PUGET SOUND ECOSYSTEM MONITORING PROGRAM

# STORMWATER WORK GROUP

**Wednesday, November 9, 2016, from 9:05 am to 12:10 pm**
**USGS, 934 Broadway, Tacoma WA, 98402**

# Draft Summary

**OF THE MEETING'S KEY DISCUSSIONS, DECISIONS AND AGREEMENTS**
*a list of acronyms is provided at the end of the document*

## ATTENDEES:

*Work Group members and alternates present, and the organizations and caucuses they represent:*
**Cami Apfelbeck** (Bainbridge Island), Local Governments, and the Work Group's Chair; **Jess Archer** (ECY EAP), State Agencies; **Abby Barnes** (WDNR), State Agencies, and the Work Group's Vice Chair; **Dick Gersib** (WSDOT), State Agencies; **Shana Joy** (WSCC), Agriculture; **Patrick Moran** (USGS), Federal Agencies; **Ben Parrish** (Covington), Local Governments; **Kit Paulsen** (Bellevue), Local Governments; **Nancy Rapin** (Muckleshoot Indian Tribe Fisheries), Tribes; **Jim Simmonds** (King Co), Local Governments; **Connie Sullivan** (Puget Soundkeeper Alliance), Environmental Groups; **Theresa Thurlow** (Federal Way), Local Governments.

*Invited speakers:* **Karma Anderson** (NRCS), **Curtis DeGasperi** (King Co), **Lisa Duriancik** (NRCS), **Nicole Embertson** (Whatcom Conservation District), **Andy James** (UW-Tacoma).

*Others in attendance:* **Fred Bergdolt** (WSDOT), **Chris Hall** (Ecology SWRO), **Jeff Kray** (Marten Law PLLC), Sam Merrick (Ecology SWRO), **Chris Montague-Breakwell** (Ecology SWRO), **Sarah Norberg** (Tacoma), **Rob Plotnikoff** (TetraTech), **Angela Vincent** (Ecology SWRO).

*Work Group staff:* **Karen Dinicola** (ECY WQP), SWG Project Manager; and **Brandi Lubliner** (ECY WQP), RSMP Coordinator.

### WORK GROUP DISCUSSES DRAFT AGRICULTURAL RUNOFF MONITORING STRATEGY AND KEY PROGRAMS

Shana Joy of WSCC is both staff and chair of the SWG Agricultural Runoff Subgroup. She and NRCS and Whatcom Conservation District staff presented information about the "Conservation Effects Assessment Project" and "Edge of Field (EoF) Monitoring" and "Discovery Farms" agricultural effectiveness monitoring programs. Their presentations will be posted with this meeting summary. In the Q&A session following the presentation, the speakers also described an approach called "precision conservation" that is pulling these three programs together in new targeted areas using coordinated investments.

Each of these programs has benefits and challenges. Work group members expressed concern about the confidentiality of the data collected in these programs and want to be certain that enough data are collected at a large enough scale that it can be aggregated, presented, and shared collectively. The data and programs overall also seem insufficient to provide a regional roll-up addressing the monitoring priorities established in our previous recommendations related to this topic. It is also unclear how many agricultural sectors will be addressed by the planned monitoring.

Can EoF inform where receiving water monitoring is needed? How can the final agricultural runoff strategy leverage EoF with Intensively Monitored Watersheds and the RSMP?

Work group members want to be certain that this strategy is informed by the findings of the 2015 RSMP Puget Lowland stream monitoring, and, in particular, the results of the WSDA-funded laboratory analysis of 100 additional pesticides at 80 of the RSMP sites. Lots of cities and counties and Ecology EAP and USGS also have monitoring programs and data that are available to provide additional perspective and definition to the plans for this strategy.

For next revisions to the implementation plan, work group members want to see more definition of who will do the literature review, and what is its scope and scale? The literature review should result in more specific research questions to drive the monitoring. The strategy especially needs to articulate how findings of agricultural runoff monitoring will be used not only by farmers but also by local governments to manage their MS4s and critical areas.

Shana will give progress updates at our next work group meetings. Work group members want to be certain that the subgroup takes sufficient time to bring in the necessary detail and people to flesh out a concrete plan for the final strategy

and implementation plan. Therefore, we expect to delay approval of a final document until our June or September meeting in 2017.

### WORK GROUP HEARS INITIAL FINDINGS OF RSMP STREAM DATA ANALYSIS

Brandi Lubliner, RSMP Coordinator, and Curtis DeGasperi of King County updated work group members on the progress toward completing the analysis of 2015 RSMP Puget Lowland stream monitoring inside and outside Urban Growth Areas. Their presentation will be posted along with this meeting summary. The analysis is focused on answering questions the SWG identified prior to the project:

- What percent of streams meet biological, water, and sediment quality standards for beneficial uses within and outside urban growth areas (UGAs)?
- What natural variables correlate with the status of streams within and outside the UGA?
- What human variables correlate with the status of streams within and outside the UGA?
- For future RSMP stream monitoring hat water, sediment, biological and habitat parameters should be carried forward, and at what timing and frequency? How should sites be selected?
- How do the 2015 RSMP findings compare to other sizeable monitoring programs in Puget Sound?

The presentation focused on answers to the first three bullets; future work will address the last two. The talk highlighted which parameters were rarely (if ever) detected in the water column or sediments, and differences between sites inside UGAs and outside UGAs as well as seasonally. Water/sediment quality standards were exceeded for metals, phthalates, and PCBs but were infrequent overall. The team also searched for meaningful benchmarks to compare concentrations for toxics parameters without official water/sediment quality standards. Correlating variables included

- Natural: December precipitation and longitude (which seems to be a proxy for density).
- Human: development, canopy, chloride (no intertidal sites were included, so this is either from leaky septics or deicing material), and zinc in sediment.

The PSEMP Freshwater Workgroup (FWG) will review and discuss in detail the RSMP Puget Lowland Stream Data analysis and findings and recommendations for future RSMP monitoring and trends analysis. The FWG will also hear about findings of USGS NAWQA and ECY EAP programs the RSMP is leveraging, and changes and adjustments being made to their programs based on results and new scientific understanding. Work group members who want to be included in those FWG meetings should contact Leska Fore. A synopsis of these discussions will be shared at SWG meetings, and work group members will review and discuss all RSMP recommendations that come out of the workgroups and subgroups.

### WORK PLAN UPDATES TO BE APPROVED IN JANUARY

Subgroups' proposals for updating our work plan for 2017-2018 were included in a document distributed with the agenda for this meeting. In addition to the plans included in the draft plan, work group members expressed interest in:

- Providing comment on Ecology's draft permit language for Special Condition S8 Monitoring and Assessment; and
- Hearing about findings of other monitoring programs (and in particular, Ecology EAP programs the RSMP is leveraging, and also USGS NAWQA) and changes and adjustments being made to their programs based on results and new scientific understanding.

Karen will add these topics to the work plan and to the topics planned for our scheduled meetings in 2017-2018. For some topics, the primary conversation might take place at another PSEMP Workgroup meeting or at one of our Subgroup meetings, with high level summaries presented at our meetings. Work group members are encouraged to review the subgroup member list and ask Karen to add them to additional subgroups for meeting agendas and notes.

### WORK GROUP UPDATED ON RSMP IMPLEMENTATION AND OVERSIGHT

RSMP Coordinator Brandi Lubliner and PRO-Committee chair Ben Parrish provided a detailed update on RSMP activities, contracting decisions, and upcoming projects. The details are listed in the meeting agenda. The PRO-C agreed to do another "report card" evaluation of Ecology as RSMP administrator in preparation for permit reissuance.

### WORK GROUP UPDATED ON PSEMP AND PSP ACTIVITIES RELATED TO OUR WORK

Andy James briefly described the new process for developing the implementation strategies for stormwater actions related to the B-IBI and Toxics in Fish vital sign indicator targets. Work group members are invited to participate in these Inter-Disciplinary Teams. Andy is leading the work on factsheets, background summaries, synthesis papers (generalizations supported by evidence), alternatives analysis, and the monitoring plan for the Stormwater Strategic Initiative and would appreciate work group members volunteering to provide review comments on those documents. The timeline for completion of this work is April 2017 to inform funding decisions in the next cycle.

George Tuttle of WSDA will be giving a presentation about other agricultural monitoring findings at the PSEMP Toxics Workgroup meeting tomorrow, November 10. Work group members are encouraged to attend in person or via the webex. We will invite George to present the RSMP data at one of our future meetings.

### FUTURE MEETING DATES AND PROPOSED DISCUSSION TOPICS

At all of our meetings, we will:

- Hear updates from the RSMP Coordinator and PRO-Committee on RSMP implementation,
- Continue to discuss recommendations for RSMP implementation and oversight outside the permit structure,
- Hear from our subgroups about the status of implementing our current work plan,
- Hear updates from the PSEMP Steering Committee and other workgroups, and Action Agenda coordination, and
- Determine messages and timing for the next SWG Reporter issue.

At our next meeting on Wednesday, January 18, 2017 from 9:00 am to 12:00 pm at the USGS Office in Tacoma, we will also:

- Accept nominations for SWG Chair and Vice Chair for a two-year term beginning in March 2017,
- Approve updates to our work plan for 2017-2018,
- Hear updates on progress toward a detailed implementation plan for agricultural runoff monitoring, and
- Discuss the recommended data fields and proposed budget for future RSMP Source ID work.

Work group meetings in 2017 are scheduled on January 18, March 15, June 7, September 13, and November 15.

### ACRONYMS USED IN THIS MEETING SUMMARY:

B-IBI – Benthic index of biotic integrity
BMP – Best management practice
ECY SWRO - Washington Dept. of Ecology Southwest Regional Office
ECY EAP – Washington Dept. of Ecology's Environmental Assessment Program
ECY WQP – Washington Dept. of Ecology's Water Quality Program
FWG – (PSEMP) Freshwater Workgroup
MS4 – Municipal separate storm sewer system
NAWQA – National Water Quality Assessment
NRCS – Natural Resources Conservation Service
PCBs – Polychlorinated biphenyls
PRO-C or PRO-Committee – Pooled Resources Oversight Committee
PSEMP – Puget Sound Ecosystem Monitoring Program
PSP – Puget Sound Partnership
RSMP – Regional Stormwater Monitoring Program
SWG – Stormwater Work Group
UGA – Urban Growth Area
USGS – U.S. Geological Survey
WDNR – Washington Dept. of Natural Resources
WSCC – Washington State Conservation Commission
WSDA – Washington Dept. of Agriculture
WSDOT – Washington Dept. of Transportation

# Final Report and Implementation Plan - DRAFT

Presented to the Puget Sound Stormwater Work Group

## Agricultural Runoff Subgroup

**11/1/2016**

This final report and implementation plan reiterates recommendations provided to the PS SWG regarding agricultural stormwater effectiveness monitoring, cropland nutrients and sediment, pesticides, and bacteria and nutrients from livestock operations. Implementation strategies recommended herein are intended to address the majority of the recommendations and leverage currently available programs and resources. Coordinated pursuit of funding opportunities and coordinated investment of available resources is needed to maximize the potential for success.

# Table of Contents

## Introduction and Background

The Puget Sound Stormwater Work Group (PS SWG) commissioned the formation of the Agricultural Runoff Subgroup (ARS) in early 2011 to consider expanding the *2010 Stormwater Monitoring and Assessment Strategy for Puget Sound* to address agricultural issues, building upon the *Recommendations for Municipal Stormwater Permit Monitoring* and other ongoing efforts. The subgroup first met in April 2011 and met regularly on a bi-monthly schedule except for a hiatus in activity between July 2014 and March 2015 due to staffing changes at the State Conservation Commission (SCC). Since March 2015, SCC staff has worked with ARS members to produce this report and implementation plan in smaller group work sessions.

Members of the subgroup, including those regular and periodic participants in select discussions, are: City of Everett, Snohomish Conservation District, Skagit County, USDA Natural Resources Conservation Service, Whidbey Island Conservation District, Department of Ecology, WA Department of Agriculture, Whatcom Conservation District, Skagit Conservation District, Western Washington Agriculture, Washington Dairy Federation, Mason Conservation District, EPA, Futurewise, Bainbridge Island, Taylor Aquatic Science, Thurston County, Clallam Conservation District, Samish Indian Nation, People for Puget Sound, and the Washington State Conservation Commission.

The process the ARS followed to make decisions or reach consensus was slightly different for each set of recommendations however, decisions were achieved via consensus of those present at the meetings. The decisions (recommendations) were sent out for review to all subgroup members. Questions from subgroup members not present at the meetings were posed to the group and answered/addressed via email. All of the recommendations were agreed to by the ARS without dissent.

The PS SWG tasked the ARS specifically to:

- Review the small streams and nearshore status and trends monitoring parameter lists and consider adding agricultural pesticides and or other parameters for analysis at status and trends sites located outside Urban Growth Area (UGA) boundaries.
- Design a regional source identification and diagnostic monitoring strategy for agricultural issues.
- Design effectiveness studies for agricultural BMPs.
- Describe how the monitoring might be funded and conducted (implementation plan).

The ARS has completed the first three tasks outlined above and has provided a set of recommendations to the PS SWG regarding pesticides, agriculture stormwater effectiveness monitoring, cropland nutrients and sediment monitoring, and bacteria and nutrients monitoring from animal operations. This final report and implementation plan is intended to memorialize the work by the ARS to date under the work plans set out by the Puget Sound Stormwater Work

Group as well as to lay out implementation strategies that could be pursued to further this work including descriptions of potentially suitable programs and funding sources.

