water quality. Depending on the stream, parameters may include stream temperature, sediment, nutrients and/or bacteria. In addition to watershed-scale monitoring, evaluation of specific actions helps local groups learn and share information about the most effective implementation strategies and approaches. Implementation of this partnered and incentive-based approach will document water quality improvement over time, and provide information to support adaptive management.

2. Oregon's Agricultural Water Quality Management Program

In 1993, the Oregon Legislature passed the AgWQ 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 to implement the Program (Oregon Revised Statute (ORS) 568.900 through 568.933). In 1995, the Oregon Legislature further clarified that ODA is the lead agency for regulating agriculture with respect to water quality (ORS 561.191).

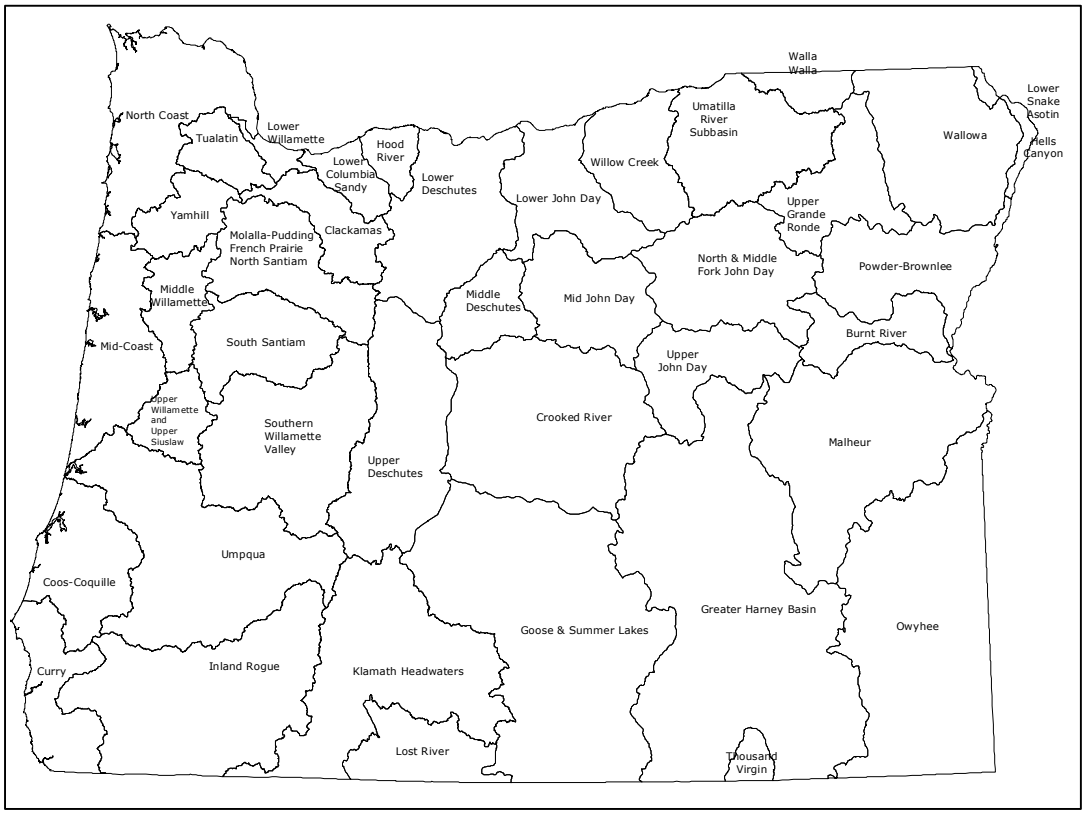
State and federal programs that drive the establishment of Area Plans and Rules include:

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

The Program applies to all agricultural activities on non-federal and non-Tribal Trust land.

Between 1997 and 2004, ODA worked with Local Advisory Committees (LACs) and other local partners to develop Area Plans and associated Area Rules in 38 watershed-based Management Areas across Oregon (Figure 1). ODA meets with the LAC, SWCD staff, and other conservation partners every two years to review and update each Area Plan.

Figure 1. Map of the 38 Agricultural Water Quality Management Areas



The Program emphasizes protection and enhancement of vegetation along streams 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 reducing solar heating of streams, streambank stability, and filtration of pollutants.

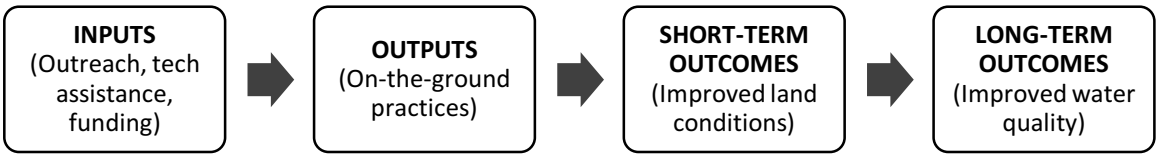
The Program uses the concept of "site-capable vegetation" (SCV) to describe the vegetation that landowners can achieve along agricultural streams to protect water quality. SCV is the vegetation that can be expected to grow at a particular site, given natural site factors (e.g., elevation, soils, climate, hydrology, wildlife, fire, floods) and historical and current human influences that are beyond the Program's statutory authority (e.g., stream channelization, roads, modified flows, previous land management). The goal for Oregon's agricultural landowners is to provide the water quality functions (shade, streambank stability, and filtration of pollutants) produced by SCV along streams flowing through agricultural lands.

2.1 Area Plans

Area Plans provide guidance for addressing water quality related to agricultural activities in each Management Area. Area Plans are unenforceable. Each Area Plan identifies strategies to prevent and control water pollution from agricultural lands through a combination of outreach programs, suggested land treatments, voluntary management activities, funding, compliance with Area Rules, and monitoring.

The goal of each Area Plan is to *prevent and control water pollution from agricultural activities and soil erosion and achieve applicable water quality standards.* This goal is the same as the Program's goal. This goal is accomplished through helping landowners make on-the-ground changes, resulting in improved upland and streamside conditions that will protect water quality (Figure 2). ODA and LACs will use the monitoring data provided at each biennial review as part of the adaptive management process to review and evaluate progress, and determine what additional efforts, if any, are needed. These may include work in prioritized watersheds and adoption of appropriate management practices.

