

# STORMWATER WORK GROUP

## REVISED WORK PLAN

*To be discussed for adoption at the Work Group meeting on January 27, 2009*

### **PURPOSE AND OBJECTIVES**

A broad, comprehensive regional monitoring and assessment strategy and plan are needed for Puget Sound. This strategy will provide a better understanding of the relative magnitudes of the sources, inputs, and impacts of pollution into fresh and marine waters from all land uses and human activities.

The purpose of the Stormwater Work Group is to develop a regional, cooperative monitoring and assessment strategy that is focused on enabling us to know whether or not our management actions are successfully reducing harm caused to Puget Sound by stormwater from developed and developing lands. The Work Group will help to develop a comprehensive program over time, in steps, starting with priority questions and data needs and building from and coordinating with other monitoring and assessment efforts. This document is intended to guide the processes to create the documents and other products that are described in the charter and bylaws of the Stormwater Work Group.

The Stormwater Work Group is charged with the following near-term objective: develop a regional stormwater monitoring and assessment program, focused on developed and developing lands, which can begin after June 2010. This deadline was established by the Department of Ecology as necessary for the strategy to be useful in developing the monitoring requirements to be included in the next round of municipal stormwater NPDES permits.

This timeline and approach also helps meet the Puget Sound Partnership's mandate to develop an ecosystem monitoring program. The program developed by the Work Group will have a coordinated implementation plan for three basic study design components:

1. Long-term status and trends monitoring to assess stormwater impacts on beneficial uses. This component of the monitoring and assessment strategy is likely to include sampling of various media (water, sediment, biota) for analysis of contamination or other impacts from stormwater at sites representing the full range of urbanization in Puget Sound.
2. Characterizing stormwater pollutant concentrations and loadings from the full spectrum of urbanization in the Puget Sound basin. This characterization effort will examine impacts from various activities, land uses, and other associated variables that contribute to contaminant loading rates. This component likely involves end-of-pipe sampling and/or flow quantification studies.
3. Effectiveness of management actions that are specifically intended to better control stormwater volumes and/or reduce pollutant loadings. This component likely involves site scale or sub-basin scale studies.

Each of the three components also will be coordinated through direct interaction with other work groups that currently exist and/or may be convened by the Puget Sound Science Panel in the near future. The program developed by the Work Group will be submitted to both Ecology and the

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Puget Sound Partnership upon its completion. Next steps for further developing the strategy should also be identified for Ecology and Partnership feedback.

This draft work plan lays out the proposed tasks that need to be completed, their timelines, and the roles and responsibilities of various parties in completing the work. This work plan is meant to be a starting point for work planning discussions of the Stormwater Work Group and will be modified based upon their input and progress toward completing the identified tasks.

## WORK TASKS

The following seven tasks (and subtasks) are proposed to be completed before June 30, 2010.

### **Task 1: Convene a broad stakeholder committee to provide direction and input for the development of the regional stormwater monitoring and assessment program**

A Launch Committee was established by the Puget Sound Monitoring Consortium to get the Stormwater Work Group started and plan an approach to developing a regional and assessment program. A broader, more representative committee is needed to engage more regional stakeholders in the process and to use their perspectives to develop the most functional regional and assessment program possible. The membership composition of the Stormwater Work Group is outlined in the draft charter and bylaws. Invitations to participate in the Stormwater Work Group will be sent no later than September 4, 2008.

The first Stormwater Work Group meeting on October 9, 2008 will orient members to the proposed goals of the Stormwater Work Group, the draft charter, bylaws and work plan, and the desired outcomes. The Stormwater Work Group will adopt a work plan that lays out tasks, timelines, deliverables, and responsible parties for developing the monitoring and assessment program. This document represents a straw dog work plan for the Stormwater Work Group to work from, since they will be asked at their first meeting to keep the process moving steadily forward. Adopting a work plan will be the first key task for the group in order for the monitoring and assessment program development to get meaningfully and productively started.