**Recommendations**

Agricultural Stormwater Effectiveness Monitoring

The group proposed recommendations in two tiers. Tier 1 recommendations met all of the following criteria: more than one member submitted that particular study idea, others could use the information from the study, broader geographic scope, and greater ecological benefit. Tier 2 recommendations are more specific and limited to a smaller geographic scope and or measure of ecological benefit. The PS SWG approved these subgroup recommendations in June 2014. See Appendix A for additional details about the recommendations.

Tier 1 Recommendations:

- What is the effectiveness of the typical suite of agricultural BMPs on reducing pollutants via stormwater into Puget Sound streams?
- What is the effectiveness of drainage and stormwater –specific BMPs in reducing polluted run-off from agricultural lands?
- What is the effectiveness of ecological restoration to improve hydrology and other natural functions?
- What are the greatest barriers to landowner participation in agricultural and, where applicable stormwater-specific, BMP use?

Tier 2 Recommendations:

- What is the effectiveness of roof runoff structural practices, such as dry wells and hard-lining to a field ditch to avoid bird fecal contributions?
- What is the effectiveness of media filters (barley straw, compost, etc.) at reducing nutrients, sediment, and bacteria?
- What is the effectiveness of settling tanks to treat runoff from non-manured production areas, such as feed/commodity areas, then running the effluent through a field/filter strip?

Cropland Nutrients and Sediment Monitoring

The ARS determined via review of existing inventory data that croplands are located primarily in the North Puget Sound and several current monitoring programs already existing in the area were reviewed. These recommendations were approved by the PS SWG in March 2014.

- Coordinate existing sampling of sediments, nitrogen, and phosphorus with each other and with future sampling.
- Develop a strategy for data sharing, particularly for the NRCS edge-of-field monitoring.

- Baseline monitoring in marine waters should be done prior to installation of BMPs intended to reduce nutrient loads to provide a better understanding of the imports and exports from watersheds.
- Inventory sub-surface drainage structures, such as tiles, throughout Puget Sound and prioritize areas for repair or improvement..
- Additional monitoring (utilizing bracketing) of nutrients and sediment.

Pesticides

These recommendations were approved by the PS SWG in March 2013 following review and discussion by the ARS of status and trends monitoring parameter lists and PS SWG suggestions.

- A more targeted approach that combines source ID and program or watershed scale effectiveness monitoring is recommended over broad-scale monitoring such as status and trends which is not the most cost-effective method of monitoring pesticides in Puget Sound.
- Seek funding to augment the current Dept. of Agriculture pesticide monitoring program to use existing data to develop a model to estimate impacts due to peak flow events, then increase surface water sampling to test the model.
- Seek funding to conduct pesticide monitoring throughout other areas of the Puget Sound region (other than Skagit Co.) using a rotating panel of randomly-selected sites that are associated with different cropping patterns.

Bacteria and Nutrients

These recommendations were approved by the PS SWG in November 2012.

- Assure adequate support by: finding the necessary technical, political, and financial support that is needed throughout the process and, develop an effective community support system to ease the need for extensive regulatory oversight.
- Use broad-scale monitoring to prioritize problem areas at a sub-watershed level where detailed source identification monitoring and implementation will occur.
- For high priority areas, further define the problems, while obtaining community support by conducting community outreach to elevate the issue and obtain support and, collecting detailed survey information for all potential sources of impact in that area.
- Conduct source identification monitoring or bracket water quality monitoring around storm events to better characterize the sources of pollutants in these high priority areas.
- Implement best management practices (BMPs) to address the identified problems.
- Provide and encourage source identification monitoring for livestock impacts to use the guidance in Appendix A.

## Implementation Strategy

The following are proposed actions or programs to further the recommendations made by the ARS.

Literature Review

The first step recommended by the ARS with respect to any of the recommendations outlined above is to conduct a literature review in each of the subject matter areas. The ARS would prefer to see effort and funding be directed first towards a literature review which in turn may inform refinement and prioritization of the recommendations for further implementation.

Collaboration with Ongoing Research and Monitoring Efforts

It is highly recommended that increased and focused collaboration be pursued among the various agencies and organizations engaged in research associated with the ARS recommendations as well as those engaged in or with interest in agricultural best management practice effectiveness monitoring such as the USDA Natural Resources Conservation Service, WSU Extension, and University of Washington. The Puget Sound Ecosystem Monitoring Program at the Puget Sound Partnership as well as Department of Ecology's Environmental Assessment Program are two key organizations currently conducting environmental assessment and monitoring work with multiple additional agencies and organizations also collecting environmental data such as Ecology, WSDA, WDFW, Tribes, and local governments such as cities, counties and conservation districts.

The Puget Sound Ecosystem Monitoring Program (PSEMP) is tasked with providing a coordination center for the various ecosystem monitoring and data collection efforts occurring in the region. Multiple recommendations of the ARS relating to cropland nutrients and sediment monitoring are associated with increased coordination and efficiency of monitoring efforts. Work remains to be done to fully integrate and coordinate all of the various ongoing efforts on a regional scale.

On a watershed or sub-watershed scale there are examples of coordinated water quality monitoring occurring that are working well. One example is the Clean Samish Initiative effort in Skagit County. The major entities and organizations involved in water quality monitoring in the Samish River watershed work together to periodically review water quality data in order to inform adaptive management decisions for the watershed. In this example, the primary data collection and analysis entity is Skagit County.

Another example is the focused watershed-scale work underway in Whatcom County under the Whatcom Clean Water Program. Multiple partners are participating in fecal coliform bacteria water quality sampling and monitoring including: Ecology, Whatcom County, WSDA Dairy Nutrient Management Program, Nooksack Indian Tribe, Lummi Nation, and Whatcom

Conservation District. Several existing programs are bringing resources to bear in the area to address sources of pollution. One of the focus areas for the Whatcom Clean Water Program is Drayton Harbor. In October 2016, 810 acres of shellfish growing area in Drayton Harbor were upgraded by the WDOH from conditionally approved to approved, a measure of success due at least in part to the collaborative and coordinated structure of the Whatcom Clean Water Program. These two examples could be emulated elsewhere in the region at a similar scale with a reasonable expectation of success.

Conservation Effects Assessment Project

The USDA Natural Resources Conservation Service (NRCS) implements a Conservation Effects Assessment Project (CEAP) program. "CEAP is a multi-agency effort to quantify the environmental effects of conservation practices and programs and develop the science base for managing the agricultural landscape for environmental quality."[1] NRCS has led ten Special Emphasis Watershed Assessments across the country since CEAP's inception in 2002. These assessments were focused on addressing specific resource concerns including the effectiveness of conservation practices in reducing soil erosion, nutrient and pathogen runoff. Currently, NRCS in Washington is not funded for this program. The ARS recommends pursuit of a Special Emphasis Watershed Assessment to provide further understanding of the effectiveness of a typical suite of agricultural BMPs in reducing pollutants to nearby waterways. Selection of a watershed(s) for assessment and the specific suite of BMPs for focus should be done by the NRCS and ARS in collaboration with the Puget Sound Stormwater Work Group. Considerations for selection of an appropriate area for study should include: HUC 8 or smaller geographic area, quantity and quality of data already available in the area, tidal influence if any, point sources of pollution in the area, and primary land use(s). Typical BMPs that may be considered for effectiveness study as part of a suite of BMPs include any practices found in the NRCS Field Office Technical Guide[2] including streambank vegetation restoration and waste treatment practices. The average cost of the Special Emphasis Watershed Assessments already completed is approximately $650,000. The cost for a Special Emphasis Watershed Assessment in the Puget Sound region will vary based on available resources from potential partners as well as the quality and quantity of applicable data already available.

Discovery Farms

Another recommended implementation strategy is to pursue expansion of the Discovery Farm program. The Discovery Farm concept initially began in the mid-west and now Discovery Farm programs exist in Wisconsin[3], Minnesota, North Dakota, and Washington. A Discovery Farm is a working farm that has entered into a contract to participate in a research/evaluation/demonstration program. Farmers agree to share the data collected on their

[1] http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/ceap/
[2] http://www.nrcs.usda.gov/wps/portal/nrcs/main/wa/technical/
[3] http://www.uwdiscoveryfarms.org/home

farms as part of the Discovery Farm program agreement. Currently, two Discovery Farms exists in Washington. Expanding this program more broadly around Puget Sound would serve to address multiple facets of the agricultural stormwater effectiveness recommendations by providing on the ground opportunities to install and monitor specific BMPs.The primary cost of establishing a Discovery Farm is in the purchase and set up of appropriate monitoring equipment. Implementing Edge of Field Monitoring in conjunction with a Discovery Farm can provide some cost off-set for the farmer. Supplemental technical assistance and coordination funding of approximately $29,000 per farm is needed for initial set up. Annual maintenance, sampling, and data analysis costs are currently estimated at $10,000 per Discovery Farm.

Edge of Field Monitoring

The USDA NRCS offers cost share funding to agricultural producers under their Environmental Quality Incentives Program for edge of field monitoring practices. While the landowner remains the owner of the data collected from implementing edge of field monitoring, there are opportunities for the data to be shared when incorporated with a Discovery Farm agreement. This financial incentive for landowners to invest in monitoring equipment to collect real-time data about the runoff from their farms is a valuable tool for daylighting agricultural non-point issues. At this time, there are currently two landowners implementing edge of field monitoring in Washington in Whatcom County; however, NRCS recently conducted a sign-up period for this practice and three additional landowners have applied to participate. Edge of Field monitoring is expensive to implement and contracts for this practice average around $250,000 each and are for a term of five to nine years. This practice is a substantial investment for a farmer. The ARS would like to see the NRCS increase opportunities and funding for edge of field monitoring practices. Further encourage for landowners to engage in the Discovery Farm program to allow for sharing of the data collected, should be considered in the form of additional financial incentives or exemption from the per-landowner Farm Bill cap set at $450,000.

Pollution Identification and Correction (PIC) Programs

PIC programs managed by county health agencies are designed to identify potential sources of bacterial nonpoint pollution and then work with private landowners, including agricultural producers, to correct them. Bracket monitoring and in some cases, DNA analysis, are being used to identify sources. PIC programs can be an effective strategy to employ to provide focused effort in a particular watershed or sub-watershed. Conservation districts in the region work with county leads on PIC program implementation by providing technical assistance to agricultural producers and other private landowners and in some cases, financial incentives for BMP implementation. Despite examples that exist in the region of PIC program success in reducing nonpoint pollution, robust PIC programs do not exist in all counties in the region. Clallam County has not taken a lead role in establishing a local PIC program even though Clallam Conservation District has provided extensive support to the county by drafting a PIC program plan. PIC programs are generally at least partially funded by the WA Department of Health in

conjunction with local county-generated revenues. The ARS recommends supporting the formation and operation of robust PIC programs at the local level region-wide.

Precision Conservation Approach

The premise behind the precision conservation approach is to focus outreach and education efforts and financial incentives from multiple sources and programs to achieve improvement in natural resource conditions in a defined geographic area. This is similar in structure to PIC programs, the Clean Samish Initiative, and Whatcom Clean Water Program. The WSCC was awarded a Regional Conservation Partnership Program grant by NRCS in 2015 to implement the Precision Conservation for Salmon and Water Quality Program (Puget Sound RCPP), providing financial incentive funding for BMP implementation in high priority geographic areas in the region. In partnership with the WSCC, the Puget Sound Natural Resource Alliance and the Nature Conservancy produced the *Opportunity Assessment for Targeted BMPs in Puget Sound*[4] which identifies high priority areas for focused BMP implementation to address salmon habitat and water quality resource concerns. This technical report is helping to guide the Puget Sound RCPPThe WSCC and NRCS combine available funding under this program with many local partners that also bring resources to the table. To date, four action area projects are underway under this program: Skykomish River and Stillaguamish River (Snohomish County), Thomas Creek (Skagit County), and Newaukum Creek (King County). By concentrating efforts in this manner and including monitoring requirements, the WSCC anticipates demonstrating natural resource improvement. While the program is fairly new at the WSCC and project implementation has just gotten underway a similar approach has resulted in measureable success elsewhere. The WSCC has proposed to expand opportunities for similar focused watershed-scale projects to be implemented across the state in its 2017-19 biennial budget request

Funding Needs and Opportunities

Implementation of this plan will require pursuit of additional funding to accomplish many of the needs outlined in the recommendations including: conducting an inventory of sub-surface drainage structures on agricultural lands throughout Puget Sound, BMP implementation, and increased sampling efforts. See Appendix B for a table of potentially suitable funding opportunities.

**Conclusion and Next Steps**

This final report and implementation plan reiterates recommendations made by the ARS to the PS SWG in recent years and presents an implementation strategy that could be pursued to further the recommendations. Work remains to be done to increase coordination and collaboration around agricultural runoff effectiveness monitoring. Much of the implementation strategy noted

[4] http://scc.wa.gov/wp-content/uploads/2016/06/TechReport_Opportunity-Assessment-for-Targeted-BMPs-in-Puget-Sound_2016....pdf

here is dependent on funding to move forward. Coordinated pursuit of funding opportunities and coordinated investment of available resources is needed to maximize the potential for success.

**Appendices**

Appendix A: Agricultural Stormwater Effectiveness Recommendations, Cropland Nutrients and Sediment Monitoring Recommendations, Pesticides Recommendations, Bacteria and Nutrients Recommendations

Appendix B: Table of Potential Funding Opportunities

Appendix C: Conservation Effects Assessment Project Information

Appendix D: Discovery Farms Fact Sheet

**SUBJECT:** **Agricultural Stormwater Effectiveness Monitoring**

**ISSUE:**

Effectiveness monitoring is an important component in program and project management. It can demonstrate and/or quantify the success or failure of actions, allowing for adaptive management to improve the actions when needed. Effectiveness monitoring has been recognized as significant need within the Puget Sound Stormwater Monitoring Strategy. Our discussion within the Agriculture Stormwater group built upon the work done by the Puget Sound Workgroup.

