PESTICIDE STEWARDSHIP PARTNERSHIP PROGRAM

2017-19 Biennial Report

OREGON WATER QUALITY
PESTICIDE MANAGEMENT TEAM

Oregon Water Quality Pesticide Management Team

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1 Introduction

This document summarizes the actions and accomplishments of the Pesticide Stewardship Partnership (PSP) Program for the period of July 1, 2017 through June 30, 2019. The PSP Program is unique to the State of Oregon. It is a cooperative, voluntary process between various agencies of the state, local and tribal agencies as well as private stakeholder groups that is designed to identify and address potential concerns regarding surface water and groundwater affected by pesticide use within Oregon. Under the Oregon State Pesticide Management Plan for Water Quality Protection approved by the U.S. Environmental Protection Agency in 2011, the inter-agency Water Quality Pesticide Management Team (WQPMT) implements the PSP Program in collaboration with numerous local partners.

2 Program Overview

The PSP Program began with pilot projects in several north Mid-Columbia watersheds in the late 1990s and early 2000s as an alternative to regulatory approaches for achieving reductions in pesticide levels detected in surface waters and groundwaters from current pesticide application activities. Since 2013, the Oregon Legislature has supported the implementation and expansion of the PSP Program, which now encompasses projects in numerous watersheds and sub-watersheds throughout the state, where water quality impacts from pesticide application activities are being addressed in a range of land use settings, including from urban, forested, agricultural and mixed land uses.

A number of state agencies are involved through membership in the WQPMT , including the Oregon Department of Environmental Quality (DEQ), Oregon Department of Agriculture (ODA) and Oregon Department of Forestry (ODF), Oregon Watershed Enhancement Board (OWEB) and Oregon Health Authority (OHA); Oregon State University's (OSU) Extension Service also plays a critical role in providing technical assistance to the WQPMT and PSP partners. The agencies and OSU work with diverse parties, including watershed councils and other natural resource groups, local landowners and growers, soil and water conservation districts and tribal governments, to identify ways to reduce pesticide levels while measuring improvements in water quality and pest and pesticide risk management. The partnerships combine local expertise and water quality sampling results to encourage voluntary changes in pesticide use and management practices.

The overall goal of the PSP Program is to achieve measurable environmental improvements in the quality of Oregon waters, thus making them safer for both humans and aquatic life. Specific watershed goals are developed by local stakeholders who use monitoring data to develop, implement, and measure the effectiveness of management measures that are designed to reduce or eliminate pesticide loading to waters of the state.

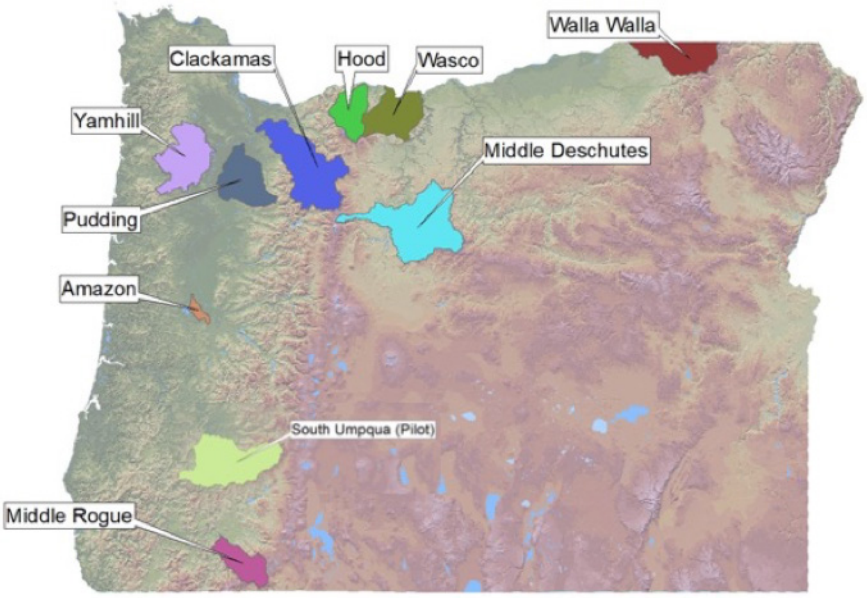
The 2017-19 budget for the PSP Program totaled $1,824,682.00. Half of these funds were allocated by the Oregon Legislature (General Funds) and half were derived from pesticide product registration fees collected by ODA. The DEQ augmented that base budget with an additional $40,000 of funding. The overall allocation of these funds within the PSP program is summarized in **Table 1**.

[1]*The Water Quality Pesticide Management Team was established by a Memorandum of Understanding between ODA, ODEQ, ODF, and the Oregon Department of Human Services in 2009*

TABLE 1: ALLOCATION OF PSP PROGRAM FUNDS (2017-19)

Activity	Allocation
Water Quality Sample and Data Analysis (DEQ)	$1,093,446.00
Program Administration (ODA)	$288,036.00
Technical Assistance Grants	$221,600.00
Waste Pesticide Collection Events	$221,600.00
Additional Funding (MWC/ODF/DEQ)	$40,000.00

FIGURE 1: CURRENTLY PARTICIPATING PSP WATERSHEDS AND PILOT AREAS (2017-19)



A map of the 10 participating watersheds in the 2017-19 PSP Program is presented in **Figure 1**. During the 2017-19 Biennium, the WQPMT made several modifications to the number of watersheds participating in the program. One change was that monitoring within the South Umpqua watershed was suspended in 2018 pending an evaluation of water quality data collected from 2014 through the fall of 2018. The status of the South Umpqua is discussed further in the Trends in Water Quality Section below. Another change involved the Middle Deschutes watershed, where the pilot study results provided sufficient information to prompt the WQPMT and local partners to propose an elevation in status from a pilot to a full, longer-term PSP. The Jefferson SWCD Board of Directors voted unanimously to support this proposal in July 2019, and the Middle Deschutes became the ninth active PSP area in the state.

3 Pesticide Monitoring and Results

SURFACE WATER OVERVIEW

During the 2017-19 Biennium approximately 1125 water samples were scheduled to be collected across the 8 PSP and two pilot areas[2]. **Table 2** below shows how the water samples analyzed during the biennium were distributed across the various PSP and pilot watersheds. The DEQ Laboratory analyzed all samples collected from these watersheds. A few pesticides were added to the analytical suite that had been used during the 2015-17 Biennium based on evolving pesticide use patterns employed by applicators. The PSP Program now analyzes for 134 compounds 57 herbicides, 40 insecticides, 16 pesticide degradates, 10 fungicides, 6 legacy pesticides, and 5 other compounds.

[2]*One of these pilot areas, the Middle Deschutes, became a full PSP during the Summer of 2019.*

TABLE 2: 2017-19 WATER QUALITY SAMPLING DISTRIBUTION

PSP and Pilot Areas	Number of Sampling Sites	Percentage of Total Samples Collected
Amazon	5	12.5
Clackamas	6	10.3
Hood River	6	8.2
Middle Deschutes	5	6.6
Middle Rogue	11	14.4
Pudding	6	5.5
South Umpqua (P)	5	9.8
Walla Walla	9	9
Wasco	5	12.2
Yamhill	6	11.5
	64	100%

(P) indicates pilot area status

Overall water quality monitoring data for each area indicates that there has been progress toward improved water quality in many of the PSP's during the 2017-19 sampling period compared to the 2015-17 sampling period[3]. The analysis of data from individual stream monitoring locations is considered when evaluating results, as some streams in a specific watershed have demonstrated improved water quality, while other monitoring locations in the same watershed indicated no measurable changes or experienced declines in pesticide water quality. The intent of the PSP Program is to focus on areas that are most impacted by pesticides, and then track improvements over time as management measures are implemented.