At some point the Stormwater Work Group should discuss the desire/need for a steering committee or similar subcommittee to continue. In the short-term a subcommittee could keep the work moving forward on the aggressive timelines proposed in this Work Plan. Once the development of the monitoring and assessment program is underway, the group could revisit the need for a steering committee; it might be considered preferable to establish subcommittees to address specific issues as they arise.

Deliverables: Approved charter, bylaws, and work plan

Timeline: Introduce at the first Stormwater Work Group meeting on October 9, 2008.  
Approve charter and bylaws at the second meeting on December 11, 2008.  
Approve work plan at the third meeting on January 27, 2009.

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### **Task 2: Review and refine preliminary assessment questions within each component of the monitoring and assessment program**

The Launch Committee developed a draft list of assessment questions (see Appendix 1) in August 2008 at the request of the Puget Sound Partnership's Science Panel, who later identified areas of research priorities for stormwater in its Biennial Science Work Plan (see Appendix 2). The initial draft list represented the views of the committee members as a group, but did not receive broader perspectives given the time constraints. The stormwater-related assessment questions are a subset of broader ecosystem recovery assessment questions and should also be considered in that context. This task should include a strategy for exchanging ideas with other work groups in Puget Sound.

Many of these preliminary assessment questions are redundant, or overlap; some are all-encompassing or vague and need to be broken down into more focused questions. A subcommittee can refine the assessment questions, categorizing them into elements and focusing them into smaller pieces so that questions are manageable and answerable with a particular strategy and reasonable to fund and implement.

At its first meeting on October 9, 2008 the Stormwater Work Group will review the draft list and task the Steering Committee with providing a first cut at prioritizing the questions for environmental impacts, characterization, and management effectiveness. Stormwater Work Group members will provide the Steering Committee with additional input from the parties they represent in advance of the Steering Committee meetings on November 12 and 25, 2008.

Deliverables: Master list of stormwater assessment questions, categorized by the three basic elements (see above) and reduced into manageable and fundable pieces.

Timeline: Steering Committee meetings on October 15, 2008 and November 12 and 25, 2008: complete and deliver revised list to the Work Group no later than December 4, 2008 with a recommended process and criteria by which the Stormwater Work Group should make its decision.

### **Task 3: Identify priority assessment questions for each component of the monitoring and assessment strategy**

The Steering Committee will, assisted by the facilitator, propose criteria by which the Stormwater Work Group can prioritize assessment questions and provide transparency in the decision making. Criteria for prioritization could include: scale of problem, connection to regional science issues, need for information or certainty in developing and/or implementing actions to address stormwater impacts, urgency, and others.

The Work Group will prioritize questions for at least two components of the monitoring and assessment strategy at its second meeting on December 11, 2008 (see next task); the prioritized list will be formally approved at the next Work Group meeting in January 2009. The Work Group may continue this prioritization exercise for another component at subsequent meetings.

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The Stormwater Work Group will apply those criteria to select priority assessment questions, or monitoring objectives, for 1) ambient status and trends, 2) stormwater characterization, and 3) management action effectiveness – but not necessarily in this order. The priorities might include both short-term needs that could be the basis for the strategies and designs developed first, and equally important questions or objectives that could be addressed over a longer time frame.

This task should include a strategy to exchange ideas with other work groups in Puget Sound as priorities are identified and the tasks are set forth for the next two years. It is important from the beginning to create ways to break down the “silos” that characterize current monitoring efforts.

Deliverables: Priority stormwater assessment questions that will be used as the basis for developing the components of the stormwater monitoring and assessment strategy and design.

Timeline: The Stormwater Work Group will begin the discussion of prioritizing assessment questions or monitoring objectives in October 2008. The Steering Committee will refine the questions and propose criteria for prioritization in November 2008, and the Work Group will prioritize the questions in December 2008. Groups of technical experts comprised of representatives of the caucuses of the Work Group identify prioritized monitoring objectives and present these to the Work Group in February 2009; these priorities may be further discussed at the Task 7 workshop, prior to the Work Group’s formal adoption of the priorities in March 2009.

