

Appendix 4 – Structural BMP QAPP Template

Eastern Washington Stormwater Effectiveness Studies

Detailed Study Design Proposal & Quality Assurance Project Plan (QAPP) Template

Study Title

Study Classification: *(select one)*

- Structural BMP Operational BMP Education & Outreach

Study Objective(s): *(indicate all that apply)*

- Evaluate Effectiveness Compare Effectiveness
 Develop Modified BMP Develop New BMP

Optional: Insert Graphic/Image/Photograph

Prepared For:

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Lead Entity Jurisdiction

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Structural BMP QAPP Template Publication Information

This publication is available on the City of Spokane Valley's web page at:

<http://www.spokanevalley.org/content/6836/6914/8301/10121/default.aspx>

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Template Instructions

Brown text located throughout this document provides the QAPP Template user (user) with instructions and guidance for developing the section. **Text highlighted in yellow** should be replaced with the information that is relevant to the specific study. All brown instructional text and highlights should be replaced or deleted before the Detailed Study Design Proposal (**Proposal**) or the Quality Assurance Project Plan (**QAPP**) is finalized and/or submitted to Ecology for review. It may be appropriate to enter “**Not applicable**” for some sections with an explanation.

The template identifies the information expected in the QAPP. When the information expected in the Proposal is different than the QAPP, the differences are described in a box with the notation shown below. For sections without these notations, the user should assume the content is expected in both documents.

Proposal – Indicates the information expected in the Proposal. However, users are encouraged to provide as much information and detail as known at the time the Proposal is developed.

The project Proposal and QAPP for all structural BMP studies should be developed following the requirements defined in the Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies (Publication 11-10-061). This document was published by Ecology in August 2011 and is referred to as the **Ecology TAPE Guidance Document** [1] in this document. The purpose of Structural BMP QAPP Template is to provide the user with a general understanding of what is expected in a section and to identify the differences between what is required for Structural BMP studies with the goal of developing a new BMP (as defined in the **Ecology TAPE Guidance Document**) compared to studies with the goal of evaluating (and comparing) effectiveness and/or developing a modified BMP. Differences in the study requirements are summarized in Appendix A and identified throughout this Template using the notations shown below. For sections without these notations, assume the content is required for all structural BMP studies regardless of these goals.

Effectiveness Studies Only – applies to studies that do not have the goal of developing a new or modified structural BMP

Develop Modified Treatment BMP – applies to studies with the additional goal of developing a modified treatment BMP

Prior to using the QAPP Template, the user should consult the following document for additional information: Eastern Washington Stormwater Effectiveness Studies: Introduction to the Studies and Phase 3 Quality Assurance Project Plan (QAPP) Templates for Structural, Operational, and Education & Outreach BMPs. The document is published on the City of Spokane Valley’s website: <http://www.spokanevalley.org/content/6836/6914/8301/10121/default.aspx>.

Disclaimer

This QAPP Template was developed specifically for the City of Spokane Valley and the Eastern Washington (EWA) jurisdictions to provide them with guidance in preparing the Proposal and QAPP for the Effectiveness Studies as defined in the 2014-2019 EWA Phase II Municipal Stormwater NPDES Permit. The guidance was developed based on the information that was available to the author(s) at the time this document was prepared. Although every effort has been made to make this document as complete and accurate as possible, the author(s) and document reviewers have neither liability nor responsibility for any loss or damage arising from information contained in this document or from informational errors or omissions.

The user of the QAPP Template is responsible for:

- Verifying that the Proposal and QAPP documents are developed following all applicable requirements and reflect good research practices
- Providing a level of detail throughout the Proposal and QAPP that is scaled appropriate to the complexity, cost, implications, and/or importance of the study
- Coordinating with the Lead Entity to verify study scope including the study classification and goals
- Developing an Ecology approved Proposal and QAPP document

Proposal Publication Information

Insert information about where the Proposal will be stored and accessible to the public (see section 15.2). Include a weblink and/or contact information.