Once data are evaluated, monitoring sites and the areas encompassed by those sites may be dropped from the sampling plan where little to no pesticide impacts are observed. Monitoring then shifts to other sites (generally encompassing smaller land areas) where pesticide impacts on water quality are greater and need additional focus. In making these adjustments, it is important to recognize that watershed water quality data, overall, may indicate a decline in water quality even when a majority of the sub-watersheds within those areas do not indicate pesticide water quality concerns. To fully understand the status of water quality and pesticide occurrence it is necessary to evaluate water quality on both a sub-watershed and watershed level.

SURFACE WATER QUALITY DATA ANALYSIS

Various water quality analysis was conducted on the PSP dataset. Water quality data collect and analyzed from the two pilot projects (South Umpqua and the Middle Deschutes were not included in the analysis. The pilot project data was excluded due to the nature of the studies. Data collected during the pilot studies are extremely varied in location. This is done to assess where more permanent, routine monitoring location may be located. Monitoring conducted within a designated PSP is more stable and is designed to assess the effectiveness of management measures that may be put into place to address an identified pesticide issue in a watershed. The stability of this dataset allows for trend analysis and comparison over time. Because of the differences in these datasets, we have elected to assess only data from the designated PSP watersheds in this report.

Sixty-nine percent of the PSP monitored locations during the 2017-19 biennium showed measurable improvement, and 14% remained essentially unchanged in terms of overall pesticide water quality. Meanwhile, approximately 17% of the watersheds showed a decline in water quality.

[3]*Statistics regarding the PSP watersheds are based on compilation of all water quality data from all monitoring locations within the specific watershed.*

FIGURE 2: CHANGES IN PESTICIDE OCCURRENCES FOR INDIVIDUAL MONITORING LOCATIONS WITHIN PSP DESIGNATED WATERSHEDS FROM 2015-17 TO 2017-19

	Improved	Slightly improved	Same	Slight Decline	Decline
Amazon	• •	•	• •		
Clackamas	• •	• •			•
Hood River	• • • •			•	
Middle Rogue	• •	•	• •		
Pudding	•	•			
Walla Walla	• •		•	•	•
Wasco	•	• •		•	
Yamhill	•	• • •		•	

Figure 2 presents data to illustrate the changes in pesticide/water quality in the PSP areas from 2015-17 to 2017-2019. Each "rating" (represented by black dots) displayed in this figure pertains to a specific monitoring location within the watershed for which there was data for both the 2015-2017 and 2017-2019 biennia. Because, some monitoring locations were either added or dropped during both time periods fewer stations are displayed than were actually monitored at any point during the two biennia.

The ratings shown in Figure 2 represent an overall evaluation of the changes observed between the two sampling periods (biennia) at the watershed level, considering (1) frequency of detection, (2) percentage of an aquatic life benchmark for the pesticides detected, and (3) number of total pesticides detected. The evaluation was conducted for all pesticides collectively, rather than attempting to isolate any single chemical. The degree of water quality improvement was based on these overall changes using the 2015-17 sampling period as a baseline.

Within the PSP Program activities designed to improve water quality have become more focused at the watershed level. For example, activities within the Yamhill PSP were refocused from the watershed level to the Palmer Creek sub-watershed. In another example, in the Amazon PSP, increased emphasis was placed on the A1 Channel and the impact of pesticides from industrial applications. Meanwhile, in the Walla Walla PSP, data indicated that most pesticide detections were occurring in the fruit growing area; therefore, beginning in 2017, data collection became more concentrated in the irrigated agricultural production areas and away

FIGURE 3: WATER QUALITY AND STREAM FLOW MONITORING

Water quality and stream flow monitoring at North Fork Deep Creek at Highway 212 near Boring.

TABLE 3: FIVE-YEAR (2014-19) TRENDS IN PESTICIDE CONCENTRATIONS

Pesticide	Amazon	Clackamas	Hood River	Middle Rogue	Pudding	Walla Walla	Wasco	Yamhill
AMPA	D	D	D	D	U	D	D	D
2,6-dichlorobenzamide	D	NC	U	U	D			D
Deisopropylatrazine	D	D	U		NC	NC	D	D
Desethylatrazine	D							
Atrazine	NC		D		U		NC	
Bifenthrin								D
Carbaryl	D	D	D		U	D	D	D
Chlorpyrifos		D			D	D		U
Dimethenamid		D			U			D
Dimethoate					U			U
Diazinon		D		D				D
Diuron	D	U	D	U	U	NC	D	NC
Ethoprop		D			D			D
Glyphosate	U	D	D	NC	NC	U	U	D
Hexazinone		D	D	D	D			
Imidacloprid		NC		NC	U			D
Linuron					D			
Melathion							U	
Metolachlor	D	NC			U			D
Metsulfuron methyl	D	U	U	D	NC			U
Oxyfluorfen		U		U	U			D
Pendimethalin				D	NC			NC
Prometryn								
Propiconazole	D	D	D		NC			NC
Pyraclostrobin		D	D		NC			NC
Simazine	D	D	U	NC	U			U
Sulfometuron- methyl	U	U	D	U	NC			U

Note: AMPA is a degradate of the herbicide glyphosate. 2-6-dichlorobenzamide is a degradate of the herbicide dichlobenil. Deisopropylatrazine and desethylatrazine are degradates the herbicides atrazine and simazine

from dryland agriculture. The move away from focusing on PSP watersheds to instead focus at the sub-watershed level allows for better use of limited resources where they may have the greatest impact in reducing pesticide impacts to waterbodies.

TRENDS IN WATER QUALITY

In an attempt to assess the overall impact that the PSP Program has had on pesticide residue levels in water, a simple five-year linear trend analysis was conducted on the 27 most commonly detected pesticides and pesticide degradates in waterbodies within the PSP watersheds. In most cases the pesticides considered to be of greatest concern by the WQPMT and PSP partners are included within this group of 27 pesticides compounds.

Table 3 presents the results of this linear trend analysis for each PSP watershed. This analysis was focused on pesticide concentrations only. This differs from the analysis presented in Figure 2, where multiple factors were used to determine overall "ratings" for the individual watersheds.

In Table 3, the cells labeled with a "D" and in green indicate a downward trend in detected pesticide concentrations. Cells labeled with a "NC" and in yellow indicate no significate change in detected concentrations. Cells labeled with a "U" and in red indicate an upward trend. Areas in grey indicate no detection of the indicated pesticide or too few detections to determine a trend.

The results presented in Table 3 Indicate a significant number of non-detections for many of the most common pesticides across all PSP areas. For many of the pesticides of greatest concern, the five-year trend indicates improvement in water quality. The table also indicates that within the PSP Program, there are areas that require increased attention in the form of additional outreach and education, and/or implementation of greater management measures to reverse upwards trends in detected pesticide concentrations.

In summary, the data in Table 3 show that there was a five-year downward trend in pesticide concentrations for 29% of these pesticides, little to no change for 9% of the pesticides during the five-year period and an upward trend in concentrations from 2014-2019 for 14% of the pesticides. No detections were noted for 52% of pesticides at multiple locations (as indicated by grey cells in Table 3).

Since the inception of the PSP Program several notable successes have been achieved. Below are highlights of some notable findings including several improving trends in water quality.

Amazon

- With the exception of the insecticide imidacloprid, the aquatic life ratio for all detected pesticides declined from the 2017-18 to the 2018-19 sampling periods. Overall detection frequencies also declined.
- The median concentration of the fungicide propiconazole remained steady during the 2017-19 biennium however, the frequency of detection showed a decline from 57% in 2017 to 35% in 2019.

Clackamas

- Overall detected concentrations of the insecticide chlorpyrifos continued to be on a downward trend during the biennium. Median concentrations of this insecticide declined from 0.11 µg/L in 2017 to 0.03 µg/L in 2019. In the two critical areas (North Fork Deep Creek and Noyer Creek) median chlorpyrifos concentrations dropped significantly (North Fork Deep Creek decline of 0.09 µg/L, Noyer Creek decline of 0.1 µg/L).
- Diazinon (a designated statewide pesticide of concern) median concentrations displayed an increase in 2018 but dropped to no detections in 2019.