**Task 4: Direct three Task Groups to develop monitoring and assessment strategies, one for each of the three basic components of the assessment program, based on the highest priority questions identified by the Stormwater Work Group**

Monitoring and assessment strategies will be developed for 1) ambient status and trends monitoring to assess impacts to beneficial uses, 2) stormwater characterization to calculate pollutant loadings, and 3) management action effectiveness. The strategies will include: hypotheses to be tested, data collection and methods and protocols, laboratory and other data analysis methods, timelines, numbers and locations or other descriptions of sampling sites, total and itemized budget estimates, etc.

The strategies will be developed by Task Groups. The Stormwater Work Group will identify a recommended set of members for the Task Group, including people that are not members of the Stormwater Work Group. Each Task Group will include technically knowledgeable agency staff and specific subject experts appropriate to the monitoring component being designed. Each Task Group may be led by a consultant.

The Project Manager will ensure coordination and facilitate communication among the Task Groups and other related monitoring and assessment programs. The Stormwater Work Group will identify one or more official liaisons to participate in each Task Group. Each Task Group will explicitly involve representatives of current monitoring and assessment efforts and will develop a strategy for exchanging ideas with other work groups in Puget Sound. *For example:*

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- ◇ The Stormwater Characterization Task Group will involve Ecology, municipal stormwater permittee representatives, and others to build from: the lessons learned in implementing the current Phase I permit, the EPA-funded toxics reduction strategy effort, and other stormwater monitoring.
- ◇ The Ambient Status and Trends Task Group will likely involve scientists involved in the Chinook Recovery Plan, Ecology's regional status and trends monitoring, PSAMP, PNAMP, NAWQA, and other monitoring and assessment efforts.

The monitoring and assessment strategies may offer specific ideas about implementation, especially by highlighting opportunities to work with and build on existing programs that might be able to include stormwater-related sampling in their ongoing program. To this end, each Task Group will identify existing capacity that could be available and provide a general idea of what additional funds, staffing, equipment and other resources would be necessary to guarantee full implementation of the strategy. This information will be the starting point for a future Task Group responsible for developing the monitoring implementation plan.

Deliverables: 1) Ambient status and trends monitoring and assessment strategy  
2) Stormwater characterization monitoring and assessment strategy  
3) Management action effectiveness monitoring and assessment strategy

Timeline: Begin in April 2009 and complete in November 2009.

### **Task 5: Direct a Task Group to develop a single coordinated implementation plan for the monitoring and assessment strategies developed for all three components**

The implementation plan will be developed through a Task Group comprised of key implementers of a regional study, including government agencies, universities, consultants, and others. Task Group members will need to be knowledgeable about their organizations' monitoring and assessment programs and ably represent their capacities and interests in coordinating and implementing a regional program. The Stormwater Work Group's facilitator will assist this Task Group.

The implementation plan will begin with recommendations from each of the Task Groups that developed the strategies, especially regarding existing capacity and additional resources needed. From there the group will consider what additional public and private resources might be available and how to ensure that the necessary resources are procured and deployed.

This Task Group may include specific recommendation to the Department of Ecology as to how the municipal stormwater NPDES permittees would participate in and/or contribute to implementing the monitoring and assessment program as a whole.

Deliverables: Detailed implementation plan with responsible parties, funding needs and sources, and draft MOAs, etc.

Timeline: Begin in January 2010 and complete in April 2010.

