

Structural Stormwater Controls (SSC) Science Review and Synthesis Project

BACKGROUND

The goal of this project is to develop an objective science-based approach and white paper that will be used by municipal stormwater permittees in selecting future projects and as a basis for stakeholder policy discussions to inform 2024 NPDES municipal permit requirements for structural stormwater controls (SSC). This project has three distinct elements:

1. **Benefit Questions:** develop answers to a series of questions (Table 1) related to the intended stormwater-related environmental benefits and impacts of the SSC Qualifying Project Types that Phase I permittees are required to include in their stormwater management programs to meet the SSC requirement (see Phase I permit S5.C.7 and Appendix 12), and that Phase II permittees may choose to include in their Stormwater Management Action Plans (see Phase II permit S5.C.1.d).
2. **Application Questions:** develop answers to a series of questions (Table 1) related to permittees' selection of SSC Qualifying Project Types.
 - a. Discuss considerations for measuring and weighing the benefits of these projects to support their appropriate implementation in various land use settings and receiving water conditions.
 - b. Explore various ways that permittees have prioritized these projects to meet permit requirements and reduce stormwater impacts.
3. **Policy Discussions:** draft a plan and schedule for a charter workshop for stakeholder discussions of the questions about Ecology's SSC point system and future permit requirements.

Table 1. Research Questions

BENEFIT QUESTIONS
1. What is the most useful definition of the stormwater-related environmental benefits or impacts of each eligible SSC project/activity type? <ul style="list-style-type: none"> ○ How does each SSC project/activity type address stormwater impacts not otherwise adequately controlled by other areas of the permit, including disturbances to watershed hydrology and discharges of pollutants in areas of existing development (including roadways) and prevention of future impacts in areas of new development?
2. What is the best metric for measuring/reporting the stormwater-related environmental benefits of each eligible SSC project/activity type? <ul style="list-style-type: none"> ○ How do land use, receiving water types, and conditions factor into quantifying the stormwater-related environmental benefit? ○ What are the limitations of metric across the gradient of urbanization and receiving water conditions? ○ Is there a single metric that would make it possible to compare stormwater-related environmental benefits across categories of project types? ○ What other approaches might there be to compare benefits of various project types?
APPLICATION QUESTIONS
1. Are there eligible SSC project/activity types that are better suited for high quality receiving waters that need to be protected versus for impaired receiving waters in need of restoration? <ul style="list-style-type: none"> ○ Within an SSC project/activity type, are there more and less effective BMPs or combinations of BMPs for various land uses and receiving waters?
2. What is the threshold below which implementation of a given SSC project/activity type might not make a difference? <ul style="list-style-type: none"> ○ How much/many are needed to achieve benefit, and/or at what scale? Is modeling necessary to quantify the benefits? ○ How can the metric be scaled for retrofit projects that, due to project constraints, are not able to fully achieve the defined stormwater-related environmental benefit?
3. What are other limitations/considerations for the most beneficial application of specific SSC project/activity for various locations, land cover, land use, and receiving waters?

Note: "stormwater-related environmental benefit" is intended to focus on water quality and hydrology improvements.

Task 1.0 Project Administration and Management

Objective: Provide project administration and management which is expected to include tracking and reporting project costs, managing and adjusting the project schedule as needed, preparing quarterly progress reports and invoices, and general project communications and coordination.

Task 2. Document Requirements, Goals, and Vision

Objective: Interpret and document the current permit requirements that are relevant to this project, understand the legal and technical basis for the current permit requirements, define the goals for the project, and establish a common vision for the results.

2.0 SubTasks

2.1 Kick-Off Meeting/TAC Meeting #1

- Coordinate, facilitate, and attend a project kick-off meeting with the Project Manager, Ecology, and the TAC. Preparation and follow up work include developing and distributing a meeting agenda and meeting minutes to the TAC. The purpose of the meeting is to confirm the project plan and logistics. This is expected to include:
 - Discuss project goals and vision for successful results
 - Review roles and responsibilities
 - Define the project communication protocol
 - Establish deliverable review process, TAC coordination plan, and process for addressing comments
 - Confirm project schedule and schedule review/deliverable deadlines and meetings
 - Identify Ecology and TAC recommended sources of information including which sources should be used for benefit questions vs application questions
 - Identify Ecology and Permittee staff to interview for subtask 2.3; Permittee staff to contact for subtask 3.1
 - Discuss TAC and Ecology comments on Task 2