**BACKGROUND:**
What monitoring and assessment information is needed and why?

Stormwater effectiveness monitoring on agricultural activities is sparse in Washington State, but has been studied around common best management practices (BMPs) in other parts of the United States. Questions have been posed as to the transferability of those results to the Puget Sound Region. Reasons why this monitoring might be region-specific include the difference in BMPs from state to state. While the Natural Resources Conservation Service has nation-wide agricultural BMPs, each state can increase conservation benefit for state-specific needs. In Washington State, we have stricter state water quality standards compared to the national Clean Water Act requirements, and we have endangered species concerns for salmon and other species that can be impacted by impaired water quality.

In addition, there is a need for effectiveness monitoring on specific activities that appear to have not been evaluated in other studies. However, the first step prior to implementing any of the recommended studies should be a literature review to ascertain the current status of information.

Who was involved in the Subgroup, and how were decisions made?

**Involvement:** Heather Kibbey (City of Everett), Bobbi Lindemulder (Snohomish Conservation District), Karen Bishop (Whidbey Island Conservation District, phone), Bob Cusimano (ECY), Chery Sullivan (Washington Dept. of Agriculture), John Bolender (Mason Conservation District), George Boggs (Whatcom Conservation District), Rich Doenges (Thurston County), Monte Marti (Snohomish Conservation District), Rick Haley (Skagit County), Kelly McLain (Washington Dept. of Agriculture), and Carol Smith (WA Conservation Commission) participated in one or both of the two meetings when these were developed. In addition, Meghan Adamire (Clallam Conservation District), Adam Lorio (Samish Indian Nation), Dino Marshalonis (EPA), Jay Gordon (WA Dairy Fed), Joe Holtrop (Clallam Conservation District), Carolyn Kelly (Skagit Conservation District), Western WA Agriculture, Clare Flanagan (NRCS), Sherre Copeland (NRCS), Bill Bowe (Snohomish Conservation District), Seth Book (Mason Conservation District), and Michael See (Skagit County) were provided with opportunities to participate in email reviews and discussions and a few of these did provide comment.

**Decision Making Process:** These recommendations were developed using the following process.

1) We reviewed the following ranking criteria spreadsheet developed by the Puget Sound Stormwater Work Group:
https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxwdWdldHNvdW5kc3Rvcm13YXRlcndvcmtncm91cHxneDoyZmRkYjdkYTJhMjg0Y2E0

The criteria of interest were:

- How many members submitted that particular study idea?
- Could others use the information from this study?
- What is the geographic impact of the study?
- What is the ecological impact of the study?
- Is it a resource intense study (not cost effective)?
- Does it provide quantifiable improvements?

2) Each member submitted agricultural stormwater effectiveness monitoring ideas to the Chair. We reviewed those at the July 2013 meeting. Although we didn't formally quantify how each topic performed relative to the criteria, we used the criteria to guide our prioritization.

3) Decisions were achieved via consensus of those present at the meetings. The decisions (recommendations) were sent out for review to all sub-group members. Questions from others were posed to the group and answered/addressed via email. All of the included recommendations were agreed-to by the Agriculture Stormwater Workgroup without dissent.

Where are we in the SWG approval process, and when are decisions needed?
Recommendations were presented at the November 2013 meeting with decision at the March 2014 meeting.

How and when are recommendations envisioned to be implemented?
The agriculture stormwater subgroup will develop an implementation and funding plan in a future set of meetings. We want to develop this plan after we have a full set of agriculture recommendations to facilitate prioritization. Also, we only want to develop this plan for approved recommendations.

What are the funding implications? See answer above.

**ALTERNATIVES CONSIDERED:**
Alternative:
1) No adoption of recommendations. No change or improvement. Lack of coordination across areas.
2) Partial adoption of recommendations.

**RECOMMENDATIONS AND REASONING:**

We decided upon a two-tiered prioritization. We discovered that most of the ideas fit into a few categories and those were deemed highest priority and equal to each other in priority. These were placed in Tier 1. They rank higher because they met all of the following criteria:

- More than one member submitted that particular study idea
- Others could use the information from this study
- These have a broader geographic scope
- These have a greater ecological benefit

The remaining ideas are important and could also benefit others, but are more specific and limited, and therefore a slightly lower in geographic scope and ecological benefits. They are listed in a second group as Tier 2.

It is recommended that a literature review be conducted on these topics as a first step.

Tier 1 Highest Priority:

What is the effectiveness of the typical suite of agricultural BMPs on reducing pollutants via stormwater into Puget Sound streams? Hypothesis form: Commonly prescribed agricultural BMPs have no effect on preventing agricultural stormwater pollution from impacting water. Specific needs: There is a high confidence in the practices, but low confidence in behavior. Need to do this at a larger scale, such as watershed or sub-watershed. Should monitor over time to study adoption rate and continued implementation over time. Another set of related questions: what is the best combination of practices per activity (hobby farm, dairy, etc.)?

What is the effectiveness of drainage and stormwater –specific BMPs in reducing polluted run-off from agricultural lands? This includes stormwater retention facilities, such as ponds, and roof runoff and tiling. Hypothesis form: Stormwater and drainage BMPs do not reduce agricultural pollutants from entering surface water. A related need is a study to show how upland sources from other land uses (urban, forestry) impact runoff from ag lands that are located more proximate to surface waters.

What is the effectiveness of ecological restoration to improve hydrology and other natural functions? This would include trees, healthier soils, and compost and viewing the farm as an ecological unit. Hypothesis form: Ecological restoration does not reduce stormwater impacts to surface water from agriculture lands. This ties into the effort by Ecological Services in Whatcom looking at CREP sites. Another example is found in the Whidbey Island District, where a project is assessing increased root masses and water flows. Ebey's watershed provides an opportunity to test flow in a similar manner.

What are the greatest barriers to landowner participation in agricultural BMP use? Conduct a survey to determine the social factors to stormwater improvements. For example, is information protection a major barrier? Some literature might be available to refine this question (Chesapeake). Focus group work might be useful.

Tier 2 Medium Priority:

What is the effectiveness of roof runoff structural practices, such as dry wells and hard-lining to a field ditch to avoid bird fecal contributions? Hypothesis form: Dry wells and hard-lining do not improve water quality from bird inputs to roof run-off from agricultural structures.

What is the effectiveness of media filters (barley straw, compost, etc.) at reducing nutrients, sediment, and bacteria? Hypothesis form: Media filters have no effect on reducing stormwater pollution inputs into Puget Sound waters.

What is the effectiveness of settling tanks to treat runoff from non-manured production areas, such as feed/commodity areas, then running the effluent through a field/filter strip? This is a method recently used in Thurston County to deal with washed dairy water. Hypothesis form: Dairy run-off treated with settling tanks and grass filters show no change in water quality.

**Other Supporting Documentation**
USGS study of ground/surface water interactions in the Nooksack Basin for fecals and nitrates.
http://pubs.usgs.gov/sir/2005/5255/index.html

NOTE: this attachment should be added to over time as the subgroup completes new sets of recommendations. Changes and new sections should be presented in track-changes.

## RECOMMENDATIONS

Summarize the overall recommendations endorsed by the subgroup members and the degree of consensus reached.

(approved by the SWG on ___)

By consensus, the subgroup recommends:

1. First overall or general recommendation
2. Second overall or general recommendation
    a. Detailed recommendation.
    b. etc.
3. etc.

By majority, the subgroup recommends:

1. Majority recommendation
    a. Minority concerns and/or suggested alternatives

## BACKGROUND

Provide a reasonably detailed summary of the issue including:

- The specific need for information to improve stormwater management.
- Interested parties, subgroup participants, and process used to make recommendations.
- Status of current knowledge and efforts to monitor and assess this topic.
    - Provide a brief but informative summary of the context for the recommendations, and background information including:
        - A summary of previous and ongoing work in the region that supports the recommendations. What gaps have been identified?
        - Relevance of the topic, including understanding impacts to biota.
        - Links to key reports and other important sources of information. These and other sources of information should be listed in the References section as appropriate.
- Priorities that must be determined to strategically expand, improve, complement, or replace current monitoring.
- How is the recommended monitoring coordinated with other programs?
- How the proposed monitoring and specific recommendations fit into SWAMPPS
    - And, if applicable, how they fit into the muni-permit-funded RSMP.

## SUPPORTING DETAILS

- Specific types of analyses that will be made.
- Data management approach.

## IMPLEMENTATION: ROLES AND RESPONSIBILITIES, AND COST ESTIMATES

- Expected timing and sequencing for implementing the recommendations.

When the subgroup is prepared to include implementation recommendations following their technical recommendations, complete this section. Call out any gaps that need to be filled and the implication of not addressing those shortcomings.

## REFERENCES

Author, date, title, source, and link if available

## APPENDICES

As needed or appropriate

February 3, 2014

# Stormwater Monitoring of Nutrients and Sediment from Cropland in Puget Sound

## Background

Cropland is a common land use in some Puget Sound Counties, particularly in north Puget Sound (Figure 1). Cropland activities can result in potential impacts to surface waters. These include pesticide pollution, excess sediment, and excess nutrient input. Best management practices (bmps) are used to minimize these impacts, but monitoring is necessary to document the extent of water quality improvements.

**Figure 1. Puget Sound Cropland**
**(WA Dept. Ag. 2012)**

| County | Acres of Cropland | % of PS Cropland |
|---|---|---|
| Whatcom | 61983 | 30.88 |
| Skagit | 57762 | 28.78 |
| Snohomish | 21896 | 10.91 |
| Thurston | 14535 | 7.24 |
| King | 12576 | 6.27 |
| Pierce | 10837 | 5.40 |
| Island | 6232 | 3.10 |
| Clallam | 4537 | 2.26 |
| Jefferson | 2796 | 1.39 |
| Mason | 1667 | 0.83 |
| Kitsap | 821 | 0.41 |

The Puget Sound Stormwater workgroup developed a strategy framework for monitoring potential stormwater impacts, including those associated with agricultural lands. Detailed recommendations are needed to complete the strategy. To address this need for agricultural lands, a sub-group was formed to analyze data and develop the recommendations for potential impacts from agricultural lands. This Agriculture Stormwater Sub-Group developed recommendations for pesticide monitoring associated with croplands last year. These were approved by the Puget Sound Stormwater Workgroup. This year, the sub-group focused on monitoring recommendations for nutrient and sediment inputs from cropland, and these findings are discussed below.

## Process to Develop Recommendations

The recommendations were developed using the following process:

1. Document existing cropland in Puget Sound and potential impacts to nutrients and sediment. This informs the level of needed monitoring for these parameters.
2. Identify existing monitoring programs that relate to nutrient and sediment monitoring from croplands in Puget Sound. Review those programs for relevancy and to define current status of monitoring these parameters.

3. Compare existing monitoring efforts to needed levels to identify data gaps towards a complete monitoring strategy for cropland sediment and nutrients.
4. Develop recommendations to fill data gaps.

Decisions were achieved via consensus of those present at the meetings. The decisions (recommendations) were sent out for review to all sub-group members. Questions from others were posed to the group and answered/addressed via email. All of the included recommendations were agreed-to by the Agriculture Stormwater Workgroup without dissent.

**Current Potential Cropland Impacts and Monitoring Programs**

To define the current status and monitoring of cropland nutrients and sediment in Puget Sound, the Agriculture Stormwater Sub-Group reviewed cropland use and current monitoring efforts for nutrient and sediment inputs.

*Cropland findings*

- Most cropland acreage is in north Puget Sound (Figure 1 and Appendix 1), which points out a regional need to focus in that area.
- Crop types in north Puget Sound include the same crop types in other areas, thereby representing cropland throughout Puget Sound.
- The timing of parameters of interest is: February through September for manure/nutrients and springtime for sediment.
- Some crop types do not fit the usual profile. These are berries, seed, and trees, which have less impact as they are not annual crops and have less soil disturbance. Also potatoes have reduced risk of nutrient input.
- Shellfish production was not included in any of our review because we are focused on terrestrial agriculture. Different participants would be needed for inclusion of shellfish and should be a future task by a different workgroup composition.

*Current Monitoring Activities and Needs*

Below is a description of current monitoring activities by county. For a detailed list of specific programs reviewed, see Appendix 2.

1) Whatcom County. Cropland monitoring has been lacking for both nutrients and sediment, but new programs are beginning to fill some of these data gaps and new NRCS funding could be used to further augment monitoring at the farm scale. Fecal coliform appears to be sampled by two programs, and total suspended solids in a new program (Natural Resource Assessment Program) that will focus on Bertrand Creek. Additional new monitoring has begun by the Department of Ecology in Bertrand Creek, which is monitoring nutrients, sediment, and other parameters.

However, even with the new sampling in Bertrand for the parameters of concern, there could be a remaining need for sediment monitoring in other areas of the county. There are numerous ditches on agricultural land that have a potential impact on transporting sediment and nutrients downstream to beneficial use areas. Also, annual crops and perennial crops that are rotated out of production and for which no cover crop has been established, can contribute sediment that

directly impacts salmon redds. The accumulation of sediment over time diminishes watercourse drainage capacity. This results in the desire/need to dredge out watercourse, eliminating fish habitat. Current monitoring does not record the magnitude of this problem. Once results from the new sampling are available, they should be analyzed and discussed as to whether or not they are sufficient to represent the remainder of the county. The new edge-of-field sampling could be used to fill some of the gaps too. Additional monitoring might be needed in the future for both nutrients and sediment, but that should be decided after the initial results from the new programs are analyzed.