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### **Task 6: Stormwater Work Group review and approval of the monitoring and assessment strategies and the implementation plan**

Task groups will provide timely updates to the Stormwater Work Group for input during development of the strategies. The Work Group will review the proposed monitoring and assessment strategies and the implementation plan, and may suggest revisions. The Work Group will discuss substantial revisions and decide how best to move forward. After adequate review and input, the plans will be approved. The Stormwater Work Group will similarly hear updates about, and review, discuss, and approve, the implementation plan.

Deliverables: 1) Approved ambient status and trends strategy  
2) Approved stormwater characterization strategy  
3) Approved management action effectiveness strategy  
4) Approved implementation plan

Timeline: Review and discuss three monitoring strategies at November 2009\* meeting and approve at December 2009 meeting. Review and discuss implementation plan at April 2010 meeting and approve at May 2010 meeting. Complete package delivered to the Department of Ecology, the Puget Sound Partnership, and other interested parties no later than June 30, 2010.

*\* Note: the November 2009 meeting needs to be longer (all day?) to meet this timeline*

### **Task 7: Host a public forum to discuss the regional stormwater monitoring and assessment program**

The purpose and outcomes of this workshop -- this potential task -- need to be developed further.

Deliverable: Opportunity for technically engaged people to comment on initial stages of developing the regional stormwater monitoring and assessment program, including assessment questions and preliminary tasks.

Timeline: Hold workshop in March 2009. In order for a workshop to be held in March the Work Group needs to agree to its purpose and scope in January 2009.

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## TASKS, TIMELINE AND STAFFING:

<b>Task</b>	<b>Start Date and Deadline</b>	<b>Committee</b>	<b>Staffing</b>
0.0 Project Start	June 2008	Puget Sound Monitoring Consortium Governance Committee	Project Manager and Consortium Facilitator
0.1 Draft Charter, Bylaws and Work Plan	June 2008 - September 2008	Launch Committee	Project Manager
0.2 Preliminary Assessment Questions	July 2008 - August 2008	Launch Committee	Project Manager
1.0 Convene Stormwater Work Group	August 2008 - October 2008	Launch Committee	Project Manager
2.0 Refine preliminary stormwater assessment questions	October 2008 - December 2008	Steering Committee	Facilitator and Project Manager
1.1 Adopt Charter, Bylaws and Work Plan	October 2008 - January 2009	Stormwater Work Group	Facilitator and Project Manager
3.0 Identify technical experts to guide prioritization	January 2009	Stormwater Work Group	Facilitator and Project Manager
3.0 Prioritize assessment questions	February 2009	Technical experts	Project Manager and consultants?
7.0 Plan and hold public workshop (?)	February 2009 - March 2009	Stormwater Work Group	Project Manager and consultant?
4.1 Develop strategy for characterization	April 2009 - November 2009	Task Group 1	Consultant and Project Manager
4.2 Develop strategy for efficacy	April 2009 - November 2009	Task Group 2	Consultant and Project Manager
4.3 Develop strategy for status and trends	April 2009 - November 2009	Task Group 3	Consultant and Project Manager
6.0 Approve plans	November 2009 - May 2010	Stormwater Work Group	Facilitator and Project Manager
5.0 Develop coordinated implementation plan	January 2010 - April 2010	Task Group 4	Facilitator and Project Manager; three consultants?
6.0 Near-term work completed	June 2010	Stormwater Work Group	Facilitator and Project Manager

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## DETAILED SCHEDULE FOR YEAR ONE

The following meeting dates and activities are scheduled through June 2009. Task Group and Steering Committee meetings will be added to this schedule.