2.2 Summary of Relevant Requirements

- Collect and review documents that define relevant requirements as identified in the RFP: previous and current Phase I permit language Special Condition S5.C.7 and Appendix 12; the permit Fact Sheets and Responses to Comments; relevant past PCHB decisions; and the 2018 informal draft permit SSC Guidance Document.
- Prepare a summary that identifies explanation, reasoning, and other information relevant to answering research questions. The summary will be included in the Task 2 Technical Memorandum.

2.3 Ecology and Permittee Interviews

- Schedule and interview Ecology and Permittees. Materials to be developed for interviews include interview questions which will be submitted to the TAC and Ecology for review and approval at TAC Meeting #1. Follow up work includes developing a typed transcript of responses to questions. The purpose of these interviews is as follows:
 - Ecology - Interview key staff from Ecology to identify their goals for this project and vision for successful results and to gather further explanation and reasoning behind relevant permit language and their responses to the Research Questions for each eligible SSC project/activity types.

- Phase I Permittees - Interview Phase 1 permittees to identify their goals for this project and vision for successful results, their responses to the Research Questions for each eligible SSC project/activity type, and recommendations for potential sources of information to answer research questions. Questions related to SSC project/activity types (subtask 3.1), metric types (subtask 3.5), and jurisdictional conditions (task 3.6) will also be asked.
- Phase II Permittees – Interview 5 or 6 Phase II permittees to identify their goals for this project and vision for successful results, their responses to the Research Questions for each eligible SSC project/activity type, and recommendations for potential sources of information to answer research questions. Questions related to SSC project/activity types (subtask 3.1), metric types (subtask 3.5), and jurisdictional conditions (task 3.6) will also be asked.

2.4 Confirm Research Questions

- The recipient will review and compare notes from the kick-off meeting and interviews to the Table 1 Research Questions from the RFP. If there is a discrepancy between the responses and the research questions, the recipient will develop recommendations for revising relevant question(s). Then a meeting will be scheduled with Ecology and the TAC to discuss. Confirmed research questions which will be included in the Task 2 Technical Memorandum.

2.5 Draft and Final Task 2 Technical Memorandum

- Prepare a draft technical memorandum that includes the contents defined in Table 6, this will become Chapter 2 of the White Paper. This will include synthesizing interview responses to develop the technical memorandum content and developing a table that identifies recommended sources of information (from kick-off meeting, recipient, and interviews) including which sources are recommended for benefit vs application questions.
- Following TAC Meeting #2, prepare the Final Task 2 Technical Memorandum by incorporating comments from the TAC and Ecology into the draft document.

2.6 TAC Meeting #2

- Coordinate, facilitate, and attend a meeting with the TAC and Ecology to discuss project progress, collect comments on the Draft Task 2 Technical Memorandum, and collect feedback Task 3 items. Preparation and follow up work include developing and distributing a meeting agenda and meeting minutes to Ecology and the TAC and developing a table of responses to comments on the Draft Task 2 Technical Memorandum.

Task 3. Benefit Questions

Objective: Collect and evaluate available data/information for the purpose of developing responses to the Benefit Questions (BQ). This will include (1) development of matrices that summarize stormwater related benefits of each SSC project type and (2) preparing Task 3 Technical Memorandum which will become Chapter 3 of the White Paper.

3.0 Subtasks

3.1 Identify Eligible SSC Project/Activity Types that are Priority for Investigation

- Collect and review Phase I annual reports and relevant stormwater design standards/development codes; contact Phase I and II permittees (subtask 2.3) to determine SSC project/activity types they have used or plan to use. Create a table (initial matrices) with the list of identified SSCs.