Hood River

- Only one benchmark exceedance was noted in the PSP area during the 2017-19 Biennium that being one detection of imidacloprid. No detections of that insecticide were observed in either 2018 or 2019. Other than the imidacloprid no benchmark exceedances were observed during the biennium.
- Diuron (a persistent herbicide) declined in both median concentration and frequency of detection. Frequency declined from 82% in 2017 to 45% in 2019.

Middle Deschutes

- In early June 2019 the Middle Deschutes partnership requested to be considered for a formal PSP designation. This request was based on an evaluation of water quality data collected since 2014. The partnership appears to be strong and committed to reducing pesticide concentration in both the Campbell Creek and Culver Drain sub-watersheds.
- With the designation of the Middle Deschutes as a full PSP, efforts are underway to coordinate water quality activities between the ODA's Water Quality Program and the PSP program. Designation of parts of the watershed as a Strategic Implementation Area will align with the watershed's development of the PSP Strategic Action Plan scheduled for the 2021-23 Biennium.
- Pesticide loading was compared to turbidity at the Campbell Creek monitoring sites. The results of this comparison indicated a strong relationship between increases in turbidity and increases in both measured pesticide concentrations and estimated pesticide loading.
- With the addition of a second monitoring location on Campbell Creek in 2017, multiple detections of chlorpyrifos above the water quality standard were observed in 2017 and 2018. However, there were no detections of this insecticide were found in 2019.

Middle Rogue

- During the 2017-19 Biennium the Middle Rogue completed the first PSP Strategic Action Plan. The plan will provide for the establishment of watershed goals, success measures, and a plan for education and outreach activities. Plans such as this will form the basis for all PSP-related activities conducted in each PSP watershed.
- Water quality data indicated a significant uptick in oxyfluorfen detections and concentrations in Jackson Creek in 2017 and 2018. A special study of the stream was undertaken and a potential source identified. As a result, OSU Extension conducted outreach to the potential sources and, subsequently, levels of the herbicide fell dramatically in 2019.

Pudding

- During the 2017-19 Biennium, four pesticides exceeded (at least once) the aquatic life benchmarks (chlorpyrifos, diuron, imidacloprid, and methiocarb). However, all four median concentrations have decline from 2017 to 2019. The largest decline was demonstrated in the concentrations of diuron with a median concentration of 0.29 µg/L in 2017 followed by a median concentration of 0.04 µg/L in both 2018 and 2019.
- Median concentrations of the insecticide chlorpyrifos decreased from 0.05 µg/L in 2017 to 0 µg/L in both 2018 and 2019.

South Umpqua

- Water quality monitoring was halted for the South Umpqua pilot study in June 2019. Data collected since 2014 consistently indicated low levels of herbicides at several of the monitoring locations (one detection of sulfometuron-methyl at 37% of the aquatic life ratio, and one detection of metsulfuron-methyl at 11% of the aquatic life ratio).
- The only pesticide detected that rose to a moderate level of concern was the herbicide atrazine. The rationale for it being designated as a pesticide of moderate concern is the detection frequency of 43% (anything above 36% triggers a moderate level of concern). The WQPMT has prepared a report with recommendations on further action within the watershed. This report is available on ODA's PSP webpage at https://oda.direct/PesticideStewardship

Walla Walla

- Between 2017 and 2019 the total number of pesticide detections in the in the Walla Walla watershed, increased from 56 to 79, whereas the total number of individual pesticide ingredients or degradates detected decreased from 15 to 7.
- A decrease in both median concentration and detection frequency was observed for the insecticides carbaryl and chlorpyrifos from 2015-17 to 2017-19.

Wasco

- The median concentrations of malathion (watershed wide) increased during the 2015-17 Biennium from 0.02 µg/L in 2015 to 0.06 µg/L in 2017. During the 2017-19 Biennium median malathion concentration increased from .06 µg/L in 2017 to 1.0 µg/L in 2019. Increases were noted in both the Mill Creek and Threemile Creek watersheds.
- No detections of chlorpyrifos, carbaryl, or imidacloprid were observed during the 2017-19 Biennium. These three pesticides were detected at levels approaching or exceeding benchmarks during the previous biennium.
- The total number of detections of all pesticides or degradates dropped from 119 during the 2015-17 Biennium to 106 during the 2017-19 Biennium a decrease of 11%. Total number of individual pesticides detected did not change over the two biennia, remaining at 18.

Yamhill

- After a continuous decline in chlorpyrifos concentrations from 2015 through 2017, an increase was observed in both 2018 and 2019.
- Benchmark exceedances within the Yamhill PSP have been the greatest among all PSP areas. During the 2017-19 Biennium benchmark exceedances occurred for (7) pesticides: They are: atrazine, bifenthrin, chorothalonil, chlorpyrifos, diazinon, imidacloprid, and simazine.

- Monitoring in Cozine Creek found that no additional pesticide loading was occurring between the upper monitoring site and lower site. This indicates that loading was moving from the upstream agricultural areas to the urban areas, with very little to no additions occurring in the urban areas.

PESTICIDE LOADING ANALYSIS

Beginning in 2016 at many of the water quality monitoring sites PSP partners began collecting stream discharge measurements. These data when combined with pesticide concentration results can provide an estimate of pesticide loading. Currently, stream discharge data are collected from 15 monitoring locations. Below are some highlights from four PSP areas for the 2017-19 sampling period.

Amazon

- Stream discharge data have been collected from the A1 Channel site since 2017. Using these data and the analytical results for a variety of detected pesticide residues, the total loading estimate for the A1 channel is between 0.5-0.6 Lbs. of active ingredient for the biennium. The pesticides detected as contributing to the loading total were: AMPA (adegradate of glyphosate), 2,4-DB, 2,4,5-t, 2,6-dichlorobenzamide (a degradate of dichlobenil), diuron, glyphosate, metsulfuron-methyl, pentachlorophenol, propiconazole, and sulfometuron-methyl.

Middle Deschutes

- Pesticide loading analysis was conducted at three locations within the Middle Deschutes watershed, Campbell Creek at the mouth, Campbell Creek at Highway 26, and the Culver Drain site. Stream discharge data was collected beginning during the spring sampling in 2018 and continues. A variety of pesticides were detected at each of these sites. The total estimated loading of pesticides calculated form this monitoring was: 0.055 lbs. of active ingredient for Campbell Creek at Highway 26 (Spring and Fall 2018) and 0.23 lbs. of active ingredient for Campbell Creek at Mouth (fall 2018 through spring 2019)
- An analysis of the stream discharge, pesticide residue, and turbidity data was conducted to assess the relationship between pesticide loading and turbidity. The statistical correlation between pesticide loading and turbidity was 0.86 which indicates a strong relationship between loading and turbidity. See **Figure 4**.