### July 2008

*SWG Launch Committee meeting on July 9*

- Discuss draft charter, bylaws and work plan (Task 0.1)

*SWG Launch Committee meeting on July 22*

- Identify preliminary assessment questions (Task 0.2)

*Puget Sound Monitoring Consortium Governance Committee meets July 9*

*Puget Sound Partnership Leadership Council meets July 23-24*

### August 2008

*SWG Launch Committee meeting on August 13*

- Select interim chair (Task 0.0)
- Agree to draft charter, bylaws and work plan to forward to Stormwater Work Group (Task 0.2)
- Plan first Stormwater Work Group meeting (Task 1.0)

*Science Panel meets August 6-7*

*Puget Sound Monitoring Consortium Governance Committee meets August 13*

*Partnership staff will release Assessment Questions document for review beginning August 15 and discussion at a workshop to be held on September 15*

### September 2008

*SWG Launch Committee meets September 18*

- Finalize Proposed Work Plan and agenda for first Stormwater Work Group meeting (Tasks 0.1 and 1.0)

*Leadership Council meets September 4-5*

~~*Monitoring Consortium and Science Panel “Conversation” on Assessment Questions and Regional Monitoring Framework will be held on September 15 (the Partnership postponed this workshop indefinitely)*~~

*Science Panel meets September 16-17*

*Puget Sound Monitoring Consortium Governance Committee meets September 18*

### October 2008

*Stormwater Work Group meets October 9*

- High-level discussion of founding documents: charter, bylaws, and work plan (Task 1.2)
- Agree to process and subcommittee for prioritizing assessment questions (Task 2.0)

*Steering Committee meets October 15*

- Respond to direction from Stormwater Work Group
- Identify prioritization criteria and begin further organization of preliminary assessment questions (Task 2.0)

*Science Panel meets October 7*

*Puget Sound Monitoring Consortium Governance Committee meets October 15*

### November 2008

*Steering Committee meets November 12 and 25*

- Finalize refining and organization of preliminary assessment questions and propose starting point for prioritization (Tasks 2.0, 3.1)
- Confirm process and criteria for Stormwater Work Group decision (Tasks 2.0, 3.1, 3.2, 3.3)

*Puget Sound Monitoring Consortium Governance Committee meets November 12*

*Science Panel meets November 18-19*

### December 2008

*Stormwater Work Group meets December 11*

- Adopt “living” documents: charter and bylaws (Task 1.2)
- Prioritize monitoring objectives for a regional stormwater monitoring and assessment plan (Tasks 3.1, 3.2, 3.3)

*Puget Sound Monitoring Consortium Governance Committee meets December 10*

*Science Panel meets December 16-17*

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## January 2009

*Stormwater Work Group meets January 27*

- Adopt “living” work plan; discuss future staffing needs (Task 1.2)
- Dialogue about near term and long term vision
- Launch three groups of technical experts to prioritize assessment questions in each category (Task 3)
- Plan Public workshop – purpose and desired outcomes (Task 7)

*Science Panel meets January 13-14*

*Puget Sound Monitoring Consortium Technical Advisory Committee meets January 21*

## February 2009

*Technical expert groups meet week of February 16-20*

- Agree on priority topic and assignment for each Task Group (Tasks 3.1, 3.2, 3.3)
- Determine whether consultants are needed to lead the Task Groups (Tasks 4.1, 4.2, 4.3)
- Plan first meetings of the Task Groups: draft invitation letters; set first meeting agendas; draft work plans that identify a schedule with interim and final deliverables (Task 4.1, 4.2, 4.3)

*Stormwater Work Group meets February 24*

- Technical expert groups present priority topics and monitoring objectives for each component of a regional stormwater monitoring and assessment strategy (Tasks 3.1, 3.2, 3.3)
- Discuss assignments for Task Groups and if consultant assistance will be needed to lead each of them (Task 4)
- Finalize plans for public workshop (Task 7.0)

*Steering Committee meets February 24 afternoon*

- Plan Public workshop – location, invitations/announcement, meeting agenda (Task 7)
- Draft RFP for consultants to lead Task Groups (Task 4)

*Puget Sound Georgia Basin Research Conference February 8-11*

*Science Panel meets February 26*

## March 2009

*Public Workshop (?) March 12*

- Update the technical community and gather input for Work Group and Task Groups developing the regional stormwater monitoring and assessment program (Task 7.0)