2) Skagit County. The Skagit County Monitoring Program samples both nutrients and total suspended solids. Originally, they sampled monthly from 2003-2008. Now they sample quarterly. While they don't specifically target crop locations, many of the sites are in actively-farmed crop areas. It is ambient monitoring every two weeks for fecal, DO, temperature, pH, conductivity, and turbidity. Given the size of their data set and the time span over many years, the county believes it has data showing impacts from storm events. This level of monitoring fills much of the data need in this cropland-heavy county.

3) Whidbey and Camano Islands. The county has a similar program to Skagit that includes both nutrients and sediment with about 5 years worth of data. However, it probably is not linked to storm events. It was developed with Critical Area Ordinance issues in mind.

All north Puget Sound counties recognized a need to know where drainage tiles exist. These convey pollutants to surface waters quickly and need to be addressed.

**Monitoring Conclusions**

- Monitoring potential cropland sediment and nutrient impacts in north Puget Sound is the top geographic priority and likely well-represents other areas in Puget Sound.
- Current levels of monitoring covers much of the need. Notable gaps include specific linkage to stormwater events, effect of bmp implementation on marine dissolved oxygen levels, certain cropland areas of interest, impacts from drainage tiles, combining existing monitoring to NRCS's new edge-of-field monitoring, and a need to address data sharing laws that impede the flow of information.

**Recommendations to Address Monitoring Needs**

1) Current monitoring is generally good in Skagit and Whidbey Island Counties. Monitoring in Whatcom County is improving with the addition of programs by the Washington Departments of Agriculture and Ecology who are separately conducting new monitoring there. Our first recommendation is to coordinate existing sampling of sediments, nitrogen, and phosphorus with each other and with future sampling. This includes the edge-of-field monitoring funded by NRCS in Fishtrap and Bertrand Creeks and the Dept. of Ecology's and Agriculture's sampling. This would leverage the work in existing programs. Sampling should include stormwater events. An action item from this recommendation would be the development of a joint plan that melds the different monitoring programs together in a cohesive, efficient way.

2) Develop a strategy for data sharing, particularly for the NRCS edge-of-field monitoring. Currently, some data from this funding source are prohibited from sharing under the federal Farm Bill. A signed agreement will be needed to assure landowners of data use limitations, while also allowing landowner data to be used by coordinated monitoring efforts, including those by the Dept. of Ecology. The ability to combine these data with state agency programmatic data will allow important linkage between bmp implementation and pollution levels. This will allow for adaptive management and demonstration of success or failure.

3) Increased nutrients can reduce dissolved oxygen levels by triggering algae blooms that upon decomposition, lower oxygen levels. One source of nutrients is agricultural lands. As BMPs are installed to decrease these loads, monitoring should be done to show the effectiveness in nearby marine areas. Data are lacking for this topic, which is becoming elevated in importance. The Puget Sound dissolved oxygen model nutrient load summary is supporting documentation for this need, and can be found here: https://fortress.wa.gov/ecy/publications/publications/1103057.pdf

4) Sub-surface drainage structures, such as tiles, are known to quickly convey pollutants and flow to surface waters. However, their locations are mostly unknown. These need to be inventoried in many areas of Puget Sound, including Whatcom, Island, Snohomish, Jefferson (Chimacum Creek Valley) and Skagit Counties. Once inventoried, areas should be prioritized to address problem areas. This work may also need a data sharing agreement as mentioned in Recommendation 2.

5) A few areas have significant cropland with unique circumstances and are lacking in monitoring of nutrients and sediment from croplands. This is needed in the Marshland, French Creek, and Warm Beach areas of Snohomish County and Ebey's watershed on Whidbey Island. Monitoring should be bracketed to separate non-ag sources from ag sources. The Ebey Watershed has potential inputs from other land uses upland that make it a unique monitoring scenario.

**Sub-Group Involvement:** Heather Kibbey (City of Everett), Bobbi Lindemulder (Snohomish Conservation District), Karen Bishop (Whidbey Island Conservation District, phone), Bob Cusimano (ECY), Chery Sullivan (Washington Dept. of Agriculture), John Bolender (Mason Conservation District), George Boggs (Whatcom Conservation District), Rich Doenges (Thurston County), Monte Marti (Snohomish Conservation District), Rick Haley (Skagit County), Kelly McLain (Washington Dept. of Agriculture), and Carol Smith (WA Conservation Commission) participated in one or both of the two meetings when these were developed. In addition, Meghan Adamire (Clallam Conservation District), Adam Lorio (Samish Indian Nation), Dino Marshalonis (EPA), Jay Gordon (WA Dairy Fed), Joe Holtrop (Clallam Conservation District), Carolyn Kelly (Skagit Conservation District), Western WA Agriculture, Clare Flanagan (NRCS), Sherre Copeland (NRCS), Bill Bowe (Snohomish Conservation District), Seth Book (Mason Conservation District), and Michael See (Skagit County) were provided with opportunities to participate in email reviews and discussions and a few of these provided comment.

# Agriculture Stormwater Sub-Committee

# Pesticide Monitoring Recommendations

The Agricultural Stormwater Sub-Committee discussed the changes suggested by the Puget Sound Stormwater Workgroup and have revised the pesticide monitoring recommendations accordingly. The changes are discussed below by topic. The bold text is the change desired by the Puget Sound Stormwater group. The regular text following the bold type is the revision by the Agricultural Stormwater Sub-Committee.

1) **Provide additional information on program for contextual understanding.** The following citation and web link provides detailed background information on the pesticide monitoring program: Sargent, D. et al. 2010. Surface water monitoring program for pesticides in salmonid-bearing streams 2006-2008 triennial report. WA State Dept. Ecology and WA State Dept. of Agriculture. Pub. # 10-03-008. 305 pp. http://agr.wa.gov/FP/Pubs/docs/302-SWM2006-2008Report.pdf

2) **Articulate the monitoring questions & consider rotating panel sampling.**

Revised Recommendation 1: Broad scale monitoring such as status and trends is not the most cost-effective method to monitor pesticides in Puget Sound water bodies. We recommend a more targeted approach that combines source ID and program or watershed scale effectiveness monitoring. The Dept of Agriculture and Ecology's current program provides a valuable foundation for pesticide monitoring in the state and uses source ID and effectiveness monitoring. We recommend continued reliance and funding for this program to serve as the baseline for stormwater agricultural pesticide monitoring. This program answers the following questions: Are pesticide levels in salmon-bearing surface waters within acceptable levels throughout the pesticide usage period in the Puget Sound region? Which chemicals are above acceptable levels? For any high level of detected pesticide, which crops are the likely contributors?

Revised Recommendation 2: The current pesticide monitoring program samples agricultural lands on a weekly basis from March through mid-September, but does not specifically sample peak flow events. We recommend seeking funding to augment the current Ag/ECY pesticide monitoring program to use existing data to develop a model to estimate impacts due to peak flow events, then increase surface water sampling to test the model. This could start as a pilot program in the Skagit Basin because that is where the baseline data exists. The monitoring questions addressed are: Are the pesticide levels in salmon-bearing surface waters within acceptable levels during peak flow events? If not, which chemicals and crop type are associated with higher levels?

Revised Recommendation 3: The current pesticide monitoring program samples water bodies susceptible to agricultural runoff in Skagit County. However, these water bodies may not be representative of areas where cropping patterns are significantly different. We recommend seeking funding to conduct pesticide monitoring throughout other areas of the Puget Sound region using a rotating panel of randomly-selected sites that are associated with different cropping patterns. The monitoring question that would be answered is: Are monitored pesticide levels in salmon-bearing surface waters associated with cropland throughout the Puget Sound region similar to those in extensively-monitored Skagit County? Based upon existing

information, the rotation period per site will need to be a minimum of three years and may need to be longer to account for annual variability. There may also be practical limitations with laboratory capacity.

3**) Reflect on Overlap Between Agricultural, Residential, and Commercial Pesticide Uses.** The Agricultural Stormwater Sub-Committee considered the issue of pesticide impacts from other land uses and appreciates the need to include these. It will be important to highlight this data need as the strategy is developed. However, the sub-committee will not be able to address other land use issues within its existing priorities and work plan.

**SUBJECT:** **Recommendations for Monitoring Potential Animal Impacts to Stormwater from Agricultural Lands**

**ISSUE:** Agricultural production of animal products can have water quality impacts that are delivered via stormwater or direct deposit to streams. These include impairments in: sediment, pH, dissolved oxygen, nutrients, fecal coliform, and certain metals, impairing beneficial uses for salmon and other fish species, humans, and aquatic ecosystems as a whole. This strategy seeks to identify then address potential sources from all livestock operations including those that exist for profit and those that are hobby-related with a focus on rural/agricultural areas.

In terms of regulatory oversight, there are two basic categories of livestock farms: those that have specific requirements under either the state dairy nutrient management program, the Concentrated Animal Feeding Operations ("CAFO") National Pollutant Discharge Elimination System ("NPDES") permit system, or County Critical Areas Ordinances; and those that do not. Dairies and permitted facilities operate under a system that collects information about the potential impacts and addresses those impacts with Best Management Practices (BMPs). Follow-up monitoring includes implementation monitoring, soil tests, and occasional water quality investigations. While all licensed dairies are covered by the state dairy program, there are currently a small number of CAFOs that are covered by the permit. Most livestock operations are not part of either system, resulting in a lack of information about where and how much total potential impact exists within a watershed or sub-watershed.

Also, once potential pollutant loadings are identified, areas need to be prioritized and a successful program, based on good stewardship, needs to be applied to address the problems. Lastly, follow-up monitoring is needed to assure that water quality has improved to the level expected.

The recommendations described below provide a framework to: 1) use broad-scale monitoring to identify and prioritize potential problem areas, 2) conduct an adequate process that can successfully address the issues, 3) use source identification monitoring to define specific problem reaches, 4) address the problems with BMPs, and 5) conduct follow-up effectiveness monitoring at a sub-watershed scale to confirm that the BMPs are implemented and have adequately addressed the problem. Lastly, we recommend that source identification for livestock impacts incorporate the suggested parameters in the attached source ID guidance paper.

**BACKGROUND:**
Which types of monitoring and assessment information are needed and why?

The Agriculture Stormwater Sub-Group reviewed existing information regarding agriculturally-produced animal products in Puget Sound. They found that not only is monitoring lacking for many types of livestock operations, but there is no process or strategy in place to address problems for farms that are not under the Dairy Nutrient Management Program, or covered by a permit system. Also for all animal facilities, follow-up water quality monitoring at a broader scale is uncommon and needed to ensure that enough actions have been done to achieve standards where it counts: in the stream or ecosystem.

The current situation is that licensed dairy farms and permitted CAFOs have oversight from the Departments of Agriculture and Ecology. The current level of monitoring for these activities are: 1) best management practices (BMPs) are monitored for implementation (were they installed and are they in use); 2) soil tests for nitrogen and phosphorus when manure and fertilizer is applied on cropland; 3)

discharges are investigated; and 4) existing ambient water quality monitoring can be examined to assess water quality impacts. However, water quality measurements may have little correlation to stormwater events. The conclusion is that while there is existing implementation monitoring of the practices on dairies and the few permitted operations, such practice implementation monitoring is lacking for other livestock activities. Also, larger scale (watershed or sub-watershed) water quality monitoring is generally lacking, especially when related to stormwater.

All other livestock farms are not under an oversight system and no monitoring or record-keeping is required. This includes heifers, feedlots, non-beef, and small/hobby farms. For these types of farms, the current situation is: 1) inventories of animals have been done in some counties, but not across the Puget Sound region; 2) Some of these inventories included prioritization of farms based upon a potential to pollute; 3) up until now, little guidance has existed on how to conduct adequate source identification monitoring to define problem reaches and how to use this information where it exists to improve water quality.

The desired monitoring strategy for all types of livestock farms is described in the recommendations below. The strategy needs to be credible (confidence in methods, results, and conclusions), effective, as least-intrusive as possible, and alters behavior to result in good water quality. It includes collecting needed information on livestock operations, applying a strategy that is believed to be successful in addressing agriculture-related livestock problems with a heavy reliance on good stewardship and support from livestock landowners and the community, and guidance regarding what and how to monitor.

**Who was involved in the Subgroup, and how were decisions made?**
Members of the Agriculture Subgroup are or have been: Heather Kibbey (City of Everett), Mike Shelby (Western Washington Agriculture), Jay Gordon (Washington Dairy Federation), Karma Anderson and Dino Marshalonis (EPA), Bob Cusimano (ECY), Monte Marti and Bill Bowe (Snohomish Conservation District), Karen Bishop (Whidbey Island Conservation District), Sherre Copeland and Clare Flanagan (NRCS), Nora Mena, Chery Sullivan, Kelly McLain, and Jim Cowles (Washington Dept. of Agriculture), Rick Haley and Michael See (Skagit County), Joe Holtrop and Meghan Adamire (Clallam Conservation District), Carolyn Kelly (Skagit Conservation District), John Bolender (Mason Conservation District), Rosie Taylor (Jefferson Conservation District), George Boggs (Whatcom Conservation District), Heather Trim (People for Puget Sound), Richard Doenges (Thurston County), Adam Lorio (Samish Indian Nation, and Carol Smith (Washington Conservation Commission). These individuals had the opportunity to review and comment on all products, but do not necessarily endorse all the recommendations.