FIGURE 4. RELATIONSHIP BETWEEN PESTICIDE LOADING AND TURBIDITY AT MIDDLE DESCHUTES MONITORING SITE CAMPBELL CREEK AT HIGHWAY 26 DURING SPRING 2019 SAMPLING

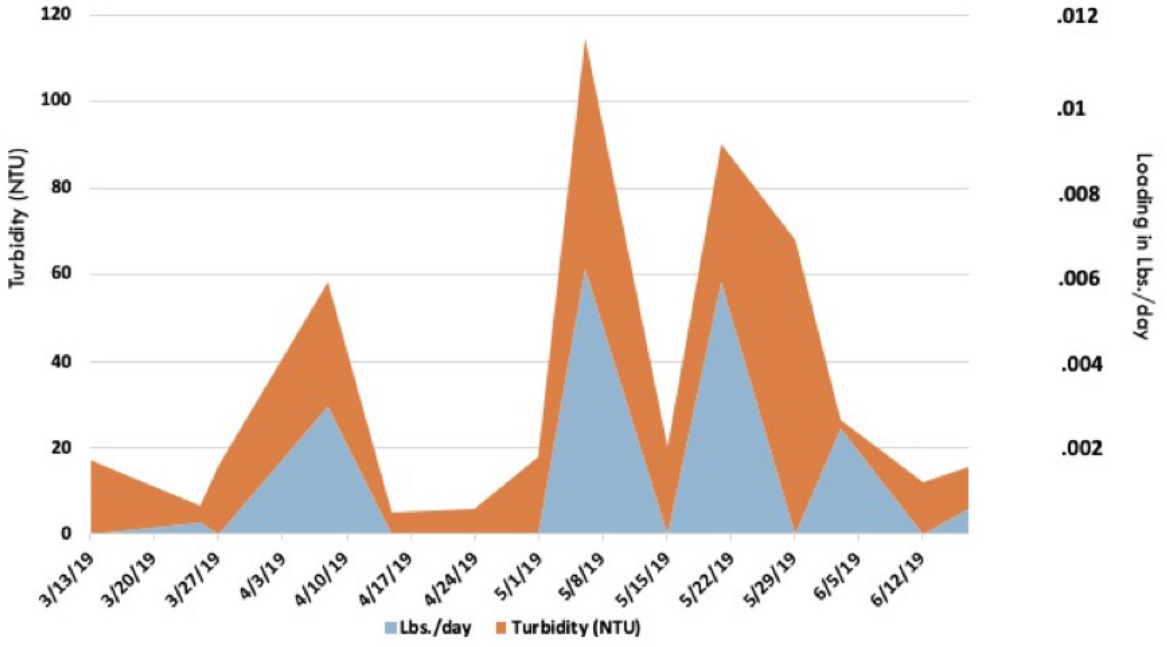
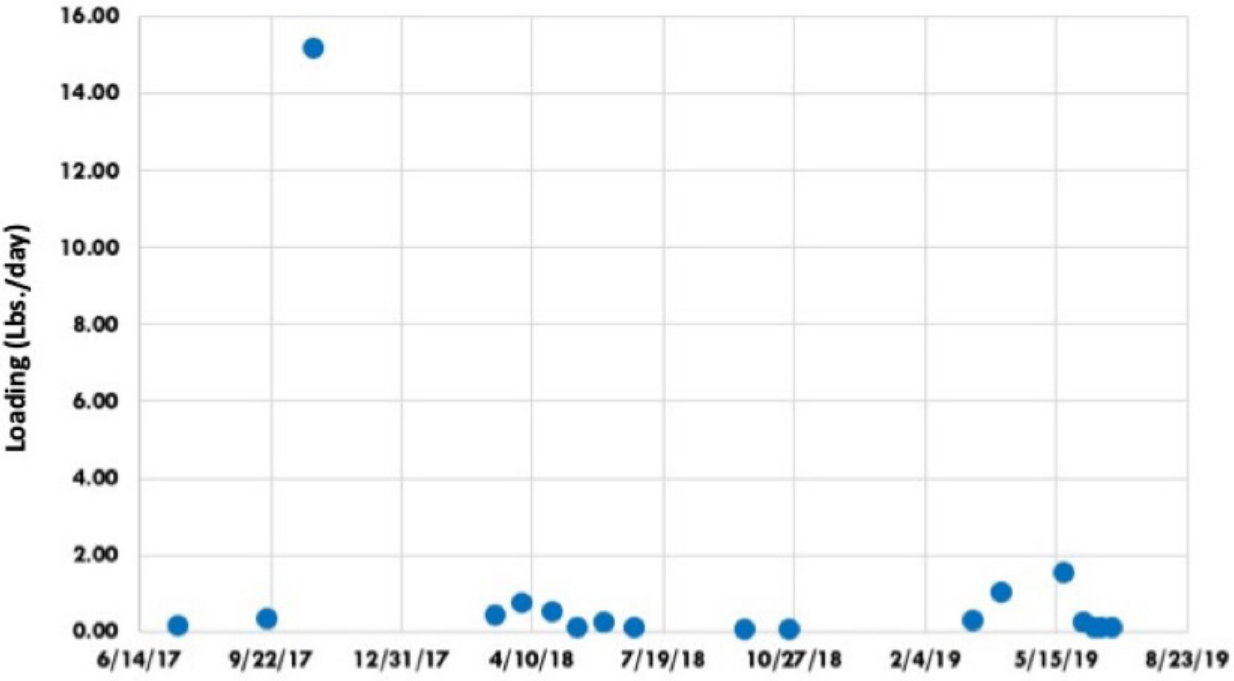


FIGURE 5: TOTAL PESTICIDE LOADING ESTIMATES AT THE PUDDING RIVER AT HIGHWAY 99E



Pudding

Five monitoring stations were utilized during the 2017-19 Biennium. One site (Pudding River at Highway 99E) is located near a U.S. Geological Survey streamflow gage (14202000). This site has been in continuous use for several decades. Pesticide loading estimates were calculated using the data from this site and the analytical data collected as a result of water quality monitoring. See **Figure 5**.

Due to the generally high stream flow (as compared to other monitoring locations within the PSP monitoring network), pesticide concentrations at the Highway 99E site are generally low and do not approach any EPA aquatic life benchmark. However, calculating pesticide loading presents a different picture.

- Based on the results of the estimated calculations and extrapolating the grab-sample data across the period of application, a year's loading has approached 50-60 lb. per year of active ingredient and degradates. The higher loading appears to coincide with storm events that raise the potential for increased runoff from agricultural fields.
- The estimated loading calculations at the 99E site represents a sum of most of the monitoring locations within the Pudding River watershed. This includes the 2017-19 upstream monitoring locations:

  » 10899 Zollner Creek at Monitor-McKee Road Bridge

  » 11516 Zollner Creek at Dominic Road

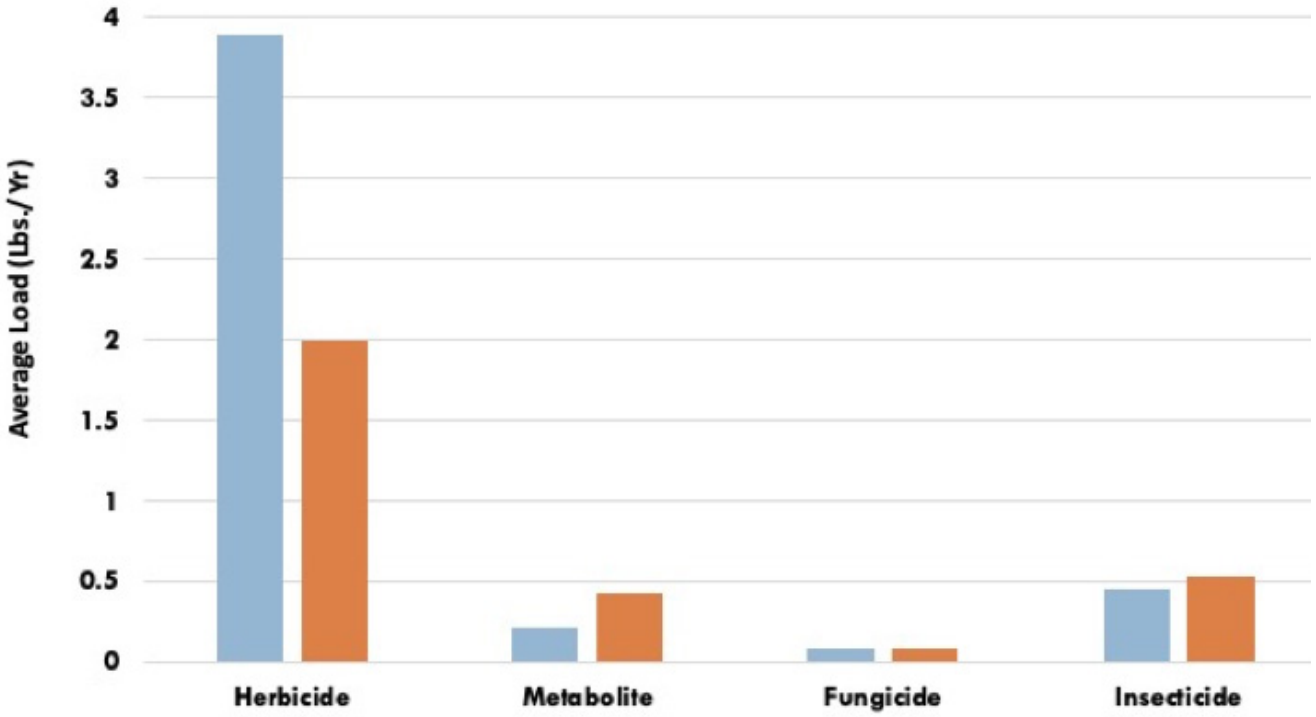
  » 31872 Abiqua Creek at Gallon House Bridge