Figure 2. Process for meeting the Area Plan/Program GOAL



2.2 Area Rules

Area Rules (Oregon Administrative Rules 603-095-0000 through 3900) require that landowners perform actions as necessary to prevent and control pollution from agricultural activities and soil erosion.

All Management Areas have at least two rules: a waste rule and a streamside vegetation rule. Some Area Rules have additional rules that are specific to that Management Area.

Waste Rule

All agricultural landowners must comply with a Waste Rule by not polluting ground or surface water, discharging wastes into waters of the state, or placing any wastes in a location where they are likely to enter waters of the state (ORS 468B.025). *Wastes* include excess soil, manure, fertilizer, or other substances that can pollute water. *Waters of the state* can include ponds, groundwater, canals, ditches, and rivers.

Streamside Vegetation Rule

At a minimum, all agricultural landowners must comply with a streamside vegetation rule by allowing vegetation to establish and grow along:

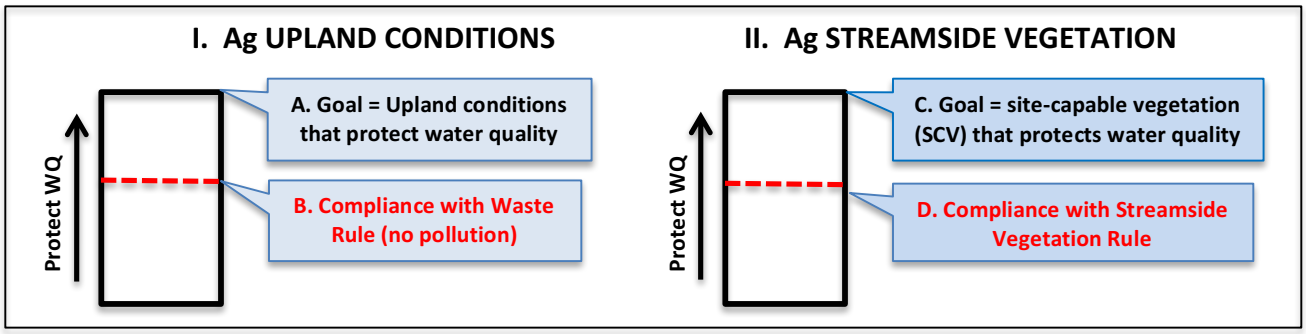
- Streams that flow all year (perennial streams), to provide shade, stabilize banks, and filter out pollutants from overland flows.
- Streams that flow part of the year (intermittent streams), to stabilize banks and filter out pollutants from overland flows.

2.3 Relationship between Area Plan Goals and Area Rule Requirements

Two types of agricultural landscapes can affect agricultural water quality: uplands and streamside areas. Both must be managed appropriately to prevent and control water pollution from agricultural activities and to protect water quality.

Area Rules specify the minimum efforts that landowners are required make to protect water quality. Depending on the type of landscape, compliance with Area Rules may or may not be sufficient to fully protect water quality (Figure 3). The Program's key monitoring questions relate to the different levels of protection (A through D) shown in Figure 3.

Figure 3. Relationship between Area Plan Goals, Area Rule Requirements, and water quality protection.



I. Uplands Explanation:

A = Goal: Achieve upland conditions that protect water quality.

B = Compliance with the Waste Rule (ORS 468B.025). This level of protection will help prevent degradation of water quality.

Gap between A and B = In many cases, compliance with the Waste Rule will be sufficient to protect water quality (achieve Level 'A'). However, there are instances where landowners can implement voluntary activities that go beyond compliance to further protect water quality. Examples include:

- Irrigated agricultural land that has no polluted field runoff but is receiving more water than needed; more efficient irrigation could leave water instream to improve water quality concerns related to low flows.
- Uplands with soil conditions (e.g. bare or compacted ground) that do not allow the desirable capture, storage and release of precipitation. Healthy soils contribute to important watershed processes that can increase streamflows and provide cool water to receiving streams. Practices are very site-specific but could include cover crops or improved livestock grazing.
- Multiple landowners in one watershed may be discharging small amounts of a pollutant but not at levels to individually exceed water quality standards. However, the cumulative concentrations could exceed water quality standards.

When there is a gap between 'A' and 'B', voluntary measures may be needed (in addition to compliance) to sufficiently improve upland conditions to improve water quality.

II. Streamside Vegetation Explanation:

C = Goal: Provide site-capable vegetation (SCV) that protects water quality

Voluntary achievement of water quality functions equivalent to those of SCV is one of the primary aims of the Program. Mature SCV provides all the water quality functions vegetation can provide at that site. However, SCV may not be able to provide all the *desired* water quality protection due to issues that agriculture alone cannot address, such as old mine tailings, historic channelization, or current reservoir operations. Therefore, additional actions may be needed such as floodplain reconnection or flow modification. These kinds of projects may require a state-level response by multiple partners.

D = Compliance with streamside vegetation rule: compliance either removes the agricultural activity or allows the agricultural activity if SCV vegetation can establish and grow. Compliance may be insufficient to provide desired water quality functions, especially in the short-term. For example, compliance alone may result in weeds rather than SCV if the agricultural activity is removed but appropriate vegetation is not planted. Landowners can implement voluntary activities that go beyond compliance to protect water quality.

Gap between C and D = This gap is either due to invasive species preventing SCV from establishing and growing, or appropriate vegetation is established and growing, but is not mature enough to provide the water quality functions of SCV. In some places, there is no gap between 'C' and 'D', e.g., when activities to achieve or maintain compliance are sufficient to result in vegetation that provides the needed water quality functions.

2.4 AgWQ Strategic Initatives

Strategic initiatives emphasize voluntary work by landowners in small watersheds. Over time, it is anticipated that these initiatives can be used to ensure both effective implementation and monitoring of AgWQ improvements:

1. Focus Areas (FAs): FAs are small watersheds with water quality concerns associated with agriculture. Through the FA process, the SWCD delivers systematic, concentrated outreach and technical assistance. A key component of this approach is measuring conditions before and after implementation to document the progress made with available resources. FAs are led by SWCDs, with ODA oversight. There are approximately 50 FAs across Oregon. ODA initiates compliance investigations only upon receipt of a complaint while a watershed is a FA.
2. Strategic Implementation Areas (SIAs): The process combines both voluntary and regulatory measures to provide the greatest benefit (uplift) to water quality. It supports and encourages innovation and local solutions while ensuring landowners comply with Area Rules. 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 a pre-evaluation of likely compliance with Area Rules based on land conditions (manure piles, bare ground, streamside vegetation) and contacts landowners with the results and next steps. Landowners may work with the SWCD or other local partners to voluntarily address water quality concerns. ODA follows up, as needed, to enforce Area Rules. Finally, ODA completes a post-assessment to document progress made in the watershed.