Proposal Author and Contact Information

Insert author and contact information here:

Name
Organization
Title
Address
City, State, Zip Code
email address
phone number(s)

QAPP Publication Information

Proposal - Not required. Leave the header, along with the following note “Will be completed for the QAPP”, as a place holder for the development of the QAPP.

Insert information about where the QAPP will be stored and accessible to the public (see section 15.2). Include a weblink and/or contact information.

QAPP Author and Contact Information

Proposal - Not required. Leave the header, along with the following note “Will be completed for the QAPP”, as a place holder for the development of the QAPP.

Insert author and contact information here:

Name
Organization
Title
Address
City, State, Zip Code
email address
phone number(s)

Signature Page

This page lists signatories to the document. Each party responsible for the contents of the QAPP and the project must sign and date this page before the study proceeds to the implementation phase (i.e. conduct the study).

Proposal – Only the parties responsible for the contents of the Proposal and the project must sign and date this page before the study proceeds to the QAPP development phase.

Approved by:

Date
Name, Primary Author, Organization

Date
Name, Lead Entity, Jurisdiction

Date
Name, Participating Entity, Jurisdiction

Date
Name, Partner Entity, Jurisdiction

Date
Art Jenkins, City of Spokane Valley Grant Project Manager (Proposal Only)

Date
Name, Ecology Contact with Approving Authority

Date
Name, Lab Director (add a line for each additional lab)

Date
Name, Title

Date
Name, Title

1.0 Table of Contents

Proposal - Include all the Proposal sections, subsection headers, figures, tables, and appendices.

The Table of Contents (TOC) provides an outline of the QAPP content and organization including section headers, subsection headers, figures, tables, and appendices. The TOC should be auto generated using a word processing program.

SIGNATURE PAGE	I
DISTRIBUTION LIST	II
1.0 TABLE OF CONTENTS	III
2.0 EXECUTIVE SUMMARY	V
3.0 INTRODUCTION AND BACKGROUND	1
3.1 INTRODUCTION TO THE STRUCTURAL BMP	1
3.2 PROBLEM DESCRIPTION	1
3.3 RESULTS OF PRIOR STUDIES	2
3.4 REGULATORY REQUIREMENTS	2
4.0 PROJECT OVERVIEW	3
4.1 STUDY GOAL	3
4.2 STUDY DESCRIPTION AND OBJECTIVES:	3
4.3 STUDY LOCATION	3
4.4 DATA NEEDED TO MEET OBJECTIVES	4
4.5 TASKS REQUIRED TO CONDUCT STUDY	4
4.6 POTENTIAL CONSTRAINTS.....	4
5.0 ORGANIZATION AND SCHEDULE	5
5.1 KEY PROJECT TEAM MEMBERS: ROLES AND RESPONSIBILITIES.....	5
5.2 PROJECT SCHEDULE	6
5.3 BUDGET AND FUNDING SOURCES	6
6.0 QUALITY OBJECTIVES	7
7.0 EXPERIMENTAL DESIGN	11
7.1 STUDY DESIGN OVERVIEW	11
7.2 TEST-SITE(S) SELECTION PROCESS.....	11
7.3 THE STRUCTURAL BMP SYSTEM SIZING	12
7.4 TYPE OF DATA BEING COLLECTED.....	12
7.5 PRECIPITATION MONITORING.....	13
7.6 WATER QUALITY SAMPLING	13
7.7 SEDIMENT SAMPLING	13
8.0 SAMPLING PROCEDURES	14
8.1 STANDARD OPERATING PROCEDURES.....	14
8.2 CONTAINERS, PRESERVATION METHODS, HOLDING TIMES	14
8.3 EQUIPMENT DECONTAMINATION.....	15
8.4 SAMPLE IDENTIFICATION	15
8.5 CHAIN OF CUSTODY	15
8.6 FIELD LOG REQUIREMENTS	15