Products included meeting summaries from five meetings: March, May, July, August, and October 2012. The recommendations were developed primarily in the March and May meetings. They were reviewed for submission to the Puget Sound Stormwater Workgroup during the August 9 meeting with revisions finalized at the October 12th meeting. A mix of participants was present at the March, May, July, August, and October meetings when this product was under development.

Decisions were reached by consensus.

**Where are we in the SWG approval process, and when are decisions needed?**
Draft recommendations were presented at the September 19th meeting. Consensus within the ag stormwater group was not fully reached at that time. A follow up presentation of revised recommendations is scheduled for the November 14th Puget Sound Stormwater Workgroup meeting.

**How and when are recommendations envisioned to be implemented?**

The agriculture stormwater subgroup will develop an implementation and funding plan in a future set of meetings. We want to develop this plan after we have a full set of agriculture recommendations to facilitate prioritization. Also, we only want to develop this plan for approved recommendations.

**What are the funding implications?**
See above answer.

**ALTERNATIVES CONSIDERED:**

We considered the circumstances as we know them, and our recommendations are in the following sections. The consideration of alternative solutions would involve work outside the scope of this sub-committee.

**RECOMMENDATIONS AND REASONING:**

**Assure adequate support.** To achieve success, certain key items need to be in place prior to implementation.

*Recommendation 1.* Find the necessary technical, political, and financial support that is needed throughout the process. Some of the funding should be from a consistent source (not grants) for basic operations and monitoring. Supplemental funding could be used for additional monitoring and implementation. Technical support also includes a coordinator to manage funds, oversee activities, manage contracts with other entities to implement the program, and interface with the local political environment for continued support.

*Recommendation 2.* Develop an effective community support system to ease the need for extensive regulatory oversight. Along with an effective community support system examine the existing enforcement process that would occur only when local voluntary efforts are unsuccessful. Is existing enforcement well-defined, well-communicated, appropriate, and sufficient?

**Use broad-scale monitoring to prioritize problem areas at a sub-watershed level where detailed source identification monitoring and implementation will occur.** Significant data gaps exist, especially regarding the extent of potential problem areas associated with small (unpermitted/unlicensed) livestock farms or dairies. Key questions needing data are: in which sub-watersheds should we focus resources initially and to what extent do farm animals contribute to pollutant problems in Puget Sound during stormwater events? Our first recommendation is to use broad-scale monitoring and other data as triggers to identify the areas with the greatest problems. The second recommendation is to provide a clearer picture of current animal impact to stormwater conditions.

*Recommendation 3.* Use triggers, such as broad-scale monitoring, to identify sub-watersheds that have a high potential impact. Triggers include the presence of a TMDL for agricultural parameters in an area with significant agriculture; documentation of downstream problems potentially relating to agriculture such as shellfish bed closures; water quality results (i.e., status and trends monitoring, ambient water quality monitoring, and others) that indicate problems; and farm survey information (focused on agricultural/rural lands). It is also important to prioritize by being proactive rather than just reactive and consider pollutant loading sources. How contributory are the sources to potential pollution? An example would be a stream with high loads and high flows contributing to total impact. This situation would be prioritized over a stream with high loads and low flows.

*Recommendation 4.* Because farm survey results can be important identifiers of potential pollution, conduct surveys where data gaps currently exist for non-dairy, non-permitted operations. Important data to collect includes: animal numbers, types, location, proximity to water bodies, BMPs in use, and BMPs needed. This information is not easily documented.

To facilitate this action, we have a few examples of forms and prioritization methods that can be used by others in the future (Appendix 1), although most importantly, the survey should include the above-listed data fields. Surveys have been completed in Whatcom, Samish, Clallam, Stillaguamish, Snohomish, Kitsap, and King County watersheds. Survey frequency will depend on local conditions, landowner turnover, and other factors resulting from adaptive management. Ideally, this work would be dynamic with GIS updates resulting from monitoring results, field visits, and implemented plans.

*Recommendation 5.* Coordinate with existing monitoring programs to avoid duplication of effort and leverage existing resources. Examples are the Pollution Identification and Correction (PIC) work that the Department of Health is funding across Puget Sound and any implementation of Ecology's Total Maximum Daily Loads (TMDLs).

**Conduct an adequate process to successfully address the problems.** Once a high priority problem area has been identified, apply the following strategy to better define the problem and then address the problem using source ID monitoring. These recommendations will address the following questions:

- What are the relative roles and value of community involvement, voluntary compliance, and enforcement in solving farm animal pollution?
- How do we effectively monitor and then reduce and prevent the impact of farm animal waste?
- Are current monitoring efforts sufficient for permitted or licensed dairy facilities. .for unpermitted facilities?

*Recommendation 6.* For high priority areas, further define the problems, while obtaining community support:

a. Conduct community outreach to elevate the issue and obtain support. Define the community to be small enough to be effective. If community support is not present, the remaining actions are unlikely to be successful. As part of building community support, identify an early adopter to show success quickly.

b. Collect detailed survey information for all potential sources of impact in that area. This includes non-ag, small farms, permitted and dairy facilities, and other commercial operations. It is recognized that pollutants from non-agricultural activities may influence the water quality in agricultural areas, and these other sources need to be inventoried as well.

*Recommendation 7.* Conduct source identification monitoring or bracket water quality monitoring around storm events to better characterize the sources of pollutants in these high priority areas. Can use the suggested parameters developed in this process (Appendix 2).

*Recommendation 8.* Implement best management practices (BMPs) to address the identified sources of problems. Monitor the implementation and maintenance of BMPs (see example of implementation monitoring form in Appendix 3). BMPs could include vegetative practices to improve water quality.

*Recommendation 9.* Conduct effectiveness monitoring and adaptive management to mark progress and implement additional practices.

**Provide guidance for choosing source identification parameters for livestock farms.**

*Recommendation 10.* Provide and encourage source identification monitoring for livestock impacts to use the guidance in Appendix 2. This is a suggested list of parameters needed for initial source identification monitoring for livestock impacts. The choice of parameters will be driven by the site-specific needs of that area. This may require the addition of other parameters in some sites. Advance new monitoring techniques when proven to be effective.

These data are important to help answer the question:

- How can bracket monitoring better identify problem areas and subsequent changes/improvements after BMP implementation?

# Appendix 1. Examples of Forms or Processes Used for Successful Livestock Surveys and Prioritization of Potential Impacts.

## Example 1. Clallam Conservation District.

AGRICULTURAL WATER QUALITY REMEDIATION STRATEGY

**STEP 1** – INVENTORY OF FARMS COUNTYWIDE - 1,252 Farms Inventoried in 2006

Performed a windshield survey of the entire county driving down all roads. Using hardcopy maps farm parcels were outlined based on field observations and assigned a farm number. The farm number and following information were entered into an access database on a laptop brought into the field:

- Parcel site address which was linked to a spatial database for mapping and data analysis
- Number and type of livestock
- Types of crops and acreage estimates
- Notation of parcels with general agricultural activities such as poultry, apiaries, farm stands, flowers, hay, nurseries, etc.
- Farms "ranking" based on their potential to impact water quality (high, medium, low). Took into account horse/livestock access to waterways, waterways with outlets, proximity of manure piles and wintertime confinement areas to surface water, etc.

**STEP 2** – PRIORITIZE FARMS according to potential impacts to surface water quality

MEDIUM and HIGH POTENTIAL IMPACT = HIGH PRIORITY

125 High Priority Farms Countywide

**STEP 3** – PRIORITIZE FARMS by WRIA, WATERSHED and SUBWATERSHED

**STEP 4** – DESCRIBE HIGH PRIORITY FARMS according to status with District

COOPERATORS – describe status (why are they still High Priority?)

NO RECENT or PREVIOUS CONTACT

UNCOOPERATIVE

**STEP 5** – CONDUCT REGIONAL WORKSHOPS targeting HIGH PRIORITY FARMS

**STEP 6** – INITIATE OUTREACH EFFORTS to HIGH PRIORITY FARMS

1. THREE CRABS AREA
2. Remainder of DUNGENESS BAY WATERSHED
3. Remainder of CLEAN WATER DISTRICT

Multiple contacts/visits over several months may be necessary before achieving cooperation.

**STEP 7** – PROVIDE TECHNICAL and/or FINANCIAL ASSISTANCE to HIGH PRIORITY FARMS

If necessary to mitigate water quality impacts

**STEP 8** – IF COOPERATION IS UNACHIEVABLE

Next steps will be evaluated on a case-by-case basis.

**STEP 9** – ADD FARMS TO THE HIGH PRIORITY LIST AS NEEDED

Any HIGH PRIORITY FARM requesting assistance is a top priority, regardless of geographic location. If resources are insufficient to meet demand, high priority farms will be prioritized according to geographic location. Geographic priorities are listed under STEP 6. A LOW PRIORITY FARM may be considered a high priority to assist if other factors, including status in the community help achieve outreach goals in region.

**Example 2. Snohomish Conservation District.**

- What data has been collected and how collected?
    - Snohomish CD has collected a lot of "visual" livestock inventory data over the years. The latest were two priority watersheds within the Stillaguamish Clean Water District. Data collected was done via windshield surveys, on county roads. The staff did not go down private drives or roads.
    - SCD also did follow-up on completed farm plans over a period of 10 years to determine the efficacy of implementation. This was done via phone calls and surveys as a way to reconnect with landowners. We found this a very useful tool to identify BMPs that had been developed after a grant or contract ended, and determine why they moved forward with implementation and were they maintaining the BMP. It also provided a way to assess why people weren't implementing BMPs.
    - SCD has also collected some livestock survey data via GPS technology.
    - Other data collected was manually written down on each site according to numbers/type of livestock, BMPs implemented, BMPs lacking, type of wetland/waterway or critical area, access by livestock to water, notes for discussion to help prioritize site based on water quality.
- How is the data analyzed or summarized (if it was?)
    - Data was manually put into an Access database, and any GPS coordinates were loaded. It was then downloaded to a spreadsheet where we used pivot tables to analyze the data. This allowed us to figure out percentages, and help prioritize "hot spots." It also allowed us to determine the amount of BMPs that were on the ground as well as how much was lacking.
- How was it used to prioritize workload or assist in decision making?
    - This data allowed us to determine and sort the "high risk" properties to use as a priority for funding as well as a priority for follow-up and continued effort within these watersheds. The watersheds were prioritized for survey work by the Stillaguamish Clean Water District and their proximity and/or impacts to shellfish beds and water quality based on TMDLs, local knowledge, and existing water quality data.

**Example 3. Department of Ecology.**

***Livestock and Water Quality Site Visit***

***Site Visit Information*** ☐ First Visit ☐ Follow-up Visit

Prepared by: _____ Arrival Time:_____ Depart: _____

Date:_____ Current Weather Conditions_____

***Owner/Operator***

Name: _____ Street:_____

Phone: _____ City: _____

E-mail:_____ Zip:_____

***Site Details***

County: _____ Watershed:_____

General Site description (include information on nearby water bodies and description of farm conditions):_____

_____

_____

_____

_____

_____

_____

_____

***Site Evaluation***

**1) Stream Corridor and Other Areas Near Surface Water:** ☐ Evaluated ☐ Not Evaluated

- ☐ Bare, exposed, eroding soils
- ☐ Contaminated run-off (active or potential)
- ☐ Slumping stream banks and erosion
- ☐ Overgrazing of grasses
- ☐ Absence of woody vegetation
- ☐ Manure accumulations
- ☐ Animal access to surface water
- ☐ Livestock paths and trails along riparian areas

Comments:_____

_____

_____

_____

_____

_____

**2) Confinement Areas:** ☐ Evaluated ☐ Not Evaluated

- ☐ Distance to surface water (_____ft)
- ☐ Presence of mud and manure
- ☐ Polluted runoff leaving the area
- ☐ Signs of polluted run-off leaving the area
- ☐ Signs of previous runoff into surface water
- ☐ Polluted run-off reaching surface water
- ☐ Roof runoff water flows to confinement areas
- ☐ Adjacent land slopes toward surface water

Comments:_____

_____

_____

_____

**3) Stock water:** ☐ Evaluated ☐ Not Evaluated

- ☐ Distance to surface water (_____ft)
- ☐ Overflow from tanks on to the ground
- ☐ Mud and standing water at tanks
- ☐ Animals accesses stream for stock water

Comments:_____

_____

_____

_____

**4) Upland Pasture Areas:** ☐ Evaluated ☐ Not Evaluated

- ☐ Animal access to stream corridors
- ☐ Distance to surface water (_____ft)
- ☐ Signs of overgrazing and erosion
- ☐ Manure accumulations and bare ground

Comments:_____

_____

_____

_____

_____

***5) Manure Management*:** ☐ Evaluated ☐ Not Evaluated

Current manure management plan?_____

Manure collected and stored?_____

Manure storage properly sized?_____

Manure storage covered?_____

Manure being collected often?_____

Manure stored on an impervious surface?_____

Applied during growing season?_____

Manure applied during non-growing season?_____

Vegetated buffer when manure is applied?_____

Manure disposed off site?_____

Comments:_____

_____

_____

_____

***Other Areas of Concern/General Comments***

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Corrective Actions Required

☐ Install livestock exclusion fencing to keep animals at least _____ft from surface waters (35ft minimum) The exclusion area should be comprised of native shrubs and trees suited to the soils and hydrology of the site.