2.5 Measurable Objectives

ODA is in the process of developing measurable objectives for the Program. Measurable objectives allow ODA to better evaluate progress towards improved water quality. 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.

3. Monitoring Strategy

3.1 Purposes

Purposes of this monitoring strategy:

1. Determine Program effectiveness in protecting water quality.
2. Determine Program effectiveness in achieving desired upland and streamside vegetation conditions that can protect water quality.
3. Inform the Program of modifications needed to protect water quality (adaptive management), including identification of geographic locations or specific issues where voluntary or regulatory Program tools could be used.
4. Guide changes to Area Plans

Oregon Revised Statutes 568.900-933 require that any Area Plan be based on scientific information. Monitoring data, combined with results of research published in scientific literature, can provide the scientific foundation for ODA to determine whether it is making progress toward meeting water quality standards and achieving agricultural load allocations.

Land cover and land conditions are important indicators for the Program. Streamside vegetation is a relatively easy type of land cover to identify through aerial photo monitoring supported with field verification. Other agricultural land conditions that affect water quality include vegetative cover or residue on croplands, healthy pasture vegetation (especially near streams), location and type of manure storage, and the type of irrigation equipment and management strategies used. In many cases, these other types of land conditions must be assessed on the ground at specific times of year to be accurate.

In 2005, the Institute for Natural Resources at Oregon State University published the results of a technical workshop to identify environmental indicators for the Oregon Plan for Salmon and Watersheds (Dent et al., 2005). The indicators were identified to answer questions about the status and trend of Oregon's environment, and whether environmental conditions are improving under current land management and restoration practices.

Several priority indicators included in the report are used as indicators for the Program. These are:

- Change in land cover.
- Area and distribution of streamside vegetation.
- An index of streamside vegetation function based on vegetation and site capability.

Where available, these indicators are included in Area Plans and updated at every biennial review.

3.2 Principles Guiding this Strategy

It is challenging to document water quality degradation from nonpoint source pollution and to measure improvements. Many factors make it difficult to assess a specific land use's nonpoint source contribution to water quality impairment, or to document improvements in water quality. Confounding factors include:

- Natural variability.
- Multiple human and natural sources of pollutants
- Localized increases and decreases in pollutant levels (or changes that occur over short periods of time) that are not detected by existing monitoring.
- Legacy effects, such as stream channelization or flow modification, that may prevent water quality from achieving standards.
- Upstream conditions that prevent downstream reaches from achieving water quality goals.

The following principles guide the Program's monitoring strategy:

1. **Align with Oregon's Governor's Office Priorities for statewide water quality protection through Coordinated Streamside Management efforts and the Oregon Plan for Salmon and Watersheds.** This monitoring strategy supports several of the desired outcomes and strategies in the Oregon Plan for Salmon and Watersheds Monitoring Strategy (Oregon Watershed Enhancement Board (OWEB, 2003), including the following:
   - Outcome 1: Assessment of watershed conditions. Habitat conditions important to salmon include water quality, and streamside vegetation.
   - Outcome 2, Strategy 4: Document implementation of restoration projects, conservation activities, and agency programs.
   - Outcome 3, Strategy 9: Integrate information from multiple sources to produce data products and reports that assess restoration efforts and evaluate progress towards recovery goals.

2. **Focus on a weight of evidence approach rather than cause and effect approach.** It is extremely difficult to separate out the influence of the Program on land conditions and water quality, compared with all of the other factors and programs that encourage agricultural landowners and operators to prevent and control water pollution from agricultural activities.

3. **Recognize that agricultural and other nonpoint impacts to water quality are cumulative.** Nonpoint source water pollution in streams is the cumulative effect of many activities and influences within a watershed. Nonpoint source water pollution is often not measurable at the scale of individual contributions or properties, and it is often challenging to separate agriculture's influence from other nonpoint sources.

4. **Monitor multiple measures of progress on the landscape and in the water column.** To evaluate the influence of agriculture on water quality, the following should be monitored: 1) inputs and outputs, 2) resulting short-term outcomes such as improved streamside vegetation, and 3) resulting long-term outcomes such as water quality or biological improvement.

5. **Focus on streamside vegetation.** ODA views streamside vegetation condition as a key indicator of water quality. Riparian areas play a critical role in water quality, fisheries, and ecosystem functions as a whole (Naiman et al., 2005). Streamside vegetation stabilizes streambanks, filters pollutants, traps sediment, and provides shade to moderate stream temperatures. In these ways, healthy streamside vegetation can help provide the conditions needed to achieve Oregon's water quality standards for turbidity, sediment, nuisance algae growth, temperature, and other parameters.

   An important reason for monitoring streamside vegetation, in addition to tracking instream water quality, is that landowners have greater control over the vegetation on their property than they do water quality in a nearby stream.

   Monitoring streamside conditions will help track progress toward achieving agricultural load allocations in TMDLs. In nearly all of the state, TMDLs for stream temperature have or will include load allocations for agriculture expressed in terms of effective shade resulting from modeled streamside vegetation. Temperature TMDLs describe the type and amount of streamside vegetation that was modeled to estimate the effective shade needed for agricultural lands to achieve the load allocation.

6. **Complement other agencies' roles and data collection.** Monitoring is jointly designed and carried out by ODA and DEQ, optimally with the support of other partners. DEQ generally leads water quality data collection and management for Oregon. Instream monitoring may be carried out by a variety of parties. Implementation, land condition, and instream monitoring must be integrated so that data are complementary and support an integrated strategy.

7. **Use monitoring data for adaptive management**. Adaptive management is achieved through evaluation and reporting of implementation, land condition, and water quality monitoring results. Monitoring and reporting may occur at the scale of Management Areas, smaller areas with focused implementation (including FAs and SIAs), regions, or statewide.

8. **Focus monitoring on agriculture's influence on surface water.** Groundwater monitoring on a large scale is beyond the scope of ODA's resources at this time. ODA may conduct groundwater-related monitoring in very specific areas.