9.0	MEASUREMENT PROCEDURES	17
9.1	PROCEDURES FOR COLLECTING FIELD MEASUREMENTS	17
9.2	LABORATORY PROCEDURES	17
9.3	SAMPLE PREPARATION METHODS	18
9.4	SPECIAL METHOD REQUIREMENTS	18
9.5	LAB(S) ACCREDITED FOR METHODS	18
10.0	QUALITY CONTROL	19
10.1	FIELD QC REQUIRED	19
10.2	LABORATORY QC REQUIRED	19
10.3	CORRECTIVE ACTION	20
11.0	DATA MANAGEMENT PLAN PROCEDURES	21
11.1	DATA RECORDING & REPORTING REQUIREMENTS	21
11.2	ELECTRONIC TRANSFER REQUIREMENTS	21
11.3	LABORATORY DATA PACKAGE REQUIREMENTS	21
11.4	PROCEDURES FOR MISSING DATA	22
11.5	ACCEPTANCE CRITERIA FOR EXISTING DATA	22
11.6	ENVIRONMENTAL INFORMATION MANAGEMENT (EIM) DATA UPLOAD PROCEDURES	22
12.0	AUDITS	23
12.1	TECHNICAL SYSTEM AUDITS	23
12.2	PROFICIENCY TESTING	23
13.0	DATA VERIFICATION AND USABILITY ASSESSMENT	24
13.1	FIELD DATA VERIFICATION	24
13.2	LABORATORY DATA VERIFICATION	24
13.3	DATA USABILITY ASSESSMENT	24
14.0	DATA ANALYSIS METHODS	26
14.1	DATA ANALYSIS METHODS	26
14.2	DATA PRESENTATION	26
15.0	REPORTING	27
15.1	FINAL REPORTING	27
15.2	DISSEMINATION OF PROJECT DOCUMENTS	28
16.0	REFERENCES	29
17.0	APPENDICES	30
	QAPP TEMPLATE APPENDIX A - OVERVIEW OF DIFFERENCES IN STUDY REQUIREMENTS	31
	QAPP TEMPLATE REFERENCES	34

2.0 Executive Summary

Proposal - Section 2.0 is not required. Leave the section, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

The executive summary is a brief (300-500 word) and non-technical summary of the project that is typically written for a more general audience and includes the “key” elements of the study. This should include:

- Description of the BMP(s) that is the focus of the study
- The study goals including whether the study focuses on: evaluating effectiveness only, developing a modified BMP, or developing a new BMP
- The study objectives
- How those objectives will be accomplished
- Estimated duration of the study
- The location of the test-site(s)
- The anticipated study outcomes and modifications the permittee expects to make to their stormwater management program using the study findings

3.0 Introduction and Background

After reading this section, the reader should understand: the Structural BMP(s) that is the focus of this study, the reason(s) why the study is being conducted including results from prior studies, and the Stormwater Management Program conditions in the EWA NPDES Municipal permit the study addresses.

3.1 Introduction to the Structural BMP

Proposal – at a minimum provide a general description for items listed; if possible provide detailed description (as much details as known at the time of proposal development)

This section provides a detailed description of the Structural BMP(s) that is the focus of this study in sufficient detail to allow the reader to fully understand how the BMP performs. This may include:

- Identify the BMP(s) name and provide a description of the BMP characteristics; include pictures or drawings.
- Describe the BMP design criteria; include dimensioned design/construction drawings and any applicable BMP material specifications
- Identify the desired flow control and runoff treatment (i.e. basic, dissolved metals, phosphorus, and oils) functions which the study intends to evaluate and seek Ecology approval of for General Use on future projects
- Describe how the BMP functions including: how the BMP receives runoff (influent), the hydraulic residence time through the BMP, and how/where the effluent discharges (i.e. storm sewer, infiltrates into the ground, etc.)
- Describe the biological, chemical, and physical treatment mechanism
- Define the BMP design flow rate or range of flow rates (i.e. infiltration rate)
- Describe the site installation requirements
- Describe the operation and maintenance requirements

Effectiveness and Develop Modified BMP Studies – This section should be completed using information about the Ecology approved BMP as defined in an Ecology approved stormwater manual. Include a reference to the manual.