☐ Install off-stream stock water watering facilities and locate them at least _____ ft from surface to prevent risk of water quality impacts (minimum of 75ft)

☐ Collect manure frequently and store it in a dry, covered area with an impervious floor or deck

☐ Apply manure during the growing season at proper rates and times (minimum of 100ft setback from surface water, or the use of a 35ft vegetative buffer)

☐ Site and design confinement and manure storage areas to prevent pollution of surface and ground water

☐ Provide heavy use protection in confinement areas and at stock tanks to prevent run-off

☐ Construct stream-crossings and emergency water locations in ways that protect the stream

☐ Other Actions _____

Photos Taken: ☐ Yes ☐ No Samples Taken: ☐ Yes ☐ No Conservation District Referral: ☐Yes ☐No

General Comments:_____

_____

_____

# Appendix 2. What parameters should be monitored to support Source ID?



## Microbiological Examination Measurements

**Fecal coliform**
**E. coli**
**% KES**
**Enterococcus**
**Chloride and Specific Conductance**

Fecal wastes carry bacteria that can cause diseases in humans and animals directly by drinking (gastrointestinal illness) or swimming (ear, nose, throat, and skin infections). Indirect contact by eating contaminated food (shellfish) and getting contaminated water on your hands can also cause illness. Since there are so many possible disease organisms, researchers have tried to find bacteria organisms that are easily tested and commonly found in fecal wastes. There are several bacteria indicators. Each has its own history, strength and weakness.

**Fecal coliform (FC)** using both the membrane filter (MF) and most probable number (MPN) methods. FC is a family of indicator bacteria for manure and fecal wastes sources, but also decaying vegetation. FC is the indicator used in Washington State Water Quality Standards to determine the primary and secondary water contact recreation use of freshwater and primary contact recreation in marine waters. The MF method is quicker and provides better precision. The MPN method is more conservative and is compatible with FDA and Washington Department of Health Shellfish Protection Program regulations for shellfish harvest areas.

**E. coli** is a more specific test for fecal sources from warm-blooded animals, and is recommended by EPA as a superior indicator organism in freshwater.

**% KES** (Klebsiella, Enterobacter, and Serratia) confirms what portion of the FC count is from vegetative sources.

**Enterococcus** is another group of fecal bacteria within the fecal streptococcus group. EPA now recommends Entercoccus for measuring marine water sanitation for secondary contact recreation. The FC/fecal streptococcus ratio was popular at one time to try and differentiate between human and animal wastes. Researchers generally found the ratio works only if samples are collected close to a fresh source of fecal material.

**Chloride and Specific Conductance measurements** are used to track potential sources of wastes. The background levels in rivers and streams in western Washington are fairly low until

estuarine environments are encountered. The measurements will not change unless sources with higher or lower levels are added to the waterway. Liquid wastes like sewage and manure have high concentrations of chloride and high specific conductance readings. When a significant source of wastes is discharged into the waterway, the increase in the chloride and specific conductance is observable downstream and becomes stronger closer to the source.

## Solids Measurements

**Total suspended solids**
**Total non-volatile suspended solids**
**Total volatile suspended solids**
**Turbidity**

Erosion of sediment into waterways is a natural process, but too much sediment in waterways can be the result of poor land management practices. Suspended solids and sediment can directly harm aquatic organisms by damaging gills of swimming organisms and suffocating organisms living on the bed of the stream, lake or estuary. Suspended solids can also interfere with feeding, behavior, and movement of aquatic organisms, and block light penetration into the water. Also, sediments and other solids transport other pollutants like bacteria, oils, pesticides, and phosphorus that bind to solids particles. Other solids in the water column besides sediment are organic materials from plants, algae, or other tissues growing in the water or materials that are mechanically broken-down by biological, chemical and physical processes in the water. An excessive amount of algae or sediment in the water column can be a problem for heat retention, light penetration, visibility for swimming and boating safety, and aesthetic enjoyment. The problem of suspended sediment and solids in the water column is one of both intensity of the concentration and the duration that intensity is maintained.

**Total suspended solids** is a measurement of the amount of material in the water column that is retained when the sample is filtered. The measurement can then be used to estimate the pounds or tons of material being transported. Depending upon the species and life-stage of the fish, concentrations as low as 10 mg/L – 20 mg/L over months of time can result in sub-lethal effects like interference with feeding behavior, hatching rates, growth rates and disease resistance. Months at 100 mg/L, and weeks or a few days of concentrations above 1000 mg/l could be lethal to a majority of a local aquatic community.

**Total non-volatile suspended solids** measures the portion of the suspended material that is not organic (by burning the sample in an oven) – mainly sediment materials. By subtracting the non-volatile portion from the total suspended portion, the organic or total volatile suspended solids fraction is found.

**Turbidity** is a measure of transparency of the water in nephelometic turbidity units (NTUs). It is regulated in the Washington State Water Quality Standards by reference to a control sample upstream of a source (not more than 5 or 10 NTUs over background). Particles that float or sink easily are not adequately measured by turbidity procedures. If the particles are suspended uniformly and suspended solid particles are not too heavy or light, turbidity can be highly correlated with total suspended solids.

## Dissolved Oxygen, pH, Nitrogen, and Phosphorus Measurements

**Dissolved Oxygen (DO)**
**pH**
**Nitrogen (ammonia, nitrate-nitrite, total N)**
**Phosphorus (total P and soluble reactive P)**

**Dissolved oxygen (DO)** is regulated primarily to ensure fish survival. Washington State Water Quality Standards are very salmon oriented. Since salmon spawn in gravels, the DO concentrations required in the water column are high to keep salmon eggs and embryos in the gravels aerated. Since DO levels in a healthy water body naturally swings to a maximum concentration during the day and a minimum at night, the one-day minimum concentration is regulated but the range between the maximum and minimum is also of interest. The one-day minimum concentration allowed is 8 mg/L for salmon migration, rearing and spawning. However, DO in some salmon areas cannot go below 9.5 mg/L. Warm water fisheries without salmon only require 6.5 mg/L DO (none of these have been designated yet). Maximum and minimum DO concentrations are affected by reaeration, temperature, biological activity, and chemical reactions. Turbulent, shallow water will increase mixing with the atmosphere and raise DO concentrations; slow and deep water will not mix as well and can have lower DO. Higher temperatures will increase oxygen movement from the water to the atmosphere and decrease DO in the water.

Algal growth, stimulated by nutrients, will increase DO concentrations in the daylight as algae produce oxygen, and decrease DO concentrations at night as algae respire. As bacteria breakdown organic materials, they use oxygen.

**pH** is a measure of the hydrogen ion activity in the water. Water bodies usually have a neutral pH near 7 units. Under acidic conditions, pH moves down the scale to 6.5 units or less. Basic conditions cause the pH to rise to 8 or 9 units. Surface waters in Washington generally fall within the 6.5 – 8.5 unit Water Quality Standards. This range is considered healthy for aquatic organisms and prevents some metals from disassociating and becoming toxic to aquatic organisms. Higher pH values also increase the unionization of ammonia – increasing its toxicity. The pH is moderated in freshwater by carbonate reactions. If CO2 is produced by bacterial decomposition of organic material, algal respiration, or interchange with the atmosphere, then pH will drop. As carbonates are formed from geochemical sources or algal productivity, then the pH will rise.

**Nitrogen** and its compounds are present in most plant and animal materials and consequently are present in decaying matter. Waters draining agricultural areas may contain high levels of the different forms of nitrogen. Ammonia in large quantities is toxic to aquatic life and levels should generally be <0.02 mg/L in non polluted freshwater. [*Note*: If stormwater discharges directly or indirectly to nutrient-impaired marine water, then nitrogen measurements will be important.]

**Phosphorus** is an essential plant nutrient and may be limiting factor for plant growth in freshwater. In comparison to other major nutritional and structural components in biota,

phosphorus is rarely found in significant concentrations in surface waters for two reasons: there is only a relatively small amount available in the hydrosphere, and what is available is actively taken up by plants. As with nitrogen, waters draining agricultural areas may contain high levels of the different forms of phosphorus and can be a major pollutant that leads to eutrophication processes. [*Note:* Phosphorus is closely associated with sediments. It can absorb to sediments in overland flow processes and especially in erosional processes.]

## Copper, Zinc, and Hardness Measurements

**Copper and zinc** are common heavy metal constituents of water and are essential for all plant and animal life. However, research has well established that higher levels of dissolved copper and zinc can be toxic to aquatic organisms including salmon. Copper sulfate is used in a wide range of application products in agriculture such as fungicides, pesticides, and herbicides. Zinc is present in fertilizers and animal feeds and mineral premixes. Copper and zinc are normally measured as both the total and dissolved fraction.

**Hardness** is a measure of dissolved minerals in water such as aluminum, calcium, iron, and magnesium, although it is mostly determined by the sum of calcium and magnesium. The toxicity of most heavy metals including copper and zinc in freshwater is a function of hardness.

## Appendix 3. An example of an Implementation Monitoring Form.

See separate email attachment for this pdf.

| | Program Name | Primary Program Objective | Allocation | Administrator |
|---|---|---|---|---|
| | ***BMP Implementation Funding*** | | | |
| **Federal Sources** | Environmental Quality Incentives Program | Best management practices on farmland | Landowner enrollment | NRCS |
| | Conservation Reserve Enhancement Program | Riparian protection and restoration on farmland | Landowner enrollment | FSA, WSCC, conservation districts |
| | NAWCA Standard Grants | Waterfowl habitat restoration | National competition | USFWS |
| | Wetland Reserve Easement Program | Wetland protection and restoration on farmland | Landowner enrollment | NRCS |
| **State Sources** | Direct Legislative Appropriation | Varies | State Agency, Local Government | Varies |
| | Centennial Grants | Nonpoint source pollution control projects | Local Government, special purpose districts, CDs, tribes | Ecology |
| | Section 319 Grants | Nonpoint source pollution control projects | Local Government, special purpose districts, tribes | Ecology |
| | Shellfish Grants | Financial incentives for implementation of BMPs associated with nutrient management and ocean acidification | Landowner enrollment | WSCC, conservation districts |
| | Non-Shellfish Grants | Financial incentives for BMP implementation | Landowner enrollment | WSCC, conservation districts |
| | Puget Sound RCPP | Technical assistance and financial incentives for targeted BMP implementation | Landowner enrollment / project lead | WSCC / NRCS |
| **Local and Private Sources** | Private Philanthropic | Farmland protection and natural resource conservation | Local competition | Counties, Conservation Districts |
| | Other Public Sector | Farmland protection and natural resource conservation | Local competition | Counties, cities, conservation districts |

# The length we go

## MEASURING ENVIRONMENTAL BENEFITS OF CONSERVATION PRACTICES

The 2002 farm bill substantially increased funding levels for conservation programs, and established the new Conservation Security Program. How can the American public and legislators know the money will be well spent? A new project—the Conservation Effects Assessment Project (CEAP)—will provide the agricultural community, the public, and others involved with environmental policy issues an accounting of the benefits obtained from these conservation program costs. Now the question: How will CEAP be implemented?

**M.J. Mausbach and A.R. Dedrick**

**Maurice J. Mausbach** is the deputy chief for the Soil Survey and Resource Assessment at the U.S. Department of Agriculture Natural Resources Conservation Service in Washington, D.C. **Allen R. Dedrick** is the deputy administrator for the Natural Resources and Sustainable Agricultural Systems in Beltsville, Maryland.

Conservation practices are designed to reduce losses of soil, nutrients, pesticides, pathogens, and other biological and chemical materials from agricultural lands, conserve natural resources, enhance the quality of the agro-ecosystem, and enhance wildlife habitat. The Farm Security and Rural Investment Act of 2002—referred to as the 2002 farm bill—substantially increased funding levels of conservation programs—up nearly 80 percent above the level set for conservation under the 1996 farm bill. While it is widely recognized that these conservation programs will protect millions of acres, the environmental benefits have not previously been quantified for reporting at the national scale. Moreover, while an extensive body of literature exists on the effects of conservation practices at the field level, there are few research studies designed to measure the larger effects.

The Natural Resources Conservation Service (NRCS) and the Agricultural Research Service (ARS) are working together on the Conservation Effects Assessment Project (CEAP) to quantify the environmental benefits of conservation practices at the national and watershed-scales as a measure for how the money being spent is meeting the goals.

CEAP is an on-going mix of data collection, model development, model application, and research. One of the goals is to develop the appropriate databases and applications over the course of the project. It is anticipated that some of the new indicators and performance measures will be included in the 2006 and 2007 annual reports, and that the 2008 annual report will include more accurate estimates for the chosen performance measures.

There are two main components of CEAP—a national assessment provides modeled estimates of conservation benefits for annual reporting, and the second component quantifies the environmental benefits from specific conservation practices at a watershed scale. The assessment provides an accounting of the environmental benefits obtained from USDA conservation program expenditures for farmers and ranchers, landowners, conservationists, the public, Congress, Office of Management and Budget, or others involved with environmental policy issues. The second component—the watershed scale approach—provides detailed, landscape-specific assessments of environmental benefits that are not possible at the national level.