9. **Communicate early and often.** ODA interacts regularly with its conservation partners and stakeholders to refine monitoring activities and describe results.

3.3 Key Monitoring Questions

Working with several natural resource partners as part of the Coordinated Streamside Management approach, ODA identified key monitoring questions and is developing methods and metrics to answer these questions. The questions, metrics, and methods are likely to evolve over time as they are discussed and further refined.

These questions (Table 1) are tied to Figures 2 and 3 on pages 4 and 5. Questions 1, 5, 7, and 8 are currently the highest priority questions.

Table 1. Key Monitoring Questions for the Program

I. Inputs and Outputs

Q1. What activities are being done to help achieve desired land conditions and water quality?

II. Short-term Outcomes: Land Conditions

Q2. What percent of agricultural uplands are in compliance with the Waste Rule? (Figure 3: Level 'B')

Q3. What percent of stream miles on agricultural lands are in compliance with the Streamside Vegetation Rule? ('D')

Q4. What percent of agricultural uplands have land conditions that protect water quality? ('A')

Q5. What percent of stream miles on agricultural lands have vegetation that provides water quality functions equivalent to site-capable vegetation? ('C')

Q6. What percent of stream miles on agricultural lands have conditions that will likely prevent site-capable vegetation from providing desirable water quality functions?

III. Long-term Outcomes: Water Quality

Q7. What are water quality status and trends in agricultural areas?

Q8. How are water quality status and trends related to changes in agricultural upland and streamside vegetation conditions?

3.4 Methodology

ODA is working to identify metrics and methods for answering the key monitoring questions. Some of these questions are easier to answer than others. The Coordinated Streamside Management Partnership is an integral part of this process to assist in identifying this methodology.

Each key monitoring question is presented below, followed by the Program Target, Measurable Target, the metric(s), and the current methodology for answering the question.

All of the metrics and methods presented in this section are draft at the time of the writing of this Monitoring Strategy and will be further developed in the next two years.

I. Inputs and Outputs

Q1 = What activities are being done to help achieve desired land conditions and water quality?

a. Program Target = not applicable
b. Measurable Target = not applicable
c. Metrics
   1) Inputs = activities (outreach, technical assistance, funding) that may lead to outputs
   2) Outputs = on-the-ground practices (e.g. 38 fence posts installed, 400 acres of no-till). ODA has not yet determined specific metrics, but they will likely include activities identified by NRCS Conservation Practice Codes.

Table 2. Metrics for Inputs.

Input Category	External (SWCDs and other partners)	Internal (ODA)
Outreach	1. # of agricultural landowners provided with written information 2. # of agricultural landowner engagement events sponsored by SWCD or other 3. # of agricultural landowners at engagement events	# of presentations on the Program to external groups
Technical Assistance	1. # of agricultural landowners provided with one-on-one assistance (phone, email, event) 2. # of on-site visits 3. # of grant applications submitted for projects 4. # of conservation plans written 5. # of acres in conservation plans that were written	
Funding	1. Cash or in-kind received for inputs, outputs, and monitoring? 2. Cash or in-kind provided by landowners?	
Strategic Initiatives		1. % of agricultural lands in FA or SIA 2. Cash or in-kind received for work in FAs or SIAs
Compliance		1. # of compliance investigations 2. # of landowners brought into compliance with the Area Rules

d. Methods (inputs) = Tracking tables in SWCD Scopes of Work and FA Action Plans, additional information gathered from partners for biennial reviews of Area Plans, ODA tracking of internal activities.

Methods (outputs) = Tracking tables in SWCD Scopes of Work and FA Action Plans, additional information gathered from partners for biennial reviews of Area Plans, and information from OWEB and Natural Resources Conservation Service (NRCS).

II. Short-term Outcomes: Land Conditions

Q2 = What percent of agricultural uplands are in compliance with the Waste Rule? (Figure 3: Level 'B')

and

Q3 = What percent of stream miles on agricultural lands are in compliance with the Streamside Vegetation Rule? (Figure 3: Level 'D')

a. Program Target = 100% of agricultural lands are in compliance with Area Rules
b. Measurable Target = 100% of agricultural lands are *likely* in compliance with the Waste and Streamside Vegetation Rules

ODA can only determine compliance with certainty through on-the-ground site visits. Therefore, ODA can only measure *likely* compliance across broader landscapes.

c. Metrics
   i. DESIRED
      Q2. Number and percentage of acres *likely* in compliance with the Waste Rule.
      Q3. Number and percentage of stream miles *likely* in compliance with the Streamside Vegetation Rule.
   ii. USING
      Q2 & Q3. Number and percentage of tax lots *likely* out of compliance (total number of tax lots identified as 'Moderate', 'Significant', or 'Serious' Concern at beginning of SIA process).

d. Method = ODA AgWQ Compliance Evaluation

ODA developed the Compliance Evaluation for use in SIAs. In this method, ODA uses satellite imagery followed by field verification from public roads to identify manure piles and bare ground that could deliver pollutants to water. ODA also identifies streamsides that have inadequate vegetation to protect water quality from agricultural activities. ODA assigns a level of concern to each tax lot within the SIA using the following criteria:

Not Applicable = Non-agricultural areas including federal lands, tribal trust lands, urban and forest lands with no agricultural activities, and rural residential properties under one acre.

No Concern = No water quality concerns related to agricultural activities were observed

Low Concern (also known as "Limited Potential for Improvement") = 1) minimal potential for agricultural activities to impact surface or ground water, or 2) vegetation along streams is inadequate, but ODA is unable to determine if agricultural activities are impairing vegetation

Moderate Concern (also known as "Opportunity for Improvement") = 1) moderate potential for agricultural activities to impact surface or ground water, or 2) agricultural activities may be preventing adequate vegetation along streams

Significant Concern (also known as "Potential Violation?") = Field-verified 1) likely potential for agricultural activities to impact surface or ground water, or 2) agricultural activities may be preventing adequate vegetation along streams

Serious Concern (also known as "Potential Violation?") = Pollution of surface or ground water or removal of vegetation along streams observed during the field verification

ODA has learned that the Compliance Evaluation often overestimates the likelihood of pollution (and therefore overestimates the level of concern) from a particular tax lot because 1) few streams have SCV communities mapped, 2) the National Hydrography Dataset sometimes incorrectly identifies intermittent streams as perennial, leading to incorrect assumptions of about what SCV to expect and the likelihood of pollutant transport, and 3) it is often difficult to determine whether a condition on the landscape is caused by a current agricultural activity without being on the property.