*Stormwater Work Group meets March 24*

- Discuss input from public workshop (Task 7.0)
- Formally adopt near-term monitoring objectives for each component of a regional stormwater monitoring and assessment strategy (Tasks 3.1, 3.2, 3.3)

*Science Panel meets March 10-11*

## April 2009

*Task Groups begin meeting to develop the monitoring and assessment strategy (Task 4)*

*Stormwater Work Group meets April 28*

- Briefings on other regional status pollutant loadings efforts (Task 3.2)
- Updates from Task Groups (Task 4)

*Science Panel meets April 29*

## May 2009

*Stormwater Work Group meets May 26*

- Briefings on other regional efficacy monitoring efforts (Task 3.3)
- Updates from Task Groups (Task 4)

*Science Panel meets May 7-8*

## June 2009

*Stormwater Work Group meets June 23*

- Briefings on other regional status and trends monitoring efforts (Task 3.1)
- Updates from Task Groups (Task 4)

*Science Panel meets June 24*

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## Appendix 1 – Revised Preliminary Assessment Questions

### INTRODUCTION

This set of preliminary assessment questions for stormwater originated from a two-step brainstorming activity by the “Stormwater Work Group Launch Committee” of the Puget Sound Monitoring Consortium at the request of the Puget Sound Science Panel. The original list of questions provided a quick snapshot from a limited group of people that is intended to inform future discussions of priorities for stormwater monitoring and assessment activities. Following the first Work Group meeting, the Steering Committee refined and reorganized the questions to facilitate meaningful discussion and ranking of priorities. Identification of data needs and appropriate study designs will be done in future steps.

The prioritization and refinement of these questions will be critical in the development of focused, management-driven actions at the federal, tribal, state and local levels. The Stormwater Work Group should discuss more specifically:

- Which of these questions are priorities?
- What are the testable hypotheses for the priority questions?
- Which questions should a Task Group “flesh out” first?
- What level of certainty is needed now and in the future for adapting policies and actions?

### DEFINITIONS

*Ambient:* means in the receiving water, sediments, biota or other media

*Characterization:* means quantifying pollutant loads, concentrations, and mitigating factors

*Effectiveness:* includes evaluation of a variety of types of management activities at multiple scales and in multiple combinations, e.g. at the project, watershed, and basin scales and for cumulative projects and/or approaches at each of those scales.

*Pathway:* a mechanism by which pollutants move through the ecosystem. For this discussion, we consider stormwater to be a pathway for pollutants rather than a source.

*Pollutants/stressors:* toxics, nutrients, pathogens, temperature, sediment, and flow volume.

*Source control:* various means of preventing pollutants from entering stormwater and other pathways, including structural and operational practices, product substitutions, and behavior changes.

*Status and Trends:* means assessing the temporal and spatial distribution of both (1) the effects of pollutants in stormwater on biota and other beneficial uses and (2) the characteristics of stormwater runoff, including quantification of pollutant loads.

*Stormwater:* runoff from developed and developing lands during and after precipitation.

*Toxic chemicals:* include metals [Cu, Cd, Hg, Pb, Zn, others]; PAHs; oil; pesticides; phthalates; flame retardants; legacy chemicals; and other chemicals and categories of concern such as personal care products, pharmaceuticals, and emerging contaminants.

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## ASSESSMENT QUESTIONS TO PRIORITIZE

### STATUS AND TRENDS – IMPACTS OF STORMWATER ON BENEFICIAL USES

What are the *effects* of flows and pollutants in stormwater on receiving waters and beneficial uses?