## THE NATIONAL ASSESSMENT

The purpose of the national assessment is to estimate environmental benefits for conservation practices implemented in each year, allowing benefits to be tracked over time. This will also allow for direct comparisons between benefits obtained and program expenditures year-by-year. Benefits will be in terms of physical measures, such as tons of soil saved, reductions in in-stream nutri-

### THE SCOPE OF CEAP

***What conservation programs does it cover?***

- Environmental Quality Incentive Program (EQIP),
- Conservation Reserve Program (CRP),
- Conservation Security Program (CSP),
- Wetland Reserve Program (WRP), Wildlife Habitat Incentives Program (WHIP),
- NRCS Conservation Technical Assistance Program (CTAP)
- Grassland Reserve Program (GRP)

***Conservation practices to be emphasized***

- Conservation buffers
- Nutrient management
- Pest management
- Tillage management
- Irrigation-, drainage-, manure-, and grazing-management practices
- Establishment of wildlife habitat
- Wetland protection and restoration

***Resource concerns***

Environmental benefits will be estimated for each of the five resource concerns that conservation programs are designed to address:

- Water quality (nutrient, pesticide, and sediment delivery to lakes, rivers, and streams)
- Soil quality (including soil erosion and carbon storage)
- Water conservation (including flood and drought protection)
- Air quality (including particulates and odors)
- Wildlife habitat (including aquatic and terrestrial habitats)

***Agricultural land use categories***

Benefits will be estimated separately for four agricultural land use categories:

- Cropland, including cropland enrolled in CRP
- Grazing lands
- Agro-forestry lands
- Wetlands

## CEAP GOES ACROSS AGENCIES AND GROUPS

CEAP is a multi-agency effort that will also include involvement from groups outside of the Federal government. The U.S. Department of Agriculture (USDA) collaborators in addition to NRCS and ARS include: Farm Service Agency (FSA), Cooperative State Research, Education, and Extension Service (CSREES), National Agricultural Statistics Service (NASS), and Office of Risk Assessment and Cost Benefit Analysis (ORACBA).

The core group of USDA agencies will coordinate with other Federal agencies involved in natural resource issues, such as the Forest Service (FS), Economic Research Service (ERS), U.S. Environmental Protection Agency (USEPA), and U.S. Geological Survey (USGS), to seek opportunities for further collaboration.

A national panel consisting of experts not directly involved in the project—including representatives outside of government—will be established to provide guidance and recommendations on CEAP.

Forums and workshops will be held periodically to obtain comments and suggestions from academic institutions, state agencies, private organizations, and the public on the analytical approach and findings. Professional societies meetings will also provide an important forum for the exchange of information and ideas. For example, the fourth annual joint symposium of Soil Water Conservation Society (SWCS) and Soil Science Society of America (SSSA) "Assessment of Measurements of Conservation" was presented during the 2003 annual meetings of the SWCS and SSSA.

This initial meeting was so successful that the fifth annual joint symposium of the SWCS and SSSA during 2004 was expanded to "Assessment of Effectiveness of Conservation Practices in North America, Including Watershed Case Studies." SWCS, SSSA, Canadian Society of Soil Science, and the Mexican Soil Science Society will sponsor the 2004 fifth joint symposium. At this meeting we will have American, Canadian, and Mexican soil scientists that will interact and talk about how to assess conservation practices throughout North America.

ent and sediment concentrations, etc.

A literature review will be the first step of the national assessment. ARS and NRCS will organize, with the help from the Soil and Water Conservation Society, a review of research literature and prepare a summary report on what is known about the environmental effects of conservation practices at both the field and watershed scale. Initially, the ARS National Agricultural Library will prepare a set of abstracts from the published literature on environmental effects/results from USDA conservation programs from 1985 to the present for each of the five resource concerns (water quality, soil quality, water conservation, air quality, and wildlife habitat). The set will also contain abstracts about studies on implementation barriers and incentives, and research needs from 1985 to the present; and data and modeling for environmental credit trading from 1993 to the present.

The summary report will establish the state-of-the-science of benefits derived from conservation practices, and consequently, will establish the scientific underpinning for the national assessment. Also, this report will identify the gaps in scientific understanding that need to be addressed to fully be able to quantify environmental benefits. Workshops will provide the content for a synopsis of findings by resource concern. Scientists and technical experts from Federal and state agencies, universities, and consultant organizations will be invited to participate in these workshops which are currently being planned for 2005.

Initially, CEAP will focus on water quality, soil quality, and water conservation on cropland and land enrolled in CRP, reflecting the availability of research findings, national-level databases, and nonpoint source modeling capabilities. During the second year, expert teams will be formed to identify the appropriate

indicators and performance factors for estimating the environmental benefits from grazing lands and wetlands, as well as benefits to wildlife. These teams will identify the data needs and develop modeling approaches needed to estimate environmental benefits at the national level.

Modeling capabilities and databases will be enhanced for all estimates throughout, and initial estimates will be revised to reflect the improved modeling capabilities and information developed during the project.

The national assessment for cropland will be built using existing modeling capabilities. This assessment will connect the conservation practice with the estimates for reductions in nutrient, pesticide, and soil losses, improvements in water quality and water use efficiency, and enhancement of soil quality.

## The data

A sampling and modeling approach will provide the basis for estimating reductions in sediment, nutrients, and pesticides from farm fields, increased water use efficiency, and enhancement of soil quality. A simulation model will be built on the National Resources Inventory (NRI). The NRI is a scientifically based survey designed to assess conditions and trends of soil, water, and related resources of the Nation's nonfederal lands. In the past, the NRI has been conducted at five-year intervals, but is currently in transition to an annual cycle of data collection (Goebel, 1998).

(For more information see www.nrcs.usda.gov/technical/NRI/.)

While the NRI is designed to provide statistical information on the natural resources on private lands, it can also be used as an analytical framework for simulation modeling (Goebel and Kellogg, 2002). NRCS has previously made extensive use of the NRI as an analytical framework for modeling to address issues related to natural resources and agriculture.

A subset of about 30,000 NRI cropland sample points will be necessary for constructing the simulation model for the national assessment on cropland. For these sample points, a farmer survey is being implemented to obtain the additional information needed for the fate and transport process model, such as crops grown, tillage, nutrient and pesticide applications, and conservation practices implemented. A separate set of about 10,000 sample points will be selected and surveys conducted over 4 years—2003, 2004, 2005,

### OBJECTIVES FOR THE ARS BENCHMARK WATERSHEDS

There are five specific objectives for the 12 ARS Benchmark watershed assessment studies:

1. Assess water quality, water conservation, and soil quality effects and benefits of conservation practices at the watershed scale, and begin investigations into how to quantify wildlife and air quality benefits beyond the edge of the farm field. Assessments will include estimates of uncertainties associated with achieving targeted improvements, such as water quality standards. Practice costs and cost efficiencies will also be evaluated as part of the watershed assessment. Some watersheds will address all resource concerns, while others will be focused primarily on one or two resource concerns.
2. Develop a set of regional watershed assessment models that can be used to address benefits of conservation practices and other environmental issues in the major agricultural regions of the nation and for use in future watershed and national assessments.
3. Develop water quality, water conservation, and soil quality databases that can be used to evaluate effects of conservation practices, and to compile air quality and wildlife habitat data for future assessment. These databases will be used periodically to validate and enhance the models used in the watershed and national assessments and to validate and verify the regionalized models.
4. Develop indicators or performance measures for documenting water quality, soil quality, air quality, and aquatic and terrestrial habitat benefits associated with conservation practices.
5. Expand research on the effects of conservation practices at the watershed scale for different soils, climates, topography, farming practices, cropping systems, and other land uses.

## WATERSHED ASSESSMENT STUDIES

There are seven major questions that will be addressed by in the watershed assessment studies:

1. What are the measurable effects of agricultural conservation and management practices on ground and/or surface water quality and other environmental effects at the watershed scale?
2. Within the hydrologic and geomorphic setting of a watershed, how does the timing and location of a suite of conservation practices affect water quality or other environmental effects?
3. What is the appropriate time scale to expect changes in surface or ground water conditions and other environmental effects from conservation practices?
4. What are the uncertainties associated with achieving these water quality and other environmental effects from conservation practices?
5. What social and economic factors within the study watershed facilitate or impede implementation of conservation practices?
6. What are the relationships among agricultural conservation and management practices implemented in a given watershed with respect to their impact on water quality and other environmental effects? Are the effects additive? Multiplicative? Contradictory? Independent?
7. What is the optimal collection and placement of conservation management practices in a watershed to achieve water quality and other environmental goals?

and 2006. The final dataset is obtained by pooling the samples for the four years. For the 2006 annual report, model results for the first three years will be used.

NRCS is collaborating with NASS and FSA to conduct the farmer survey. In the fall, workers will interview farm operators to obtain field-specific data associated with the selected sample points. Questions are asked about physical characteristics of the field and conservation practices associated with the field, for the most recent three years. The local NRCS field office will provide information on the operator's participation in conservation programs, conservation practices associated with the field, and resource concerns.

When the data collection is completed, NRCS will release summaries of the full set of survey results at an appropriate level of aggregation for use by other researchers. Since the sample frame is based on the NRI points—which are geospatially located—NRCS will explore possibilities for summarizing the results of the survey for large watersheds and ecosystems in addition to national-level summaries.

### Modeling benefits for cropland

Estimates for each sample point will be generated using the field-level physical process model called EPIC—the erosion-productivity impact calculator. EPIC is a continuous simulation model that can be used to determine the effect of management strategies on agricultural production and soil and water resources. EPIC was initially developed to assess the effect of

soil erosion on soil productivity (Williams et al., 1984). Since then, the model has been expanded and refined to allow simulation of many processes important in agricultural management as well as fate and transport of potential pollutants such as nitrogen, phosphorous, soil erosion, salt, and pesticides. EPIC operates on a daily time step, integrating daily weather data, soil characteristics, farming operations such as planting, tillage, and nutrient applications, and a plant growth model to simulate the growth and harvest of a crop. All farming operations that take place on the field throughout the year are taken into account. On a daily basis, EPIC tracks the movement of water, the cycling of nitrogen, phosphorus, and carbon, and water induced soil erosion. The drainage area considered by EPIC is generally a homogeneous field-sized area of up to about 100 ha (250 ac). Model outputs represent pollutant and water movement to the bottom of the root zone and edge of the field. A wide variety of soil, weather, and cropping practice data input options allow simulation of most crops on virtually any soil and climate combination.

For more information on how EPIC simulates the various processes, see www.brc.tamus.edu/epic/documentation.

The final step in the calculation of conservation benefits is to multiply the per-acre estimates of reductions in soil erosion, nutrients, and pesticides from farm fields, increased water use efficiency, and enhancement of soil quality from the EPIC model by official USDA accounting records on the number of acres of practices implemented from the EQIP practice database, the NRCS Performance Results System database, or FSA's database on CRP enrollments. The calculation will be done on a regional basis to account for regional differences in per-acre estimates. The calculation will be done for each year, providing a time series of national estimates of reductions in soil erosion, nutrients, and pesticides from farm fields, increased water use efficiency, and enhancement of soil quality associated with conservation practices implemented each year.

Water quality benefits will also be assessed at the eight-digit hydrologic unit code watershed scale using a combination of models and databases called HUMUS, which stand for Hydrologic Unit Modeling for the United States (Arnold et al., 1998). HUMUS includes databases on land use and sources of nonpoint and point source pollutants that are used with the Soil and Water Assessment Tool (SWAT) model, which simulates the transport of water from the land to receiving streams and routes the flow downstream to the next watershed and ultimately to the oceans and estuaries. Outputs from the EPIC model runs will be combined with HUMUS databases and the SWAT watershed model to estimate in-stream concentrations of nutrients and sediment at the outlet of each watershed in agricultural regions. This will allow estimation of the reduction in in-stream concentrations attributable to implementation of conservation practices. Other outcome measures are also possible, such as: 1) reductions in the number of days during the year that in-stream nitrogen concentrations exceed the drinking-water-standard, and 2) reductions in the number of days during the warm summer months that in-stream nitrogen and phosphorus concentrations exceed critical thresholds related to algal blooms and eutrophication. (For more information on HUMUS, see srph.brc.tamus.edu/humus; for more information on the SWAT model, see www.brc.tamus.edu/swat/.)

To assure that the national assessment is based on the best possible models and fully captures the existing research findings on the environmental effects of conservation practices, a component of the national assessment will focus on model evaluation, and will make recommendations on enhancements that are needed.

## WATERSHED ASSESSMENT COMPONENT

The watershed assessment studies component of CEAP complements the national assessment by providing more in-depth assessment of water quality and other benefits at a finer scale of resolution than is possible for the national assessment. An extensive body of literature exists that describes plot or field-scale conservation practices aimed at protecting water quality, and in some cases, improving soil quality or enhancing water conservation (Hapeman et al., 2003; Hatfield et al., 2001; Howell, 2001; and Sharpley et al., 2003). However, research results from plot- and field-scale studies are limited in that they cannot capture the complexities and interactions of conservation practices within a watershed.

### Which watersheds

Only a few watersheds will be selected for study. No attempt will be made to aggregate estimates of benefits for the watershed studies to represent national-level estimates, since too many watersheds would be needed to properly represent the various environmental and resource-based characteristics in the country. The objective is to select watersheds where there is on-going research that includes, either, monitoring, modeling or both in agricultural areas with databases and resource concerns (Hatfield et al., 2000; 2002). Funding and assistance will be provided to adapt and augment the existing watershed models and databases for the specific purpose of evaluating environmental benefits associated with implementation of conservation practices.

There are three categories of watershed studies that will be conducted as part of the CEAP—ARS "benchmark" watersheds, "special emphasis" watersheds, and a collection of watershed case studies funded through a competitive grants program by Cooperative State Research Education and Extension Service (CSREES) and NRCS.