  » 31874 Butte Creek at Butte Creek Road

Yamhill

- Pesticide loading estimates were calculated for all five monitoring sites in the Yamhill PSP. Four of these sites showed a significant loading of pesticides. This was in line with the concentration data collected during the 2017-2019 monitoring period.
- One location (Lower Cozine Creek) showed no additional pesticide loading when compared to the Middle Cozine Creek monitoring site (see **Figure 6** on Page 12). The Lower Cozine Creek site represents contributions from the urban area of the City of McMinnville, which appear to be minimal.

FIGURE 6: ESTIMATED PESTICIDE LOADING DISTRIBUTION IN LOWER COZINE CREEK, 2017-10



UNCERTAINTIES ASSOCIATED WITH WATER QUALITY DATA

Water quality samples collected as part of the PSP Program are generally obtained through the use of grab-sample techniques. Grab sampling for pesticide residues is the predominant method employed by federal and state agencies for reconnaissance studies like those conducted as part of the PSP sampling activities.

Grab sampling is a sampling technique in which a single sample or measurement is taken at a specific time. Grab samples provide the ability to obtain an immediate sample (as opposed to sampling using automated samplers or Polar Organic Chemical Integrative Samplers, POCIS) and are preferred for the pesticide active ingredients detected by the PSP program. The primary advantage of grab sampling is that set-up costs are small and sample scheduling can be easily modified to account for pesticide application timing or weather events. In addition, specific in-stream concentrations can be determined with grab samples, unlike with passive sampling devices (e.g., POCIS) that collect pesticide residues on a membrane over time.

Use of grab samples for water quality monitoring does have several disadvantages compared to more extensive and expensive monitoring techniques. A grab sample takes a snapshot of the characteristics of the water at a specific location and point in time, and it may not be completely representative of the entire flow of the water body being sampled. A grab sample does not necessarily capture the peaks and valleys of pesticide concentrations. Because it represents a snapshot in time, results for a grab sample can be influenced by stream flow, weather conditions leading up to and following pesticide application, and timing of the collection in relationship to pesticide applications. These disadvantages can contribute to uncertainties in applying laboratory results to characterizations of land use influences related to pesticide use. The uncertainties lie not with the laboratory results but with how those results are applied to characterizations of the pesticide water quality impacts of specific land use.

Uncertainties regarding pesticide contributions to surface waters from upstream land uses can be reduced by addressing some if not all of the disadvantages described above. Specifically:

- Include the measurement of stream flow at

the time of sample collection to allow for the calculation of estimated pesticide loads

- Schedule sampling events as close to pesticide application as possible to reduce or eliminate factors such as pesticide degradation and dilution

To reduce uncertainties associated with sample collection techniques, DEQ provides technical assistance in proper monitoring techniques to local partners. To ensure that data are collected per established protocols necessary to maintain high data quality and allow for data comparison, DEQ conducts annual audits of sampling staff. Results for audits conducted in 2016 and 2017 indicate that protocols are being followed, ensuring that data quality is being protected at the point of sample collection within the individual PSP monitoring locations[5].

SEDIMENT SAMPLING RESULTS

Sediment sampling is periodically conducted as part of PSP activities within select watersheds. During the 2017-19 Biennium sediment samples were collected at sites within the Amazon, Clackamas, Hood River, Middle Deschutes, Middle Rogue, Pudding, Wasco, and Yamhill watersheds. Several pesticides and pesticide degradates were detected. The number of currently used pesticides included in the sediment laboratory analysis is much smaller than the number analyzed for water column samples, reflecting the relative differences in pesticides that stay soluble in water versus those partitioning to sediment.

Concentrations of pesticides in the organic fraction of sediment are more relevant than dry weight concentrations when observing adverse effects on aquatic organisms especially benthic organisms. In order to assess that fraction of the sediment to which these chemicals preferentially partition it is necessary to carbon normalize the results by using dry weight concentrations and organic carbon concentrations collected at the same time.

The results of the organic carbon normalization can be used along with the LC 50 for a reference organism and the soil adsorption coefficient to estimate pore water concentration of a pesticide. The pore water estimate can be directly compared to the aquatic life benchmark or a water quality criterion.

As shown in **Table 4**, among the currently used pesticides found in sediments were the insecticides bifenthrin and chlorpyrifos and the herbicide oxyfluorfen. Other detections included

TABLE 4: RESULTS OF SEDIMENT ANALYSIS FOR CURRENTLY REGISTERED PESTICIDE

PSP area	Site ID	Date	Pesticide	Result ng/kg	Carbon normalized µg/kg	Pore water estimate µg/l
Amazon	25270	10/15/18	Bifenthrin	557	51.1	.0002
Clackamas	10868	10/22/18	Bifenthrin	2680	124.7	.0005
Clackamas	10868	10/22/18	Chlorpyrifos	1320	61.4	.0062
Clackamas	32066	10/22/18	Bifenthrin	4230	180	.00075
Clackamas	32068	10/22/18	Bifenthrin	15800	301.5	.00126
Clackamas	32068	10/22/18	Chlorpyrifos	43100	822.5	.0828*
Clackamas	32068	10/22/18	Oxyfluorfen	253000	4828.2	.1491**
Middle Rogue	38280	10/10/18	Bifenthrin	664	39.5	.00016
Pudding	40122	10/23/18	Bifenthrin	383	20.4	.00008
Yamhill	34232	10/22/18	Bifenthrin	2590	179.9	.00075

** Exceeds the aquatic life benchmark and water quality standard for Oregon*

*** Exceeds 50% of aquatic life benchmark*

[5]The results of the 2016-17 individual audit can be found in the 2017 PSP Field Audit Summary Report on the Department of Environmental Quality's PSP web page under "Other Resources": https://www.oregon.gov/deq/wq/programs/Pages/Pesticide.aspx.

FIGURE 7: 2018 PSP SEDIMENT SAMPLING LOCATIONS

degradates of the legacy[6] pesticides DDT and chlordane (results not shown in the Table 4).

An evaluation of the samples collected indicates that a majority of the currently used pesticides did not approach a threshold to be considered pesticide of high concern. However, the 10/22/18 sample collected at site 32068 did meet the threshold for bifenthrin and oxyfluorfen.

4 Frequently Detected Pesticides of Concern

The WQPMT has developed a process to determine which frequently detected pesticides are of greatest concern to the State of Oregon. This process relies heavily on the frequency of detection and the highest concentration level (in the past five years) in relationship to U.S. Environmental Protection Agency's (EPA) aquatic life benchmarks and the year-to-year changes in these two parameters.