- What are the effects/potential impacts of pollutants/stressors from stormwater on the habitat and quality of our marine, lake, stream, ground, and other receiving waters? On biota? On human health?
  - What are the best indicators that stormwater has impacted water or sediment quality, habitat or biota?
  - Which pollutants/stressors most influence biota or human health? Where or under what conditions?
    - What are the concentrations of *nutrients and pathogens* in waters that receive stormwater and where do nutrients and pathogens have the greatest impact on human health and biota?
    - What are the concentrations of *toxic chemicals* in waters and sediments that receive stormwater and where do toxic chemicals have the greatest impact on human health and biota?
      - What is the relative severity of the impact of specific toxic chemicals, or categories of toxic chemicals, in stormwater?
      - What are the chronic and acute effects of toxic chemicals in stormwater? What are the processes/mechanisms by which toxic chemicals harm biota?
    - What are the effects of altered *flow* rates and volumes from stormwater? How do these changes impact the habitat and biota?
- Where does stormwater significantly impact receiving waters, resources, species, or beneficial uses in the Puget Sound basin?
  - Where does stormwater *currently* have a known, defined impact on water quality, habitat, or biota, and where may stormwater soon *become* a problem?
    - What are the potential impacts of climate change on stormwater?
    - Where do altered *flow* rates and volumes from stormwater have the greatest impact?
      - What differences in magnitude and timing of peak and low flow in a particular basin (WRIA) are due to stormwater?
  - What size, location, or other variable makes a particular stormwater discharge more or less likely to cause harm?
  - How does stormwater from one part of the Puget Sound basin affect other parts?
    - What is the relationship between stormwater discharges and habitat and water quality conditions in the nearshore environment?
    - What is the relationship between stormwater discharges and water quality conditions in deepwater Puget Sound?

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## STATUS AND TRENDS – STORMWATER CHARACTERIZATION AND POLLUTANT LOADINGS

What are the *relative contributions* of stormwater to harm compared with other pathways in the Puget Sound basin? How do these relative contributions vary geographically and how are they changing over time? Where did the pollutants in each part of the Puget Sound basin come from?

*[Note: Although these questions are beyond the scope of the Stormwater Work Group, we propose to contribute to the overall answers by answering the highest priority questions about stormwater.]*

- What are the concentrations of toxics, nutrients and pathogens entering Puget Sound and the food chain from stormwater?
  - What are pollutant concentrations and loads from stormwater? What factors affect fate and transport of stormwater pollutants? How do concentrations and loads vary based on geography, geology, climate, land use, season, and other conditions? Where are the greatest loads? Where do we need to be focusing our efforts?
    - What proportions of the pollutants (nutrients, pathogens, toxic chemicals) in stormwater reach surface waters via: air deposition, specific land uses (commercial, residential, industrial, transportation), groundwater, spills, permitted point sources?
    - What is the variability in stormwater pollutant loads by land use or geographic area? What other variables influence the spatial and temporal distribution of pollutant loads?
    - How does land use influence pollutant concentrations and loadings? What pollutants are coming from each land use type and what are the primary and secondary sources of those pollutants? What land uses or land use combinations are of greatest interest?
    - What factors within a land use control pollutant concentrations and loadings?
      - ◇ How do differences in stormwater infrastructure (*i.e.*, pipes versus ditches) affect pollutant loads and flows from similar land uses?
    - How do air transport and deposition affect stormwater pollutant loads?
    - What proportion of pollutant loads from stormwater reach Puget Sound? Where significant differences exist (*i.e.*, pollutant loads do not “add up” likely due to losses between upper reaches and mouths of rivers/streams) what are the explanations for the differences?
    - What is the seasonal and annual variation in toxics concentrations and loadings throughout the Puget Sound basin?

## EFFICACY OF STORMWATER MANAGEMENT

Are our stormwater management actions preventing and reducing future harm in Puget Sound?

- How effective are the current suite of BMPs in preventing and reducing future harm?
  - What techniques are most effective at the site or local scale, and under what conditions?
    - Among the most widely used practices and promising new practices that are available, what specific individual BMPs are most effective in reducing pollutant loads at new development sites?
      - ◇ How effective are structural treatment BMPs in reducing pollutant loads?
      - ◇ How effective are source control practices in reducing pollutant loads?