ODA has been tracking the number of tax lots identified in each 'concern' level, thereby creating a coarse metric for acres and miles of lands in compliance. To develop a more accurate metric for Q2 and Q3, ODA is currently piloting a method for identifying specific acres of manure piles and bare ground and miles of streams that trigger 'Moderate', 'Significant', or 'Serious' concerns within tax lots in an SIA. This new method will allow ODA to quantify the number and percent of lands likely out of compliance, rather than the number and percent of tax lots in each concern level. Results of the pilot will be available in 2018.

The level of compliance with Area Rules is unknown in most of the state. ODA currently relies on SIAs to determine levels of compliance.

Q4 = What percent of agricultural uplands have land conditions that protect water quality? (Figure 3: Level 'A')

a. Program Target = 100% of agricultural uplands protect water quality
b. Measurable Target = 100% of agricultural lands are *likely* protecting water quality
c. Metrics
    1) Number of acres likely protecting water quality, and
    2) Percentage of agricultural lands likely protecting water quality.
d. Method = none yet.

ODA has not yet developed methods for answering Q4, although some SWCDs have developed their own methods to use in their Focus Areas. For instance, one is evaluating irrigated fields for likelihood of delivering pollutants in agricultural runoff to irrigation drains, a second evaluated drylots near La Pine based on animal use and depth to groundwater, and a third is evaluating uplands to determine "the potential to impact water quality" using soils information and aerial photography. Because of the difficulty of developing a consistent statewide procedure, metrics may end up varying by Management Area.

Q5 = What percent of stream miles on agricultural lands have vegetation that provides water quality functions equivalent to SCV? (Figure 3: Level 'C')

a. Program Target = 100% of stream miles have vegetation that protects water quality
b. Measurable Target = 100% of stream miles have vegetation that *likely* protects water quality.
c. Metrics = number and percent of stream miles that are *likely* protecting water quality, based on SCV.

d. Method = ODA developed a method to compare current streamside vegetation conditions to SCV at the watershed scale, but does not have the capacity to use this method. ODA does not have a method to compare current streamside vegetation conditions to SCV at the Management Area or statewide scale.
    i. DESIRED: A method that incorporates remote sensing data and automated mapping to efficiently evaluate streamside vegetation conditions at any scale. This method needs to relate existing conditions to SCV or to the load allocation in a temperature TMDL. The Coordinated Streamside Management Partnership is helping ODA develop this method.
    ii. USING: ODA currently has two methods to evaluate streamside vegetation conditions. Both calculate the area and percentages of ground cover in different categories from aerial photographs, based on human interpretation of remote imagery, along with limited field verification.
        a) ODA Streamside Vegetation Assessment (SVA): This method was developed in 2013 and is still currently in use. The user digitizes the correct stream locations, defines an assessment area that extends 35 feet on both sides of the stream, interprets satellite imagery, draws polygons in GIS around features in the assessment area, and assigns each polygon to one of 11 categories (tree, tree-agriculture, shrub, etc.). While this method does not directly quantify SCV, it can quantify the area where trees, shrubs, and grass contribute to the protection of water quality.

            While developing the SVA, ODA worked with DEQ to ensure that the SVA process could utilize vegetation heights from LIDAR data (where available) and that the SVA polygons (from human interpretation or from LIDAR) could be modeled for effective shade. Unfortunately, neither agency has had the capacity to develop and use these more advanced SVA methodologies.

            Most of the SWCDs use the SVA to quantify and track streamside vegetation conditions in their FAs. This allows ODA to aggregate results statewide, since the SVA is a consistent methodology. The SVA is also being used to track streamside vegetation conditions in the 14 watersheds participating in the ODA-led stream temperature monitoring project, initiated in 2017.

            Prior to developing the SVA, ODA had requested that SWCDs use a Class I, II, III (or similar) method to classify streamside vegetation based on brief vegetation descriptions related to site-capable vegetation, provided by ODA. SWCDs developed their own methods to determine the classes. Due to the diversity of methods and metrics used, ODA cannot aggregate these results across the state.

        b) Aerial Photo Riparian Method: From 2003 to 2017, ODA evaluated streamside vegetation conditions using aerial photos specifically acquired for the purpose. Stream segments representing 10 to 15 percent of the agricultural lands in each Management Area were randomly selected for long-term aerial photo monitoring. Stream segments are generally 3-5 miles long. ODA evaluates streamside vegetation at specific points within 30-, 60-, and 90-foot bands along both sides of stream segments from the aerial photos and assigns each segment a score based on streamside vegetation recorded at points on a 50 foot grid. The score can range from 70 (all trees) to 0 (all bare ground). The same stream segments have been re-photographed and re-scored every five years (three cycles) to evaluate changes in streamside vegetation conditions over time. Because site-

capable vegetation varies across the state, there is no single "correct" streamside vegetation index score. The purpose of this monitoring is to measure positive or negative change for an individual reach. The project is ending in 2017 after 15 years of analysis. ODA will incorporate the latest results in each of the relative Area Plans. The project will not be reinitiated because technological tools have advanced since 2003.

Q6 = What percent of stream miles on agricultural lands have conditions that will likely prevent site-capable vegetation from providing desirable water quality functions?

a. Program Target = All locations identified where SCV cannot provide sufficient water quality functions
b. Measurable Target = All locations identified where SCV *likely* cannot provide sufficient water quality functions
c. Metrics = number of stream miles within a Management Area that likely cannot support SCV that protects water quality. This metric will also include an explanation of the limiting factors.
d. Method = none yet, because it is challenging and time-consuming. However, the Coordinated Streamside Management Partnership will help ODA develop this process in SIAs.

III. Long-term Outcomes: Water Quality

Q7 = What are water quality status and trends in agricultural areas?

a. Program Target = Meet water quality standards
b. Measurable Target = not yet determined by ODA
c. Metrics = concentrations (and loads where available) of selected parameters as appropriate for the location.
d. Method = varies, based on parameter, location, and monitoring entity.

As part of monitoring water quality status and trends, DEQ regularly collects water samples at over 130 'ambient' sites on more than 50 rivers and streams across the state. Sites are present 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, chlorophyll a, specific conductance, dissolved oxygen, dissolved oxygen percent saturation, *E. coli*, ammonia, nitrate and nitrite, pH, total phosphorus, total solids, temperature, and turbidity.