A designation as a pesticide of high concern is used by states and EPA to track progress in reducing the frequency and concentrations of pesticides in groundwater and surface water bodies. The WQPMT also uses the designation to assist PSP partners in prioritizing outreach, education, and other efforts within the various watersheds to address major pesticide concerns.

In several PSP sub-watersheds, a few pesticides have occurred and continue to occur at levels of high concern on a regular basis and in some cases in increasing frequency and concentrations. In those areas the WQPMT along with the watershed partners are implementing or developing strategies to address the root causes of the detections and better define the boundaries of the watersheds most impacted. In watersheds where sources have been determined and management measures have been implemented, the partner organizations and agencies are conducting water quality monitoring designed to assess the effectiveness of those measures by evaluating changes in pesticide concentrations before and after measures are put in place.

In some areas, pesticides have been detected at frequencies at or above 35%. These pesticides

[6] *Legacy pesticides are chemicals that were once used in the US but are now canceled or banned because of health risks to humans, animals, or the environment*

TABLE 5: DESIGNATED PESTICIDES OF CONCERN IN CURRENT PSP AREAS, 2017-19

Pesticide	Category	Level of Concern	Number of PSP Areas
Imidacloprid	Insecticide	High	7
Chlorpyrifos	Insecticide	High	4
Dimethenamid-p	Herbicide	High	3
Oxyfluorfen	Herbicide	High	3
Diuron	Herbicide	High	2
Diazinon	Insecticide	High	2
2,6-dichlorobenzamide	Degradate	Moderate	6
AMPA	Degradate	Moderate	6
Glyphosate	Herbicide	Moderate	4
Atrazine	Herbicide	Moderate	3
Carbaryl	Insecticide	Moderate	3
Dimethoate	Insecticide	Moderate	2
Propiconazole	Fungicide	Moderate	3
Malathion	Insecticide	Moderate	2
Metsulfuron-methyl	Herbicide	Moderate	2
Sulfometuron-methyl	Herbicide	Moderate	2
Simazine	Herbicide	Moderate	1

have been designated as pesticide of moderate concern. In areas where this occurs, monitoring results are routinely reviewed to detect any rise in detection frequency or concentration. If an increase in frequency or concentration occurs, land uses are reviewed to determine potential sources and education an outreach resources are focused in the watershed.

In general, the six pesticides currently designated as statewide pesticides of high concern have demonstrated a downward trend in both concentration and frequency detected. **Figure 8** illustrates this downward trend from 2015-2019. In the case of dimethenamid, two extremely high concentrations detected in the Clackamas PSP over a two-week period were the source of the "spike" in 2018. 2019 concentrations showed a downward trend from both the 2017 and 2018 averages.

FIGURE 8: CONCENTRATION AND FREQUENCY TRENDS FOR CURRENTLY DESIGNATED STATEWIDE INSECTICIDES OF HIGH CONCERN

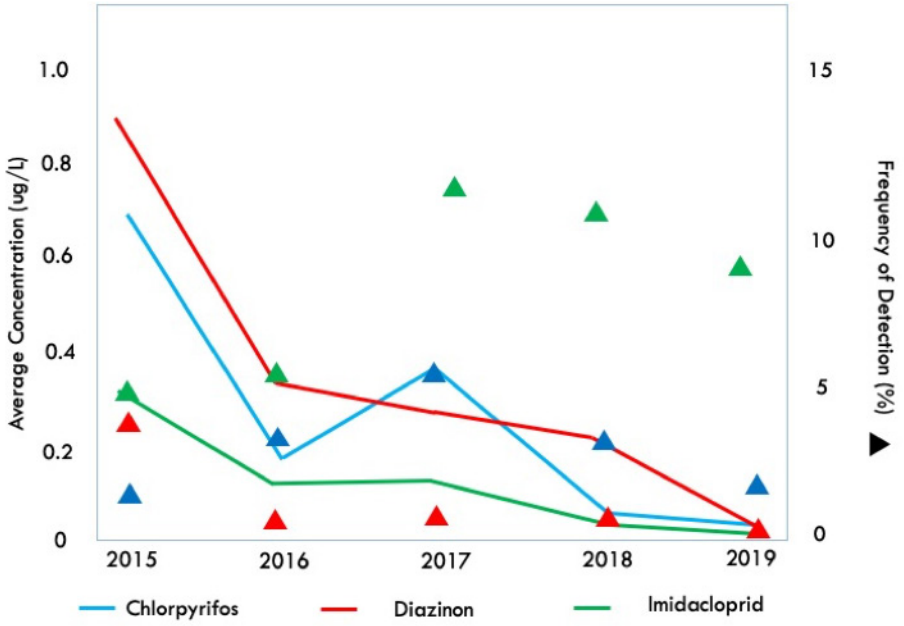
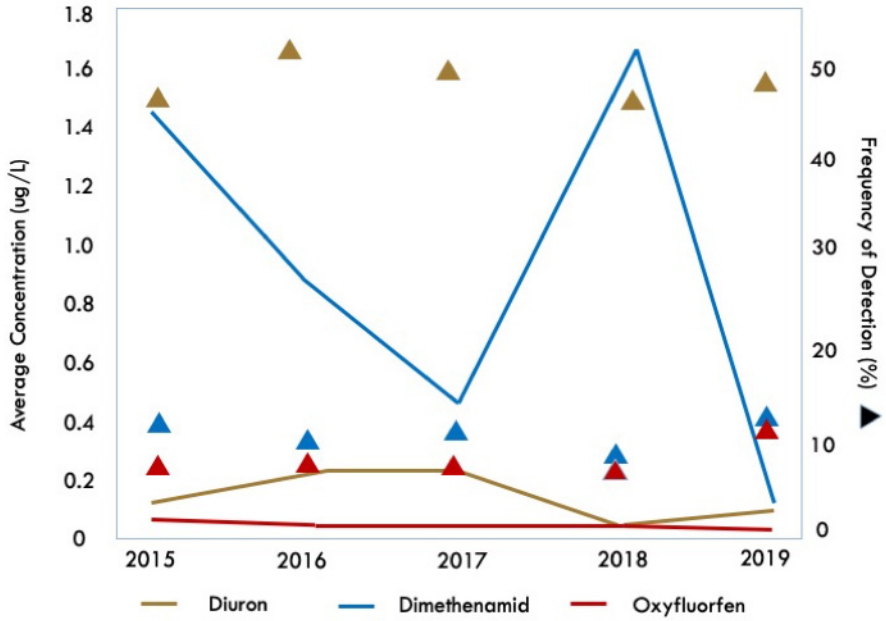


FIGURE 9: CONCENTRATION AND FREQUENCY TRENDS FOR CURRENTLY DESIGNATED STATEWIDE HERBICIDES OF HIGH CONCERN



As shown in Figures 8, trends in concentration and frequency for the three insecticides currently designated as statewide pesticides of high concern are trending downward. The results for the three herbicides of statewide concern are mixed.

Generally, detection frequencies are slightly up while concentrations for two of the three herbicides (dimethenamid and oxyfluorfen) are down. Diuron continues to be detected at rate of around 50% at average concentrations between 0.1 and 0.2 µg/L.

5 Distribution of Grant Funding

The the PSP Program funded four grant projects during the 2017-19 Biennium. This was a decrease of one project over the number funded during the 2015-17 Biennium[7]. The decrease in funding for competitive projects was the result of an increase in funding for watershed partners to support water monitoring and data analysis, development of strategic action plans and expansion of education and outreach activities at the local level. The project recipients were:

- Oregon State University for development of innovative, non-pesticidal alternatives to address spotted wing drosophila (SWD). This project analyzed the effectiveness of two products (Hydroshield) and (Decoy) when used together to provide a significant alternative to pesticides for the management of SWD. The project results were better than anticipated, verifying the effectiveness of the product when used together. The project demonstrated the SWD-control effectiveness on cherries, blueberries, and cane berries.
- Yamhill Soil and Water Conservation District for developing a project to increase the adoption of fall mulching and cover cropping in hazelnut orchards and other agricultural operations to minimize pesticide loading from erosion. The project also attempted to develop a list of pesticides that are labeled for use in hazelnut orchards and that have low Koc values and have been identified using OSU's guide to hazelnut management.