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- ◊ How effective are infiltration practices in reducing pollutant loads?
- To what extent are Low Impact Development (LID) and other flow management approaches effective in preventing and reducing future harm?
  - What is the ability of watershed-scale application of low impact development in an area of new development to effectively maintain the hydrologic regime in a stream?
  - Is there a significant difference in stream flows in basins where LID is encouraged and practiced?
  - How do LID practices affect critical areas and wetlands?
- What specific techniques or combinations of techniques are most effective at the collective or regional scale and under what conditions?
  - What is the effectiveness of watershed-scale combinations of stormwater management actions (techniques) at reducing harm?
    - ◊ Under what conditions are findings likely to be transferable to other watersheds?
  - How effective are cumulative BMPs, or targeted suites of BMPs, in reducing pollutant loads at a watershed scale? At the Puget Sound basin scale?
  - What changes in land use practices are most effective in reducing pollutant loads?
  - What are the most effective land use planning tools to protect existing high-functioning habitat from harm caused by stormwater?
- Are there unintended effects of BMPs?
  - Are there places where stormwater management practices are causing harm?
  - To what extent are BMPs for flow control reducing particulate pollution and exacerbating temperature problems?
  - Can stormwater be infiltrated into the ground without creating a soil or shallow groundwater pollution problem?

### How can we most effectively target and prioritize retrofit projects throughout the Puget Sound basin to reverse past harm?

- To what extent can retrofits reverse past harm? To what extent can the beneficial uses of water bodies be restored in sub-basins that already have some degree of development? At what degree of development, or under what other specific conditions, is a particular retrofit strategy most likely to be successful?
  - Among the most widely used practices and promising new practices that are available, what specific retrofits or restoration practices are most effective in reducing pollutant loads and recovering damaged habitat?
    - What are the benefits of restoring hydrologic equilibrium to an urban stream that is not returned to its historic condition?
    - To what extent can retrofits reduce loading of toxic chemicals to surface waters and sediments in an urban watershed?
    - To what extent can retrofits reduce loading of nutrients and pathogens to surface waters in a suburban or rural watershed?

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- How effective are source control practices in reducing pollutant loads from existing development?
  - How effective are site-specific or targeted land use practices?
  - How effective are public education and outreach in achieving behavior changes that result in reduced pollutant loads?
  - How much will new practices, products, or product substitutions used on the landscape reduce pollutant loads? Are they better or worse than existing practices/products for pollutants of concern?
- To reduce pollutant loads, is it most effective to target new development, retrofit existing development, or a combination of both?

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## Appendix 2 – Puget Sound Science Panel Strategic Priorities for Stormwater

*From p. 13 of the 9/15/08 Draft of the Biennial Science Work Plan  
(One of four topics of priority interest, subject to the Panel's revision)*

Watershed-scale study of changes in land use patterns or stormwater management strategies on pollutant loads in stormwater and biological effects

Seeking projects that address the four Partnership strategic priorities in watersheds of approximately 100 square miles in size:

1. Focus on most important/urgent problems

Measure/define the effects of stormwater on receiving waters, habitat, biota or human health in a watershed: what size, location, or other variable makes a particular stormwater discharge more or less likely to cause harm?

2. Protect intact ecosystems

Does watershed-scale application of LID maintain the hydrologic regime in a stream?

3. Restore ecosystem processes

To what extent can retrofits reverse past harm? Measure benefits of retrofitting a basin to:

- (a) restore hydrologic equilibrium to an urban stream, but not return to its historic condition
- (b) reduce toxics in an urban watershed
- (c) reduce nutrients/pathogens in a suburban or rural watershed

4. Reduce pollution at the source

Evaluate the effectiveness of watershed-scale combinations of stormwater management actions/techniques at reducing harm in Puget Sound and identify under what conditions these findings are likely to be transferable to other watersheds.