- For each SSC develop a permit related definition that includes the characteristics of eligible SSCs based on the available data from Task 2. The definition and characteristics will be confirmed with Ecology and the TAC and included in the Task 3 Technical Memorandum.
- Confirm that all identified SSCs in the list are eligible.
- The recipient will review the matrices of eligible SSCs, and Performance Indicators identified in subtask 3.2 for the purpose of identifying SSCs that are the highest priority for investigation. Initial priority will be based on the recipient's area of expertise/understanding of the project types and available Task 3 budget. Then the recipient team will seek TAC feedback during TAC Meeting #2 and confirm which SSCs will be included in this project. This will include adding any important projects/activity types that are missing and removing SSC types that are rarely implemented.
- Update the matrices to only include SSCs selected for investigation. A complete list of SSCs identified during this task and the process/reasoning for reducing the list will be summarized in the Task 3 Technical Memorandum.

3.2 Define SSC Benefits/Impacts Related to Performance Indicators (PIs) - Performance Indicators (PI) are variables that can be used to measure the stormwater-related environmental benefits/impacts provided by SSCs. The categories of PIs are defined below which will be submitted to the TAC for review and confirmation prior to during TAC Meeting 2 and starting the literature search. The PIs will provide a guide for the literature collection and review.

Performance Indicator Categories

- Design and Hydraulic/Hydrologic PI: Related to characteristics of the structure types and hydraulic/hydrologic benefits/impacts such as sedimentation, flow attenuation, water treatment, sediment/nutrient export, etc.
- Water Quality PI: For regional pollutants of concern (POC), which include those regulated by the Phase I and II permits (e.g., TSS, dissolved Cu and Zn, Total Phosphorus, TPH, etc.) and TMDLs for pollutants from municipal sources (e.g., Bacteria, Dissolved Oxygen, Contaminated Sediment, pH, Temperature, etc.)
- BMP Maintenance PI: Maintenance standards by SSC type, including maintenance activity type, frequency of maintenance, approximate cost, etc.

- Collect and review data/information (from subtask 2.5 Potential Sources of Data/Information) for the purpose of developing a definition for each SSC identified as a priority for investigation and define PIs as they relate to each SSC. Definitions are expected to include:
 - Physical characteristics
 - Description of SSC stormwater-related function
 - Benefits/impacts related to each PI including mechanisms for providing benefits, reported effectiveness, and limitations of performance
 - Other non-stormwater environmental benefits
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- For BMPs in the Ecology SWMMWW, the manual definitions will be used for consistency but variations in approaches will be documented.
- Update the subtask 3.1 matrices to include the PIs and updated SSC definitions. This is expected to include consolidating the data/information in the matrices using basic statistics.

3.3 Benefit Question 1 Responses

- The recipient will collaborate to prepare responses to Benefit Question 1 (Table 1) using the updated subtask 3.2 matrices and information collected from Task 2. Responses will be included in the Task 3 Technical Memorandum.

3.4 Confirm Metrics and Modeling Definitions - Before addressing Benefit Question 2, the recipient will confirm the terms “metrics” and “modeling” to ensure a shared understanding and application. This is expected to include:

- Discuss the proposed definition below with the TAC during TAC meeting #2 and collect their feedback. The definitions will be updated to reflect the TAC feedback and included in the Task 3 Technical Memorandum.

Proposed Metrics and Modeling Definitions

- Metrics are defined as a single variable or multiple variables that are used to evaluate and measure the SSC(s) project/activity benefit.
- Modeling is defined as an analysis of two or more variables to quantify SSC project benefits.

3.5 Identify How Metrics are Reported:

- Interview Phase I permittees (Subtask 2.3) to determine the types of metrics they have used or are familiar with. Develop a summary of responses.
- Collect and review literature to identify metrics used nationally for a broader perspective.
- Develop an inventory that synthesizes metric types, what the metrics are intended to measure, assumptions, whether/how metrics were validated, and accuracy for predicting, measuring, and reporting stormwater benefits.
- Metrics or categories of metrics will be compared using a rubric evaluation process that compares benefits (PIs), limitations, validation methods, and accuracy for measuring stormwater benefits.
- Identifying the “best” metric requires defining “best” in the context of permit implementation. The recipient will consult Ecology and TAC during TAC Meeting #2 to confirm the characteristics of the “best” metric. A likely characteristic is accuracy for predicting the SSC success and/or quantifying the measured stormwater benefits.
- Synthesize collected information and the approach to define and recommend the ‘best’ metric. Update the subtask 3.3 matrices to include the “best” metric or metrics for each SSC PI. The synthesis and updated matrices will be included in the Task 3 Technical Memorandum.