[7]During the 2013-15 biennium the PSP Program did fund the purchase of two pieces of pesticide spray equipment that are currently on loan to local Extension and SWCD partners to enhance grower education and outreach efforts, in addition to supporting 3 separate technical assistance projects.

TABLE 6: PARTNER GRANT FUND DISTRIBUTION

PSP Watershed	Activities Funded	Funding Amount
Amazon	WQ Sampling, Discharge Measurements, Strategic Planning	$30,932
Clackamas	WQ Sampling, Discharge Measurement	$13,875
Hood River	WQ Sampling	$5,050
Mollala-Pudding	WQ Sampling, WQ Data Cataloging	$4,250
Middle Deschutes	WQ Sampling, Discharge Measurements	$8,125
Middle Rogue	WQ Sampling, Outreach Education, Discharge Measurements	$5,850
South Umpqua	WQ Sampling	$6,288
Walla Walla	WQ Sampling, Weather Station Maintenance	$7,570
Yamhill (Greater)	WQ Sampling, Data Collection Supporting OSU, Discharge measurements	$7,300

- Rogue River Watershed Council for the development of the first PSP Strategic Action Plan. The Plan consisted of numerous elements including a communication plan, key messages, crop calendars, goals, monitoring guidelines, designation of pesticide of high and moderate concern, and implementation of a coordinating council to oversee plan measures. The plan was approved by the WQPMT in September 2019 and will serve as a template for other PSP plan developments slated for the 2019-2021 Biennium.
- Oregon State University to support the ongoing development of a science-based information system focused on non-agricultural pest management and pesticide reduction for audiences that are currently under-served by Oregon State University's Integrated Pest Management resources. The project helps people diagnose pest problems and determine safe and effective management strategies for homes, buildings, landscapes, and other community locations, while limiting impacts from pests and pest control practices.

The total amount of funds awarded to these projects was $152,471.

Additional funding was provided to individual PSP watershed partners to assist in the collection of water quality samples and promote special education and outreach activities within the individual watersheds[8]. These grants were termed "partner grants" and were non-competitive in nature. Nine such grants were awarded. The activities covered in the grants and the funding amounts are presented in **Table 6**.

A total of $89,240.60 was awarded to the eight watersheds and two pilots to continue water sampling and to enhance local programs in support of the PSP objectives. This amount was an increase over the 2015-17 allocation by approximately $30,000 and begins to fully address the true costs of implementing the PSP program at the local level. These numbers are expected to increase as strategic planning expands during the 2019-21 Biennium.

6 Data Communication and In-Kind Outreach and Services

WQPMT members presented information about the PSP program at numerous forums throughout the state during the 2017-19 Biennium. These included presentations at regional grower organizations, eight OSU pesticide re-certification courses and numerous other continuing education programs, farm fairs, and other meetings dealing with pesticide management. In addition, members of the WQPMT regularly attend meetings of PSP partner organizations to provide technical assistance or advice. The purpose of these presentations is to increase awareness and catalyze stewardship actions.

[8]*These grants were originally developed to address shortfalls in funding from the Oregon Department of Environmental Quality non-point source grant program (CWA 319) that previously supported much of this activity..*

Members of the WQPMT presented the results of water quality monitoring data to every designated PSP and pilot area, during the spring or fall each year of this biennium. The purposes of these presentations are to help interpret the data and assist the partners in the development of management actions that should be considered as a result of the water quality findings. At the request of several partners, members of the WQPMT provided technical analysis and materials to partners in support of public presentations given to local entities.

During the 2017-19 Biennium a significant amount of resources were spent discussing the development of, strategic action plans for the biennium. These meetings included an in-depth discussion of the major elements of the plans and timing as to when each PSP would be ready to commence strategic action plan development. As of June 30, 2019, three additional partners groups representing three PSP watersheds had committed to beginning work during the 2019-21 Biennium. Needs for additional grower technical assistance, changes in monitoring locations, new public outreach projects, funding, and waste pesticide collections were evaluated during semi-annual meetings with partners.

During the 2017-19 period, WQPMT members devoted a significant amount of time in improving the technical capabilities of the PSP partners. This included training on collection of field stream discharge data, methods to analyze and calculate pesticide loading estimates, designation of pesticides of high and moderate concern at a watershed level and instruction on a PSP data viewer designed to provide access to water quality data in a simple graphically format.

7 Changes in Watershed / Program Activities

MODIFICATION OF CRITERIA TO DESIGNATE PESTICIDES OF HIGH AND MEDIUM CONCERN

During the 2018 Region 10 Water Quality Annual Meeting, Oregon made a proposal to update the matrix used to determine pesticide of concern and pesticides of interest. After several months of consultation between Idaho, Oregon and Washington the states agreed upon a new matrix that would be used by all three states, making the Pacific Northwest the only area of the country using a uniform set of criteria for these designations. The new methodology is be used at the statewide, subbasin, and watershed levels and provides a valuable prioritizing tool when allocating efforts to address pesticide occurrences..

FIGURE 10: DESIGNATION MATRIX FOR DETERMINING PESTICIDES OF HIGH AND MODERATE CONCERN

Decision Matrix Based on Water Monitoring Data (2019)
Detected concentration relative to aquatic life benchmarks (ALB) and frequency of detection

REFERENCE LEVEL CRITERIA

FREQUENCY OF DETECTION IN % LAST 3 YEARS	≥1 detection at or above 50% of an acute ALB	≥3 detections at or above 50% of a chronic ALB	1 to 2 detections at or above 50% of a chronic ALB	No detections over 50% of any ALB
100 to 65.1	High Level of Concern	High Level of Concern	High Level of Concern	Moderate Level of Concern
65 to 35.1	High Level of Concern	High Level of Concern	Moderate Level of Concern	Moderate Level of Concern
35 to 0	High Level of Concern	High Level of Concern	Moderate Level of Concern	Low Level of Concern

Each Pesticide Stewardship Partnership area will determine the level of concern for detected pesticides. Pesticides that are deemed of high concern in over 30% of the PSP areas will be designated as statewide pesticides of high concern or statewide Pesticides of Concern (POCs).

STREAM DISCHARGE MEASUREMENTS

Several changes were made to PSP watershed activities during the 2017-19 Biennium. The collection of stream discharge data was begun in the Amazon PSP to explore the value of such data in determining pesticide loading in streams. Stream discharge data augments the pesticide concentration data by providing information that helps the WQPMT evaluate whether management measures implemented in watersheds are resulting in reductions in pesticide loadings entering waterbodies. Discharge data collected at two locations in the Amazon PSP initially have provided a clearer picture of the relationship between discharge and concentration resulting in pesticide loading to a waterbody.

FUNDING TO PSP PARTNERS

Funding to PSP partners was significantly increased during the 2017-19 Biennium. These increases were based on the need for further funding to support water quality sampling and steam discharge measurements (including equipment purchases). Additionally, work to prepare watershed stakeholders for the development of strategic action plans was funded. It is likely that this trend will continue with more funding directed to PSP partners and less technical-competitive project grants being awarded.

PILOT PROJECTS

Two pilot projects were continued during the 2017-19 Biennium. The two areas under pilot study were the Middle Deschutes and South Umpqua (Figure 1). Data evaluated the two pilot areas resulted in the Middle Deschutes becoming a fully designated PSP and the South Umpqua activities being suspended. Monitoring in the Middle Deschutes has documented a significant number of pesticide detections that have exceeded aquatic life benchmarks. Local partners elected to support the establishment of a full PSP in 2019 and began the assessment of land use and irrigation practices to gain an understanding of the link between those activities and pesticide concentrations.

