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

Comments:_____

_____

_____

_____

4) Upland Pasture Areas: ☐ Evaluated ☐ Not Evaluated

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

Comments:_____

_____

_____

_____

_____

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

Current manure management plan?_____

Manure stored on an impervious surface?_____

Manure collected and stored?_____

Applied during growing season?_____

Manure storage properly sized?_____

Manure applied during non-growing season?_____

Manure storage covered?_____

Vegetated buffer when manure is applied?_____

Manure being collected often?_____

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
Solids
Dissolved Oxygen, pH, Nitrogen, and Phosphorus Measurements
Copper, Zinc, and Hardness Measurements

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.