PUBLICATION 8087 FWQP REFERENCE SHEET 9.2

Reference:

Developing a Nonpoint Source Pollution Evaluation Program

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Farm Water Quality Planning
A Water Quality and Technical Assistance Program for California Agriculture
http://waterquality.ucanr.org

This Reference Sheet is part of the **Farm Water Quality Planning (FWQP)** series, developed for a short course that provides training for growers of irrigated crops who are interested in implementing water quality protection practices. The short course teaches the basic concepts of watersheds, nonpoint source pollution (NPS), self-assessment techniques, and evaluation techniques. Management goals and practices are presented for a variety of cropping systems.

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DEVELOPING AN EVALUATION PROGRAM

There is significant interest in nonpoint source (NPS) pollution monitoring within California's agricultural community. This interest reflects growers' awareness of water quality issues related to nonpoint source pollution. Regulatory agencies and citizen monitoring groups are involved in controlled monitoring studies of nonpoint source pollution in many of California's watersheds. In most cases, this type of monitoring is beyond the finances, labor resources, technical expertise, and needs of individual growers. A simple program can be useful for self-evaluation, however, and particularly for evaluation of the effectiveness of a grower's management practices. The purpose of this publication is to familiarize growers with the basics of self-evaluation.

A valid evaluation design is necessary if you are going to identify the changes to water quality that result from modifications to farming operations. Evaluation should answer two questions:

- *Is water quality degraded as a result of farming operations?*
- *If water quality is degraded, is the water quality improved by subsequent changes in farming operations?*

FUNDAMENTAL QUESTIONS

The following questions will help guide the development of a meaningful and practical nonpoint source pollution evaluation program:

- *Why do you want to evaluate?*
  - — *What specific variables will be evaluated?*
  - — *What do you intend to do with the information you obtain?*
  - — *How confident do you need to be in the accuracy of this information?*

By answering "why," you help establish clear, explicit, and realistic objectives. You will also need to know the following:

- *Who will conduct the evaluations? What is their level of understanding of water quality evaluation and data interpretation?*
- *What devices are necessary to evaluate the stream, lake, ground water, or water well for these water quality variables?*
- *When (in terms of seasonal and with regard to storm events) will water quality be evaluated? What relation does the sampling interval have to the evaluation objective?*

- *How long will the program last and how will you know when it is time to conclude?*
- *Where will you sample the water to be evaluated? What relation do the locations have to the evaluation objective?*
- *How will the self-evaluation be achieved? (Two designs commonly used in formal monitoring programs are termed* before-and-after *and* above-and-below.*)*

"BEFORE-AND-AFTER" DESIGN

The *before-and-after* design involves evaluating water quality before and after a change in land management practice to determine whether the change affected the water quality. For instance, the question might be, "Does the establishment of a vegetative buffer strip alongside a riparian area reduce suspended sediment concentrations in the stream?" Given that streamflow affects suspended sediment concentrations, let's look at two possible scenarios:

Scenario 1. A vegetative buffer strip is established. For the next four years rainfall is below normal. Streamflow and sediment concentration are also below normal. Was the reduction in sediment concentrations attributable to the buffer strip or to the low rainfall?

Scenario 2. A vegetative buffer strip is established. For the next four years rainfall is above normal. Streamflow and sediment concentration are also above normal. Was the buffer strip an ineffective method for reducing sediment concentration, or was the increased sediment concentration attributable to large storm events?

To determine the effectiveness of the vegetative buffer strip, you need a way to account for the masking effect of natural weather and streamflow variations. Evaluation of an area where there is no vegetative buffer strip, a *control treatment,* helps to discern the effectiveness of the vegetative buffer strip in reducing sediment concentrations from the influences of rainfall and streamflow.

The value of the control treatment is not in comparing the two sites, but in comparing changes in the sediment concentrations in the stream at each site over the four-year period. For instance, let's say after four years of high rainfall the site with the vegetative buffer strip has sediment concentrations that are only moderately higher than they were before the buffer strip was established. At the same time, the control (the site with no buffer strip) has sediment concentrations that are much higher than they were at the beginning of the evaluation. You could then conclude that there is a good chance that the vegetative buffer strip is effectively reducing the sediment concentrations deposited into the stream despite the fact that those sediment concentrations are higher than they were at the beginning of the evaluation period.

You can also evaluate sediment in non-riparian locations. For instance, sediment loss can be measured and compared for seeded and non-seeded furrows.

"ABOVE-AND-BELOW" DESIGN

The *above-and-below* design involves evaluating water quality above and below a land management practice in the watershed. The primary advantage of this design over the before-and-after design is that it allows for separation of NPS pollution contributed upstream (surface water) or up-gradient (ground water) of the area of interest. When there is a stream running through your property, this can provide a useful method for determining the potential contributions from your property. You can also evaluate nitrate, salt, and sediment concentrations in irrigation water at the source and as it leaves a field. Evaluate both the "above" and "below" locations within a short time frame so that conditions are the same at each site.

CONCLUSION

Although self-evaluation can be as simple as using photographs to document a management practice's effectiveness, referring to pesticide use records, or walking through the area and noting runoff patterns, evaluation programs generally require a good deal of planning and dedication. The intensity of the evaluation program depends upon what information you are trying to obtain. Evaluation programs used by growers do not necessarily provide sufficient information for scientific or regulatory purposes; they are simply a means of assessing the effectiveness of a landowner's management practices for the purpose of making future management decisions. Each evaluation program will be different, and some may require professional assistance.

Regardless of the intensity of the evaluation program, the detection of changes in nonpoint source pollution will take years to accomplish. For instance, when performing in-stream grab bag sampling, a 30 to 60 percent change in average pollutant concentration over a 5-year period is required in order to document a significant trend in improvement of stream water quality as a result of management activities (Spooner et al. 1987). Groundwater evaluation may require even longer periods of evaluation to determine the success of NPS pollution management.

A more direct method for evaluating groundwater NPS pollution attributable to specific crop management practices is to take representative soil water samples below the root zone. There, changes in the leaching of chemicals or pathogens that occur as a result of changes in management practices can be observed within a period of 1 to 5 years. Soil samples only provide an uppermost estimate of pollution, however; they do not account for the retention and degradation of chemicals or pathogens between the root zone and the water table or within the aquifer. To assess groundwater pollution levels at the location of the well, you can sample the well water (see Groundwater Sampling and Monitoring [UC ANR Publication 8085]).

Self-evaluation takes careful planning and long-term commitment, but it is a valuable tool that you should not overlook for making and assessing the effectiveness of management decisions on your property.

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ACKNOWLEDGMENT

The authors would like to thank Ben Faber, UC Cooperative Extension Farm Advisor, Ventura County, for his contributions to this publication.

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Publication 8087

pr-01/03-WJC/VFG

This publication has been anonymously peer reviewed for technical accuracy by University of California scientists and other qualified professionals. This review process was managed by the ANR Associate Editor for Natural Resources.