3.6 Identify Impact Factors (IF) - Because a small subset of conditions or constraints often limit the choice of SSCs, Impact Factors will be identified for site-specific conditions that may significantly influence the benefit of each SSC. Impact Factors will be identified from the jurisdictional conditions (permittee interviews) and journal articles. This is expected to include:

- Interview Phase I and Phase II permittees (Subtask 2.3) for the purpose of identifying the range of jurisdictional conditions that could influence the performance of SSCs. Examples of IF include site constraints, O&M constraints, zoning, land use, proximity of receiving waters and other critical areas, benefit to underserved populations, condition of water body (i.e. if 303d listed, or other conditions if known), population growth/urbanization, sources of pollutants, etc.
- Collect and review literature for the purpose of defining how IF (identified during Phase I and II interviews) influence SSC performance.

- Develop an inventory that defines each IF and describes how it can influence SSC performance relating to each PI.
 - Synthesize collected information and update the subtask 3.5 matrices to include the IFs as they relate to each SSC. The synthesis and updated matrices will be included in the Task 3 Technical Memorandum.
- 3.7 Define Multivariant vs Single Metric - Metrics that use a multivariant approach will be distinguished from single metric approaches to measure/compare benefits. This is expected to include:
- Collect and review literature regarding multivariant and single metrics approaches
 - Develop a rubric to compare multivariant and single metrics approaches where both apply to a single project type. Variables that will be compared may include the benefits/limitations, intended use/applications, how weight factors and normalization are incorporated to comparing stormwater benefits, and metric accuracy for measuring project benefits.
 - Synthesize collected information, approach to compare and evaluate, and provide recommendations for using different metric types. The synthesis will be included in the Task 3 Technical Memorandum.
- 3.8 Benefit Question 2 Responses
- The recipient will collaborate to prepare responses to confirmed Benefit Question 2 (Subtask 2.4) which will be included in the Task 3 Technical Memorandum.
- 3.9 Draft/Final Task 3 Technical Memorandum
- Prepare a draft technical memorandum that includes the contents defined in Table 6, this will become Chapter 3 of the White Paper. This will include developing a table of the data/information collected with references.
 - Prepare the Final Task 3 Technical Memorandum by incorporating comments from the TAC and Ecology into the draft document.
- 3.10 TAC Meeting #3
- Coordinate, facilitate, and attend a meeting with the TAC and Ecology to discuss project progress, collect comments on the Draft Task 3 Technical Memorandum, and collect feedback on the Task 4 items. Preparation and follow up work include developing and distributing a meeting agenda and meeting minutes to the TAC and Ecology and developing a table of responses to comments on the Draft Task 3 Technical Memorandum.

Task 4. Application Questions

Objective: Provide responses to Application Questions that relate to how to apply the information collected. This will include preparing Task 4 Technical Memorandum which will become Chapter 4 of the White Paper and finalizing the matrices. Table 5 provides an overview of the schedule and fees for each deliverable.

4.0 SubTasks

4.1 SSC Effectiveness and Suitability

- SSC PI information (from subtask 3.2) and IF (from subtask 3.6) will be compared, sorted and ranked to determine which SSCs or combination of SSCs are better suited for specific locations.

- Basic statistics and/or a rubric will be used to quantify the performance of each of the SSCs.
- Based on the performance evaluation, the recipient will recommend which SSCs are more effective for reducing discharges of pollutants and/or mitigating hydraulic impacts based on various receiving waterbody types and conditions, and land use types including various degrees of urbanization.
- Update the subtask 3.6 matrices and prepare a synthesis of the work complete in the Task 3 Technical Memorandum.

4.2 Application Question 1 Responses

- The recipient will collaborate to prepare responses to Application Question 1 (Table 1) which will be included in the Task 4 Technical Memorandum.

4.3 Threshold – This subtask focuses on defining a threshold below which implementation of an SSC provides negligible benefit. This is expected to include:

- The recipient will collect, and review literature and report threshold identified in the literature including recommendations of methods to calculate whether the threshold is exceeded for a specific SSC installation or how many installations would be required to exceed the threshold for a given receiving water body.
- Prepare a summary of the methods and recommendations for thresholds which will be included in the Task 4 Technical Memorandum.