In 2016, DEQ started providing status and trend reports for biennial reviews of Area Plans that summarize the information from these ambient sites in addition to other data collected by DEQ or found in the databases used by the US Geologic Survey and US Environmental Protection Agency.

ODA will work with local partners in each Management Area over the next five years to review all relevant data, determine data gaps, and prioritize future monitoring needs. This is a very time-consuming process and more urgent priorities may take precedence.

Q8 = How are water quality status and trends related to changes in agricultural upland and streamside vegetation conditions?

a. Program Target = not yet determined
b. Measurable Target = not yet determined
c. Metrics = concentrations (and loads where available) of selected parameters and measures of upland and streamside veg conditions as appropriate for the location.

d. Method = vary, based on parameter, location, and monitoring entity.

This question is answered by deliberately pairing Q7 with Q2, 3, 4 or 5. This kind of work is being done in only a few areas, and primarily by SWCDs. For instance, one SWCD is tracking conditions of irrigated cropland while monitoring water quality in ditches.

In 2017, ODA embarked on a project to gather long-term stream temperature and streamside vegetation data on agricultural lands of interest. The purpose is to compare stream temperature changes to streamside vegetation improvements that result from riparian restoration on agricultural lands. Streamside vegetation conditions will be tracked using the ODA SVA method. Air temperature and flow information will also be gathered. Fourteen SWCDs and/or watershed councils will monitor 18 watersheds at the reach or watershed scale for 15 to 20 years.

In addition, the Coordinated Streamside Management Partnership will be incorporating long-term monitoring in SIAs where appropriate.

3.5 Data Needs

ODA relies on available information to implement the Program and measure progress. However, data gaps lead to many assumptions and limitations. ODA has identified gaps (Table 3) that limit our ability to effectively answer our key monitoring questions.

Table 3. Data gaps identified by ODA and key monitoring questions being affected

Gaps	Questions
An accurate, detailed statewide GIS layer of agricultural lands	Q2-8
An accurate, detailed statewide GIS layer of perennial and seasonal streams	Q2-8
An accurate, detailed statewide GIS layer of site-capable streamside vegetation communities	Q3, 5-6, 8
Comprehensive documentation of conservation activities implemented at the Management Area scale	Q1
Sufficient data to characterize agricultural water quality in most Management Areas	Q7-8
Adequate water quality data for seasonal streams	Q7-8
An affordable, repeatable, automated method for assessing the characteristics of streamside vegetation at the landscape scale	Q3, 5-6, 8
An assessment method that characterizes land conditions on uplands that is applicable across the state	Q4
An assessment method that relates existing streamside vegetation to site-capable vegetation	Q5
An assessment method that identifies stream segments on agricultural lands that have conditions that likely prevent SCV from providing desirable water quality functions	Q6
Adequate flow data for perennial and seasonal streams to calculate loads	Q7-8

3.6 Quality Assurance/Quality Control

I. Inputs and Outputs Methods

Question 1:

- Program staff (Regional Water Quality Specialists, Grant Administrative Officer, and others) review Scope of Work and FA Action Plan reports provided quarterly by SWCDs.
- Scope of Work and FA Action Plan formats are adjusted every biennium to increase accuracy of reporting.

II. Short-Term Outcomes: Land Conditions Methods

Questions 2 and 3 (compliance):

- *SIA Implementation Process* (Fenn, K., 2017) provides guidelines to ensure that different Program staff use the method consistently and accurately. Staff training also ensures consistent implementation of the method.

Question 5 (streamside vegetation):

- *ODA Streamside Vegetation Assessment Tool User's Guide, v.3* (Hummon, C., 2017) provides detailed instructions to ensure that the method is used consistently and accurately. ODA also trains all users and provides technical assistance as needed to ensure consistent and accurate use of the method.
- Non-SVA assessment methods used to document conditions in FAs; the Program does not have QA/QC procedures, guidelines, or user's guides.
- *ODA Aerial Photograph Monitoring Desk Manual* (Measeles, P. et al, 2003) includes field verification and other quality assurance procedures to ensure aerial photos are interpreted correctly.

III. Long-Term Outcomes: Water Quality Monitoring Methods

ODA relies on DEQ ambient water quality data in addition to volunteer-collected data to track water quality conditions on agricultural lands. The DEQ laboratory implements a full quality assurance program, which is described in multiple documents (DEQ 2009, 2011, 2013).

ODA's stream temperature monitoring project strives to conform to Quality Level A data, as defined by DEQ in their Data Quality Matrix (DEQ 2013). The Sampling and Analysis Plan, following DEQ guidelines, is almost finalized (ODA 2017).

In some areas, local partners such as SWCDs or watershed councils are gathering water quality data. Those that are paid by ODA through Scopes of Work to monitor follow the DEQ Volunteer Sampling and Analysis Plan (DEQ 2011) and Quality Assurance Project Plan (DEQ 2009).

3.7 Data Management

I. Inputs and Outputs Data

Results are provided in Scope of Work and Focus Area quarterly reports that are maintained on the ODA server. (Q1)

II. Short-Term Outcomes: Land Condition Data

ODA has developed a database to store information about compliance investigations. The database, along with spreadsheets, is also used to store compliance-related information for SIAs. The database may be used to generate reports for the monitoring program to provide information about the level of compliance with the Area Rules found during investigations, by Management Area or by SIA. (Q2, Q3)

Aerial photo riparian monitoring imagery and results are stored on the ODA server as GIS layers and in Excel spreadsheets. (Q5)

Land condition data for Focus Areas, from the SVA and other methods, are stored at each SWCD office and reported to ODA in assessment classes aggregated across the Focus Area. ODA compiles the results of these assessments, and aggregates the SVA results, and stores the results on the ODA server. ODA may explore a better system for reporting and aggregating this information. (Q5)

III. Long-Term Outcomes: Water Quality Data

Ambient water quality monitoring data are available from DEQ. Their redesigned database has just been made available to the public and is still being tested. (Q7)

Data from the ODA temperature monitoring project are housed by the local partner that is deploying the temperature loggers. Stream temperature data will be provided to DEQ and ODA at the end of each field season. Streamside vegetation data will be provided to ODA after reassessment every five years. The Sampling and Analysis Plan, following DEQ guidelines, is almost finalized (ODA 2017). (Q7, Q8)

3.8 Reporting

Data gathered as part of this ODA monitoring strategy will be used in reporting at multiple scales and time frames. Many of the reports, including the following, are reports done routinely as part of normal Program operations.