Data from the South Umpqua pilot were reviewed and meetings held with local stakeholders during 2019. As a result of these activities, monitoring was suspended at the end of the Spring 2019 sampling period. Data indicated no exceedances above 15% of an aquatic life benchmark from 2014-2019. With the exception of the herbicide atrazine, pesticide detection frequencies were also relatively low. The WQPMT has released a final report which summarizes the findings from the study. That report is available on ODA's Pesticide Stewardship Partnership website. The WQPMT will coordinate with local partners in deciding whether further actions are warranted in the watershed in late 2020 or early 2021.

STAKEHOLDER ADVISORY GROUP

A stakeholder advisory group (SAG) was established by WQPMT member agencies in November 2019. The purpose of the SAG is to provide advice to the WQPMT regarding issues related to the implementation of the PSP Program. The SAG consists of members from a wide range of stakeholders and stakeholder organizations which represent a balance between pesticide user groups and environmental and environmental justice organizations. This group will be used to assist the WQPMT in the development of a statewide PSP Strategic Plan, development of a series of standard operating procedures, and will provide review of various reports that will be generated by the WQPMT. The intent is to have the SAG meet every two months initially for the first year as foundational documents are developed.

8 Waste Pesticide Collection

TABLE 7: WASTE PESTICIDE COLLECTIONS JULY 2017 THROUGH JUNE 2019

Event	Date	Participation	Pounds Collected
Milton-Freewater	7/21/17	6	10343
Klamath Falls	10/14/17	8	2582
Mt. Angel	11/19/17	24	25000
Ontario	2/15/18	10	7805
White City	3/30/18	9	3485
Molalla	6/1/18	34	20955
Pendleton	9/21/18	7	6170
McMinnville	11/20/18	32	25860
Madras	4/19/19	2	7056

From July 2017 through June 2019, the PSP Program held nine waste pesticide collection events. This was a decrease from the 14 events held during the 2015-17 Biennium. While the number of events was less than the previous biennium the amount collected per event was up from 10,905 lbs. during 2015-17 to 12,139 lbs. during 2017-19.

Table 7 provides information on participation and locations for events held during this time frame. As a result of these evenst a total of 109,256 lbs. of unused or unusable pesticides was removed from sensitive watersheds. These events are coordinated with local stakeholders (watershed councils, OSU Extension, Soil and Water Conservation Districts, grower groups, and solid waste management businesses). These stakeholders provide support to the program through publicizing the events via newspaper, radio, and posting on web pages.

During several collection events, surveys were conducted by local event sponsors to assess the effectiveness of various aspects of the program. Those elements include value of the program, effectiveness of publicity, ease of accessing the event (distance), and types of material brought to the collection.

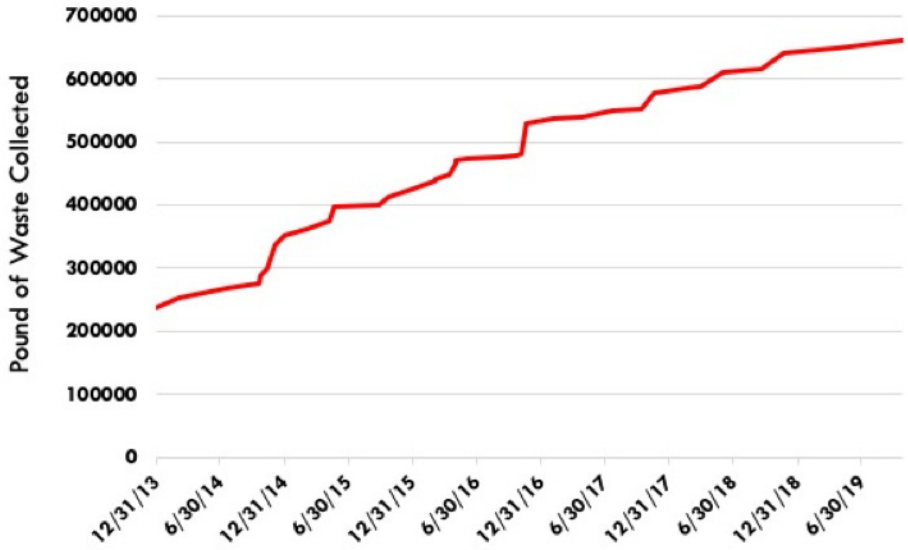
General responses regarding the program are:

- The participants continue to value the program and welcomes the opportunity to dispose of unwanted material in a safe, voluntary manner
- The majority of materials being brought to the events are pesticides that are still registered for use but are no longer needed by the grower or pesticide distributor. Based on the materials received, the WQPMT implemented additional eligibility criteria designed to improve the accessibility of the program to as many stakeholders as possible.
- A large percentage of participants continue to be first-time users of the program who operate farms or are nurseries, and landscapers who would participate in the program again if additional events were offered.
- The public and stakeholders value how the program moves collections to various areas of the state to provide access to the program to as many areas as possible.

FIGURE 11: WASTE COLLECTION EVENT

Waste pesticides are seen at a collection event Nov. 20, 2018, in McMinnville.

FIGURE 12: CUMULATIVE WASTE PESTICIDE AMOUNTS COLLECTED BY PESTICIDE STEWARDSHIP PARTNERSHIP



The Waste Pesticide Collection activities continue to remove a significant amount of pesticides from the environment. This trend is expected to continue as currently used pesticides are removed from registration and newer formulations emerge and enter the market.

Appendix 1: Common Trade Names of Pesticides Cited in Report

Pesticide	Common name
AMPA	Degradate of Glyphosate
2,4-DB	Butoxone 200
2,4,5-t	Sesone
2,6-dichlorobenzamide	Degradate of Dichlobenil (Casoron)
Atrazine	Aatrex
Bifenthrin	Brigade
Carbaryl	Sevin
Chlorpyrifos	Lorsban
Chorothalonil	Bravo, Daconil
Diazinon	Basudin
Dimethenamid	Outlook
Dimethoate	Dimate
Diuron	Karmex
Ethoprop	Mocap
Glyphosate	Roundup
Hexazinone	Velpar
Imidaclorprid	Gaucho, Merit
Linuron	Lorox
Malathion	Cythion, Fyfanon
Metalachlor	Bicep, Dual
Methiocarb	Mensurol
Metsulfuron methyl	Escort, Osprey
Oxyfluorfen	Goal
Pendimethalin	Prowl
Prometryn	Caparol
Propiconazole	Stratego, Banner Maxx
Simazine	Princep
Sulfometuron-methyl	Oust

Appendix 2: Definition of Terms Used in Report

Aquatic Life Ratio: The aquatic life ratio is the highest pesticide concertation in a detected at a specific location or time divided by the Aquatic Life Benchmark as developed by the U.S. Environmental Protection Agency. For example: If the highest concentration of the herbicide atrazine detected at location "A" is .3 µg/L and the EPA developed Aquatic Life Benchmark is 1 µg/L the Aquatic Life Ratio is .3 µg /1µg or .3. An aquatic Life Ratio of 1 indicates that a Aquatic Life Benchmark has been met. An Aquatic Life Ration exceeding 1 means that the Aquatic Life Benchmark has been exceeded.

Pesticide Degradate: A substance that results from the transformation, via environmental mechanisms, of a pesticide into a benign substance or a substance of lower toxicity that is environmentally compatible with the site to which it was applied

POCIS: The Polar Organic Chemical Integrative Sampler or POCIS is designed to sample water-soluble (polar or hydrophilic) organic chemicals from aqueous environments. The POCIS is an integrative sampler which provides time-weighted average concentrations of chemicals over deployment periods ranging from weeks to months.