4.4 Weight Factors (WF) – The focus of this subtask is to identify weight factors which are a scale used to quantify the magnitude of site-specific condition on pollutant discharges and hydrology alterations (Impact Factors) or conditions that may enhance or impair the SSC benefits (Performance Indicators). This is expected to include:

- Collect and review literature to identify how weight factors can be applied to metrics to account for IF and how weight factors can be developed to provide an accurate representation of the magnitude. The recipient will review the information collected and make recommendations for applying weight factors.
- Prepare a summary of the methods and recommendations for weight factors which will be included in the Task 4 Technical Memorandum and subtask 4.1 matrices will be updated.

4.5 Quantify SSC Benefits & Metrics vs Modeling – The focus of this subtask is to answer questions regarding whether modeling is necessary or if metrics are enough to quantify benefits, we need to define what the metrics specifically need to quantify (e.g. reduction in pollutant discharges, evidence of improvement in receiving water body conditions, etc.) and the level of accuracy needed. This is expected to include:

- Consult with the TAC and Ecology regarding what metrics need to quantify and the level of accuracy needed.
- Collect and review information regarding the “best” metrics from Task 3 to determine what the metrics are intended to measure, whether/how metrics were validated, and the level of accuracy for predicting/measuring benefits. For each metric, identify the extent and limits that can be measured and provide recommendations for suitable metric applications.
- Compare with responses from Ecology and the TAC to determine whether the available metrics are suitable for providing the desired measurement/accuracy.
- Develop recommendation for future research to review types of models that can reasonably be expected to provide or predict that measurement.
- Prepare a summary of the work complete and recommendations for the Task 4 Technical Memorandum.

4.6 Application Question 2 Responses

- The recipient will collaborate to prepare responses to Application Question 2 (Table 1) which will be included in the Task 4 Technical Memorandum.

4.7 Draft and Final Matrices

- Consolidate the information collected using basic statistics and by grouping common items and organizing information into a relative ranking
- Submit the draft matrices to Ecology and the TAC for review and comment.
- Develop the final matrices by updating the draft matrices to include Ecology and TAC comments.

4.8 Draft/Final Task 4 Technical Memorandum

- Prepare a draft technical memorandum that includes the contents defined in Table 6, this will become Chapter 4 of the White Paper. This will include developing a table of the data/information collected with references. Prepare the Final Task 4 Technical Memorandum by incorporating comments from the TAC and Ecology into the draft document. This will include developing a table of responses to for each comment.
- Prepare the Final Task 4 Technical Memorandum by incorporating comments from the TAC and Ecology into the draft document.

4.9 TAC Meeting #4

- Coordinate, facilitate, and attend a meeting with the TAC and Ecology to discuss project progress, collect comments on the Draft Task 4 Technical Memorandum, and draft matrices. Preparation and follow up work include developing and distributing a meeting agenda and meeting minutes to Ecology and the TAC as well as developing a table of responses to comments on the Draft Task 4 Technical Memorandum and draft matrices.

Task 5. Reporting and Communication of Findings

Objective: Summarize project findings and communicate/disseminate project results. This will include developing a White Paper (Table 6), Fact Sheet, and Power Point Presentation as well as presentations to the TAC, Stormwater Work Group (SWG), and a webinar for the Western Washington Permittee Coordinators Groups.

5.0 SubTasks

5.1 Draft White Paper

- Prepare a draft White Paper that includes the contents summarized in Table 5. Submit a copy of the paper to Ecology and the TAC prior to TAC Meeting #5 for review and comment.

5.2 Stormwater Work Group (SWG) Presentation

- Prepare a draft presentation that provides an overview of the White Paper contents. Submit the draft copy to Ecology and the TAC for their review and comment via email.
- The recipient will present the final power point presentation to the SWG on February 10, 2021. This will include preparing for the presentation, collecting/discussing comments from the SWG during the meeting, and developing a summary of SWG comments.