Incoming reports:

1. Every quarter, SWCDs will submit numbers of inputs and outputs via their Scope of Work reporting (Q1)
2. For each Area Plan biennial review, ODA will solicit numbers of inputs and outputs from SWCDs and other conservation partners (Q1)
3. At the end of each biennium, SWCDs will submit a report for the Focus Area's pre- and post-assessment via the Focus Area Action Plan (Q5).

4. For each Area Plan biennial review, DEQ will provide a status and trends report on water quality (Q8)

Reports outgoing from ODA:

1. In 2018, ODA will prepare a final report detailing results from 15 years of evaluating streamside vegetation in selected watersheds using aerial photos. (Q5)
2. Annually, monitoring data may be summarized for the Agricultural Water Quality Program Advisory Committee in either presentation or report format (Q1-8)
3. At the end of each biennium, ODA develops a report that quantitatively aggregates the pre- and post-assessment results from all Focus Areas. (Q5)
4. Every two years, ODA prepares an updated Area Plan for the biennial review process that includes a variety of monitoring data (potentially Q1-Q8)
5. Every 4-5 years, ODA develops a report that quantitatively aggregates the pre- and post-evaluation results from all Strategic Implementation Areas. (Q2, Q3)
6. Every five years, ODA will provide a report for the long-term temperature monitoring project. (Q8)
7. ODA will develop other reports upon request, e.g. from the Board of Agriculture, the Legislature, etc. (Q1-8)

The process for disseminating ODA's reports is being discussed.

3.9 2017-2019 Priorities

ODA identified the following priorities for the 2017-2019 biennium:

1. Continue incorporating monitoring data from partners in our biennial reviews. (Q1, Q4-Q8)
2. Improve method for aggregating inputs and outputs at the Management Area scale for Area Plan biennial reviews. (Q1)
3. Finalize and use method for receiving information on outputs from OWEB and NRCS. (Q1)
4. Determine acres and stream miles likely out of compliance for all SIAs established since 2014. (Q2 and Q3)
5. Develop and test a Management-Area scale Compliance Evaluation. (Q2 and Q3)
6. Start to work with partners in Management Areas across the state to evaluate existing data, identify data gaps, and develop monitoring plans as necessary. (Q4-Q8)
7. Compile and aggregate FA assessment results for 2015-2017 and report on progress. (Q5)
8. Evaluate the use of remote sensing technology for estimating vegetation heights as applicable to the Program. (Q5)
9. Provide a 15-year analysis for each Management Area of the aerial photography analysis. (Q5)
10. Continue to track and participate in efforts to develop remote sensing methods to characterize streamside vegetation conditions at landscape scales. (Q5, Q6, and Q8)
11. Work with DEQ to make their Status and Trends reports, provided for each biennial review, as useful as possible for the Program. (Q7)
12. Evaluate the ambient sites currently monitored by DEQ to determine which ones are appropriate for the Program. (Q7 and Q8)

13. Initiate the ODA stream temperature monitoring and streamside vegetation tracking project. (Q8)
14. Revise methods and metrics for Key Performance Measures*.

* ODA has traditionally used DEQ's Oregon Water Quality Index (OWQI) as the basis for the Program's Key Performance Measures and to characterize water quality status and trends in agriculturally influenced watersheds. This information was reported during Area Plan biennial reviews and presented in each Area Plan. However, in 2016, DEQ's Water Quality staff notified ODA that their TMDL and nonpoint source programs did not support the use of the OWQI for implementing those programs because the OWQI 1) is not based on water quality standards or TMDL allocations, 2) inappropriately uses grab sample temperature data, 3) does not include some parameters that are associated with nonpoint sources, and 4) can give conflicting results to water quality data analysis for specific parameters.

4. Monitoring Resources

ODA has several positions that spend a significant component of their time on Program monitoring activities:

- Monitoring Specialist: Coordinates the Program's monitoring activities internally
- Policy Specialist: Coordinates the Program's monitoring activities with other agencies
- Program Analyst: Tracks compliance activities, including SIAs
- Riparian Specialist: Coordinates the SVA (training, technical assistance, reporting, and aggregation of results); compiles FA results and reports on progress; coordinates with other agencies who are developing advanced streamside vegetation assessment methods
- SWCD Grants Administrator: Tracks incomes and outputs in SWCD Scope of Work reports

The Oregon Legislature committed funding for Program monitoring activities through the 2017 -2019 biennium for:

- Ambient water quality monitoring at 19 additional agriculturally-influenced sites to complement the 42 existing agriculturally-influenced sites monitored by DEQ ($230,000 per biennium for contract with DEQ)
- Streamside vegetation and temperature monitoring ($70,000 per biennium)

The Program's monitoring activities will include the following as long as resources are available. An estimate of the funding and staff needed to accomplish each priority task is included. Many of these tasks are distributed among several staff; the time estimated for each staff person is added together to calculate the total Full Time Equivalent (FTE) needed for the task.

- Coordinate Program's internal monitoring activities (0.5 FTE)
- Coordinate ODA's monitoring activities with others agency partnerships (0.75 FTE)
- Coordinate development of monitoring plans for Management Areas (0.25 FTE)
- Track compliance activities (1.0 FTE)
- Track SWCD inputs and outputs (2 FTE)
- Conduct analyses and collaborate with partners to prioritize and select SIAs (1 FTE)
- Support or conduct pre- and post- assessments of land conditions in Focus Areas; compile, aggregate, and report statewide results at end of each biennium (1 FTE)
- Support development and potential Program use of advanced remote sensing methods to assess streamside vegetation conditions (0.25 FTE)
- Track and implement monitoring in Groundwater Management Areas; support monitoring programs with hydrology expertise (0.25 FTE)

5. Key Partners

The Oregon Department of Environmental Quality and ODA work together closely to ensure that Area Plans and Rules are sufficient to fulfill agriculture's responsibilities to achieve water quality standards and meet load allocations. DEQ and ODA review each Area Plan for sufficiency prior to the biennial review, and have agreed to jointly evaluate monitoring data prior to the biennial review to determine whether the data suggest that changes need to be made to the Area Plan. Further, ODA and DEQ are collaborating to track water quality at agriculturally influenced sites as part of DEQ's statewide long-term ambient monitoring network.