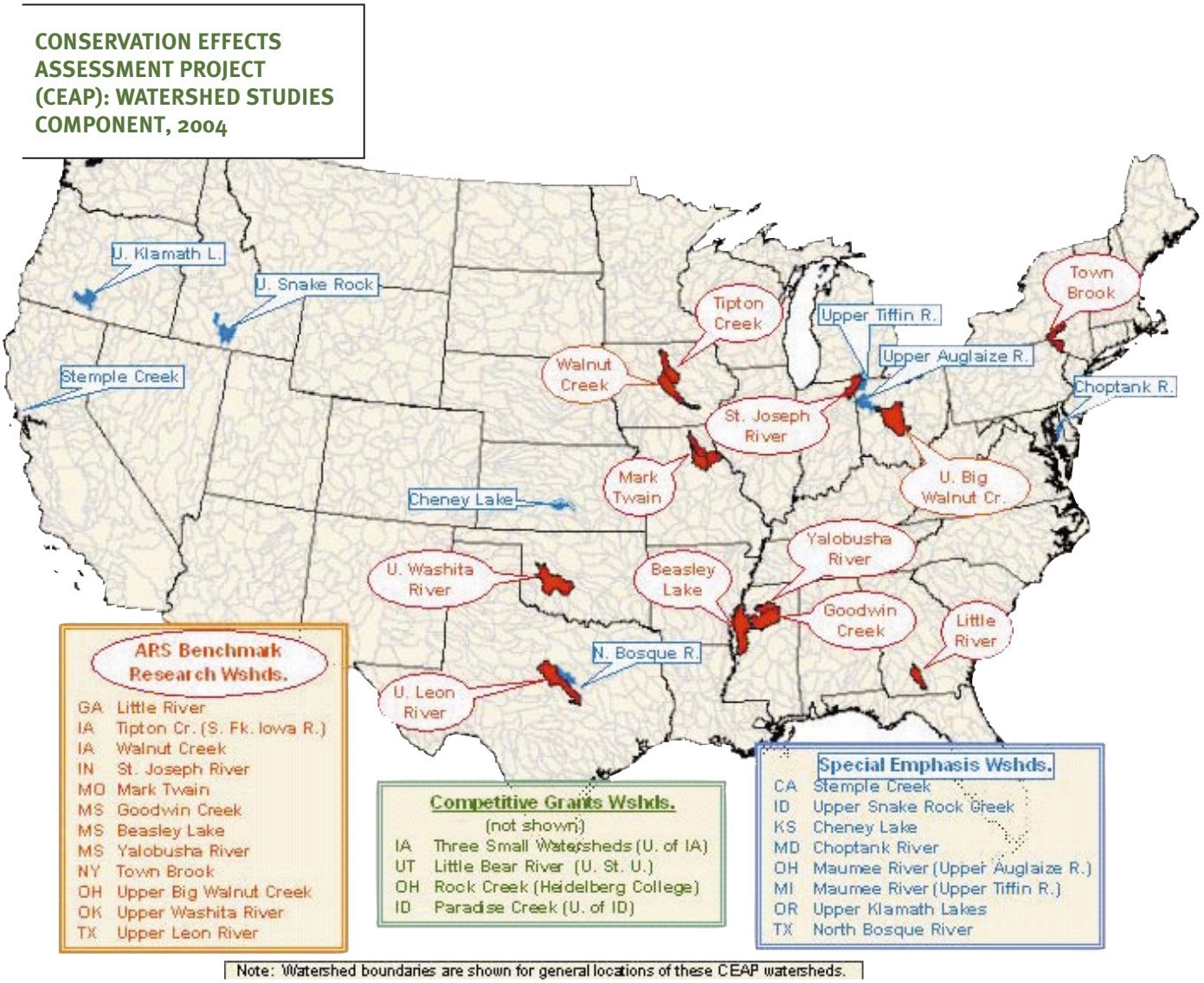
The first set of watersheds is the ARS "benchmark" watersheds where ARS has conservation effects research projects underway. These are primarily long-term research sites where it is anticipated that watershed-scale research and assessment will be continued over many years. Most of these already have water resource and soil quality research projects underway. Development of the regional watershed models will be associated primarily with the ARS research watersheds. The ARS watersheds contribution to CEAP became fully operational on January 1, 2004. (For information on the present research being conducted on the ARS watersheds, see the Water Quality and Management National Program at www.ars.usda.gov/research/programs.)

The 12 ARS benchmark watersheds are located near Ames, Iowa; Tifton, Georgia; El Reno, Oklahoma; Temple, Texas; Oxford, Mississippi; University Park, Pennsylvania; Columbia, Missouri; West Lafayette, Indiana; and Columbus, Ohio

(See map of the ARS benchmark watersheds). In addition to these ARS locations, scientists from Ft. Collins, Colorado are assisting with a portion of the modeling activities. Environmental effects will be estimated for water quality, soil quality, and water conservation. These watersheds represent primarily rainfed or non-irrigated cropland. ARS anticipates selecting additional benchmark watersheds in 2005 and 2006 that represent irrigated cropland and grazing lands. The ARS project plan for the 12-benchmark watersheds will undergo comprehensive scientific peer-review.

The ARS Benchmark watersheds will also focus on field data collection along with laboratory data management issues. ARS Benchmark watersheds will provide information needed to verify the accuracy of models used to conduct the national assessment. In the first phase of the watershed assessments, both the Soil and Water Assessment Tool (SWAT) and the Annualized Agricultural Non-Point Source (AnnAGNPS) models will be utilized to conduct comparative evaluations of environmental benefits associated with conservation practices.

One of the goals of the ARS benchmark watersheds is to develop a set of USDA Watershed Assessment Models that can address environmental quality assessments for specific regions of the nation. Although the USDA Watershed Assessment Models will be designed to primarily address the watershed scales, the set of regionalized models will also be able to evaluate conservation-planning measures at the field scale on a preliminary



assessment basis as requested by USDA agencies such as NRCS and Farm Services Agency (FSA). Currently, these technologies have not been integrated into a unified tool for application by action agencies. The integration of these technologies into a unified USDA Watershed Assessment Model will provide an opportunity to perform watershed analyses of conservation practices beyond water quality impacts.

The second set of watersheds is called "special emphasis" watersheds. These have been selected to address specific resource concerns over a 2-3 year period of time. Two specific concerns to be addressed by these watershed studies are manure management from animal feeding operations and water use on irrigated cropland. Other issues of concern that may be addressed are: drainage management practices, declining surface or groundwater supplies, flood control structures or reservoirs, wetland construction and rehabilitation, or other special land use activities that relate to the management and operation of primarily cropland (irrigated and rainfed) watersheds. Special emphasis watersheds selected for study beginning in 2004 include:

1. Choptank River in Maryland
2. Maumee River-Upper Tiffin River in Michigan
3. Maumee River-Upper Auglaize River in Ohio
4. Upper Snake Rock Creek in Idaho
5. Cheney Lake in Kansas
6. Upper Klamath Lakes in Oregon
7. North Bosque River in Texas
8. Stemple Creek in California

The third set of watersheds will be selected through the CSREES Water Quality Initiative Competitive Grants Program. This program will sponsor a collection of watershed case studies that will explicitly investigate the linkages among a variety of conservation and land management practices as implemented over space and time and the resultant effects on water quality. The ultimate goal of the program is to understand how to optimally locate and schedule the implementation of conservation practices within a watershed in order to achieve locally defined water quality goals. The request for applications responds to the need to conduct research that evaluates the interactions among conservation practices and their biophysical setting on water quality at the watershed scale. The request for applications became available in 2004, and is sponsored by CSREES and NRCS for approximately $3 million dollars. Four to six watershed projects will receive funding each year for up to three years. The four watersheds selected for study in 2004 include:

1. Paradise Creek watershed in Idaho
2. Rock Creek watershed in Ohio
3. Three small watersheds in Iowa
4. Little Bear River watershed in Utah.

## Conclusion

The 2002 farm bill substantially increased funding levels for existing conservation programs and established the Conservation Security Program (CSP). NRCS and ARS have joined together, in collaboration with other Federal agencies and universities to initiate studies that will quantify the environmental benefits of conservation practices implemented through these programs. A national assessment is being implemented to track environmental benefits over time at the national scale. In selected regions, watershed studies are being initiated to provide more in-depth assessments at a finer scale of resolution. This national effort will advance the knowledge of how watershed scale assessments should be done and provide additional research findings and insights on the expected off-site effects of conservation practices. Annual reports that document the environmental benefits of conservation practices will be published beginning in 2006. Tracking the progress of conservation programs in terms of the outcomes achieved will allow policymakers and program managers to improve the effectiveness of existing programs and design new programs to increase the conservation of our nation's natural resources.

## Endnote

This paper was presented at two symposia events held at the 2003 annual conferences of the Soil Water Conservation Society, in Spokane, Washington, July 28, 2003, and at the Soil Science Society of America in Denver, Colorado, November 3, 2003. Together these two symposia, that addressed the effectiveness of conservation practices, mark the fourth annual joint symposium organized by the two societies and presented at both societies' annual meetings.

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# Washington Discovery Farms Program Summary

*This is a brief summary of development for the Discovery Farms program for Washington State.*

## Discovery Farms

The Discovery Farms model was originated by the University of Wisconsin as a way to better understand the impact of on-farm practices on water quality through applied, field-level research, outreach, and understanding efforts. It is a producer led and results oriented program.

A Discovery Farm is an operating farm cooperatively participating in an on-farm systems research/evaluation/demonstration project. The goal of the Discovery Farm programs is to:

- Increase understanding of agricultural impacts on water quality and work toward reducing adverse impacts though a collaborative approach;
- Integrate outreach and research programs with environmental management and regulatory efforts;
- Provide research-based information on agricultural production and natural resource management to public policymakers;
- Promote the economic viability of agriculture across diverse livestock and cropping systems.

## Discovery Farm Engagement

A farm that volunteers and/or is selected to be a Discovery Farm agrees to certain set of parameters. These parameters will be outlined in a contact of work to protect both the DF and the Research Team.

A Discovery Farm (DF) will:

- Work with the DF Research Team to come up with a research plan, including practices to be installed, and QAPP for conducting needed research on farm.
- Work cooperatively with the Research Team to install and maintain agreed upon practices or management strategies.
- Allow installation of equipment necessary to accomplish research tasks. This may include surface runoff monitoring station(s), weather station, and other agreed upon equipment.
- Allow access for monitoring and equipment maintenance for the length of research contract.
- Agree to a data sharing agreement (TBD) for appropriate use of data collected on-site.
- Actively engage in data assessment and practice modification.
- Be open to educational opportunities to share information with other produces in the area.

## Discovery Farms Organization

The Discovery Farm model is organized with a central, voting Steering Committee composed of farmers and industry representatives that provides input on research needs, identifies project possibilities, selects projects for funding, and solicits/selects farms for implementation of projects. A secondary, non-voting component of the Committee provides input and guidance on topics and projects as appropriate. A producer selected to be a Discovery Farm is supported by a Local Advisory Committee chaired by the producer. Working with the producer, the Advisory Committee, which is composed of neighboring

farms, consultants, Extension, Conservation District, NRCS, and other local agencies, will implement the project, monitor progress, collect and analyze data, discuss results, and disseminate findings.

The Discovery Farms model benefits farms by giving them a trusted model and process to select, implement, and share practices and research. It also recognizes cooperators as leaders and innovators in their industry. Since it is producer led, it ensures relevancy, participation, and applicability of work conducted. A pooled funding structure, with multiple funding sources, gives flexibility to the process and allows various types of projects to be conducted as deemed relevant by the Steering Committee.

## Discovery Farms Summary Points

- Uniform structure of conducting research/demonstrations on farms across Washington State
- Can be implemented with all forms of crop and livestock based agriculture
- Farmer led process
- Steering Committee composed of voting members (i.e., producers, industry, Conservation Districts) and non-voting advisory members (i.e., University, regulatory agencies, NRCS, Dept of Ag, environmental groups, etc.)
- Research projects and Discovery Farms chosen by Steering Committee
- Local Advisory Committee (producer chair, neighboring farms, consultants, Extension, Conservation District, NRCS, and other local agencies) oversees progress, implementation, and monitoring of local projects
- Data is shared in a timely manner via a website, tours, field days, seminars, and publications
- Strong outreach and education component of program
- Funded by multiple agencies, industry, and other pooled sources

## Discovery Farms Site Establishment

Discovery Farm sites can be established as individual sites or as a watershed cluster, and as a standard site (no treatment effect, just monitor current practices) or as a special site (impose and test specific practices against a control). All options will yield beneficial results in unique ways and help improve practice implementation and management in an area.

The greater the number of Discovery Farm sites established in an area (i.e., watershed, county, District, Region), the better the overall results. All sites are set up in the EXACT same way with a uniform and consistent Quality Assurance Project Plan (QAPP), Stand Operating Procedures (SOP), field set ups and equipment, sampling protocols and handling procedures, data reporting, outreach objectives, and project administration. This is to ensure the highest quality of research being conducted, but also to increase the comparability and applicability of sample results over a larger region.

## Discovery Farms Sampling Focus

At this time, Discovery Farms are proposed as surface water sampling sites using Edge-of-Field technology, but future sampling can be added on approval of the Steering Committee for groundwater, air quality, soil quality, crop production, and more. The sky (and funding) is the limit.

## Discovery Farm Site Budget Proposal

The Discovery Farms (DF) program will be funded by pooled dollars from industry and agencies. For Washington, we are hoping to get a collaborative funding network that can help install new Discovery Farm sites, as well as support ongoing monitoring at current DF sites. It currently costs approximately $29,000 to install a DF site and $10,000 for annual maintenance, sampling, and analysis costs.

## Discovery Farms Program Partners

The Washington Discovery Farms (DF) program will engage partners both locally and statewide. This will include all interested agencies, organizations, institutions, and entities. Partners are TBD.

## Washington Discovery Farms Contact

For questions about Discovery Farms Washington, please contact:

**Nichole Embertson, Ph.D.**
Director, Washington Discovery Farms
6975 Hannegan Road, Lynden, WA  98264
O: (360) 526-2381 x 126
E: info@wadiscoveryfarms.org
W: www.wadiscoveryfarms.org