5.3 TAC Meeting #5

- Coordinate, facilitate, and attend a meeting with the TAC and Ecology to discuss project progress, present the draft WWA Permittee Coordinators Group power point presentation, and collecting/discussing feedback on the draft White Paper and presentation. Preparation and follow up work include developing and distributing a meeting agenda and meeting minutes to Ecology and the TAC and preparing for the presentation and developing a table of responses to TAC and Ecology comments.

5.4 WWA Permittee Coordinators Group Draft/Final Presentation

- The recipient will prepare for and present the final power point presentation during a webinar for the Western Washington permittee coordinators’ groups. The webinar will be recorded for the Washington Stormwater Center (WSC) to include on its municipal stormwater technical assistance webpage.

5.5 Final White Paper

- Revise the draft white paper to reflect comments from SWG (from SWG power point presentation), Ecology, and the TAC.

Table 6. Overview of Whitepaper Contents

Chapter Title and Description
<p>Executive Summary</p> <p><i>Purpose: Provide an overview of the project, abbreviated responses to questions, recommendations for applying results, and recommendations for future work. Note: The executive summary will be formatted similar to an Ecology Fact Sheet and provide a 1,000-word summary of the project results/findings</i></p>
<p>Chapter 1. Introduction</p> <p><i>Purpose: Introduce the project and provide an overview of the White Paper contents.</i></p>
<p>Chapter 2. Define Requirements, Goals, and Vision</p> <p><i>Purpose: Provide a synthesis of permit requirements relevant to this project, reasoning for permit language/project, project goals and vision for results, and confirmed research questions.</i></p>
<p>Chapter 3. Benefit Questions</p> <p><i>Purpose: Provide a synthesis of the stormwater benefits and impacts of the SSC Qualifying Project Types that Phase I permittees are required to include in their stormwater management programs to meet the SSC requirement. This will include a summary of the evaluation approach, the data/information collected noting any data/literature gaps, responses to benefit questions, and recommendations.</i></p>
<p>Chapter 4. Application Questions</p> <p><i>Purpose: Provide a synthesis related to the selection of SSC Qualifying Project Types including a discussion of how the science best supports the application of a given project in a given setting to produce the desired stormwater benefit. This will include a summary of the evaluation approach, the data/information collected noting any data/literature gaps, responses to benefit questions, and recommendations.</i></p>
<p>Chapter 5. Conclusion</p> <p><i>Purpose: Provide a summary of the work completed, a summary explanation of the science foundation of current Phase I permit S5.C.7 requirement and recommendations for policy discussions, and recommendations for future work/research.</i></p>
<p>Appendix</p> <ul style="list-style-type: none"> • Final Matrices showing expected stormwater benefits, and metrics

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| <ul style="list-style-type: none">• Table of Data/Information Collected Including References• Meeting Agendas, Notes, and Action Items• Interview Notes• Tables summarizing all comments and responses to all deliverables |
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Task 6. Optional Policy Discussion

Objective: Develop a draft plan for a future charter workshop that outlines how recommendations from the White Paper could be applied to SSC requirements in the 2024 Permits.

6.0 Optional SubTasks

6.1 Summary of Relevant New Information

- Schedule and attend a meeting with Ecology to identify any new information that the SSC permit requirements may need to address in the 2024 permits. Following the meeting prepare a summary of topics that should be addressed in the charter outline in 6.3.

6.2 TAC Meeting #6

- Coordinate, facilitate, and attend TAC Meeting #6, which will include additional invitees that are identified by Ecology. The purpose of the meeting is to develop a plan for the Charter Workshop that includes a list of stakeholders to invite to the workshop and a timeline for scheduling the workshop and identifies the SSC issues that stakeholders want Ecology to address in the 2024 Permits.
- Preparation and follow up work include developing and distributing a meeting agenda and meeting minutes to the TAC and Ecology and creating an agenda for the Charter Workshop.

6.3 Charter Outline

- Using meeting notes from TAC Meeting #6, prepare an outline for the Charter that describes the project hand-off and transitions plan to determine how the project findings can be applied in the 2024 Permits.

Assumptions:

- Task 6 is noted as optional because it is dependent on the timing of the PCHB hearing or new information that the SSC permit requirements needs to address in the future 2024 permit. Ecology and the receipt will discuss whether this task is needed. If the task is not needed, Ecology and the receipt will decide how to reallocate the funds to other project tasks.