Oregon provides state and federal funding to SWCDs to help implement the Program locally through on-the-ground project implementation with farmers and ranchers. Oregon law (ORS 568.906) specifically states that SWCDs are to be involved in the Program's planning and implementation work to the maximum extent practicable. ODA and OWEB work together to distribute funding and to track the projects accomplished by SWCDs using state and federal funds. Additional local partners include NRCS, Farm Service Agency, DEQ, watershed councils, and Oregon State University Extension Service.

Inter-agency monitoring efforts are coordinated primarily through these partnerships or teams:

- Pesticide Stewardship Partnership: Through these partnerships, state agencies and local partners work together to monitor pesticides in selected watersheds and to improve water quality. 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 partnerships have made noteworthy progress in reducing pesticide concentrations and detections.
- Strategic Enterprise Approach to Monitoring (STREAM) Team: This team facilitates collaborative decision making to support responsible environmental stewardship through coordinated planning, monitoring, and communication of water related data and information among Oregon's natural resource agencies. Data management and retrieval is provided through a single data storage system implemented by DEQ called the Ambient Water Quality Monitoring System (AWQMS. These data are used to determine status and trends for measuring progress in meeting water quality goals, in addition to identifying future restoration needs and data gaps for Oregon's Natural Resource Agencies. This portal is still undergoing refinement and troubleshooting.
- Conservation Effectiveness Partnership: This partnership is an ongoing collaboration among NRCS, DEQ, ODA, and OWEB that evaluates water quality improvement efforts across Oregon. The partners work together to share information and technical expertise to monitor, evaluate, and report the effectiveness of cumulative conservation and restoration actions in achieving water quality and other natural resource outcomes.
- Water Quality Pesticide Management Team: This team is a statewide multi-agency team that works in tandem with DEQ's Pesticide Stewardship Partnership program. Established in 2000, the partnership approach uses local expertise combined with water quality sampling results to encourage voluntary changes in pesticide use and practices. The team evaluates pesticide monitoring data, communicates findings and recommendations to partners and stakeholders, and supports and facilitates efforts intended to minimize or prevent water quality degradation from pesticides registered for use in Oregon.
- Oregon Plan Monitoring Team: This team consists of OWEB, DEQ, ODA, Oregon Department of Fish and Wildlife, Oregon Water Resources Department, and Oregon Department of Forestry. This team reviews monitoring grant proposals that are submitted to OWEB annually and provides recommendations to the OWEB Regional Review Teams for ranking of monitoring grant proposals.

Additionally, ODA receives advice from two key groups:

- The LACs continue to advise ODA during implementation, review, and revision of the Area Plans and Rules. Currently, ODA is working with LACs to make greater use of monitoring information to guide revisions to the Area Plans and their implementation strategies.
- The Agricultural Water Quality Program Advisory Committee includes representatives from the Board of Agriculture, agricultural organizations, conservation groups, agencies with permits for point source pollution, and other natural resource agencies. The committee provides input and recommendations on Program policies and priorities, including monitoring strategies.

5.1. Memorandum of Agreement with DEQ

In 2012, DEQ and ODA updated a Memorandum of Agreement (MOA) that describes how the agencies will work together to implement TMDLs in Oregon. The MOA states that the agencies will collaboratively develop a monitoring strategy, evaluate monitoring information prior to biennial reviews of Area Plans, and recommend revisions to Area Plans and Rules or their implementation to improve progress in achieving Oregon's water quality goals.

Monitoring is a centerpiece of the 2012 MOA. The MOA states that:

- ODA will develop a monitoring strategy for the Program as resources allow, in consultation with DEQ. The strategy will include monitoring to evaluate the effectiveness of the Program including tracking water quality, land conditions, and conservation practice implementation
- ODA will evaluate the effectiveness of Area Plan and Rule implementation in consultation with DEQ. To support the evaluation,
    - ODA will determine the percentage of lands achieving compliance with the Area Rules.
    - ODA will determine whether target percentages of lands meeting desired conditions, as outlined in the goals and objectives of the Area Plan, are being met.
- The agencies will review and evaluate existing information to determine:
    - Whether additional data are needed to conduct an adequate evaluation.
    - Whether goals and objectives need to be revised to facilitate better measuring of progress.
    - Whether existing strategies have been effective in achieving the goals and objectives of the Area Plan.
    - Whether the rate of progress is adequate to achieve the goals of the Area Plan. Achievement of Area Plan goals should be consistent with legislative direction to achieve water quality standards and within time frames established under TMDLs.
- The agencies will coordinate monitoring and reporting efforts to evaluate land conditions and water quality trends, and whether agricultural load allocations are being addressed.
- Prior to the Area Plan biennial review, ODA and DEQ will review and evaluate available monitoring and implementation information and provide the results of the evaluation to the LAC.
- As part of the biennial review process, DEQ will review available data for water quality trends and whether waterbodies are achieving water quality standards and meeting TMDL agricultural load allocations.

References

Dent, L., H. Salwasser, and G. Achterman. 2005. Environmental indicators for the Oregon Plan for Salmon and Watersheds. Oregon State University Institute for Natural Resources, Corvallis, Oregon

Fenn, K. 2017. SIA Implementation Process. Oregon Department of Agriculture.

Hummon, C. 2017. Streamside Vegetation Assessment tool – user's guide, version 3. Oregon Department of Agriculture.

Measeles, P., Barrington, M., and D. Walker. 2003. Aerial photograph monitoring desk manual. Oregon Department of Agriculture.

Naiman, R. J., H. Décamps, and M. E. McClain. 2005. Riparia: ecology, conservation and management of streamside communities. Elsevier, San Diego, California.

Oregon Department of Agriculture. 2017. *DRAFT* ODA's Long-Term Stream Temperature and Vegetation Monitoring Sampling and Analysis Plan.

Oregon Department of Environmental Quality. 2009. Quality assurance project plan. D.EQ04-LAB-0047-QAPP.

Oregon Department of Environmental Quality. 2011. Volunteer sampling and analysis plan. DEQ04-LAB-0072-TMPL.

Oregon Department of Environmental Quality. 2013. Data Quality Matrix. DEQ04-LAB-0003-QAG.

Oregon Watershed Enhancement Board. 2003. Monitoring Strategy: the Oregon Plan for Salmon and Watersheds.