Develop Modified BMP – This section should also describe any modifications to the existing Ecology approved BMP.

3.2 Problem Description

This section explains the reason(s) why the proposed effectiveness study is needed (i.e. this section should answer the question: what is the problem and why does problem need to be solved) and provide a basis for the identified problem. This may include:

- MS4 permit requirement to evaluate effectiveness of Structural BMPs
- Limitations or challenges with the current BMP (i.e. availability of media, difficult to install, expensive operation and maintenance requirements, etc.)
- Optimize the BMP design guidance
- Unknown or presumed information about the BMP effectiveness

Provide a basis for the identified problem (i.e. justification that this is really a problem). This may include:

- History of relevant problems with the BMP and/or test-site
- A literature search from related studies
- Empirical observations made by the lead or participating entity and/or information collected from interviewing experts which may include individuals who work in the field.
- A description the conditions and how these conditions may impact the practice

3.3 *Results of Prior Studies*

Proposal - Section 3.3 not required. Leave the section header, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section describes findings from previous studies that support the need for the study and/or the potential success of the study. This may include:

- A summary of a literature search of studies previously conducted or in progress (including relevant results) regarding the specific Structural BMP(s) that is the focus of this study
- Provide references for any reports that are sources of information or data provided

3.4 *Regulatory Requirements*

This section identifies the specific Stormwater Management Program conditions or other conditions in the EWA NPDES Phase II Municipal Stormwater permit that the study will address. Include the relevant permit section(s) including S5.5 Post-Construction Stormwater Management for New Development and Redevelopment.

4.0 Project Overview

The purpose of this section is to provide an overview of the entire study. If the reader only read this section, they should generally understand what the study intends to accomplish as well as how it will be accomplished (*save the detailed project description details for the subsequent sections*).

4.1 Study Goal

Define all the study goal(s) (i.e. the reason(s) the study is being conducted). This should include:

- Whether the study intends to compare the effectiveness of more than one BMP and/or evaluate the effectiveness of one BMP
- Describe potential decisions that may be made as a result of this study. For example, describe modification(s) that may be made to a stormwater management program or how the study findings will be used to support implementation of future permit conditions, etc.
- If applicable, indicate how the study could advance the regional understanding of Structural BMP(s)

4.2 Study Description and Objectives:

The section briefly describes how the study goal(s) will be accomplished (*the detailed description will be provided in Section 7.0*). This should include:

- A short description of the proposed study (a detailed description will be provided in Section 7.0)
- If the study has multiple phases, specify the phase(s) that is the focus of this study
- A list of all the study objectives (*note: an objective is a measurable statement that includes an action verb that defines how the project goal will be accomplished*)

4.3 Study Location

Proposal – At the proposal phase the test-site may not be selected. It is only necessary to describe the general characteristics of the proposed test-site and indicate the number of potential sites.

Identify and provide an overview of the test-site location where the study will be conducted (*the process and justification for selecting the site(s) will be described in Section 7.0*). This may include:

- Identify the test-site(s) locations, where the study will be conducted including the number of sites if applicable
- Briefly describe the various site characteristics (i.e. major land uses, average daily traffic, climatic conditions, soil conditions, etc.)

- If the study includes multiple test-sites; briefly, address how the sites compare (*more specific details regarding how sites should be compared are provided in Section 7.0*)
- Use maps, photos, and/or drawings to identify the location and boundaries of the test-site as well as any relevant stormwater features

4.4 *Data Needed to Meet Objectives*

This section describes the types of data and any other information that will be collected during the study, how the data will be collected, and the source of data. Indicate how the data will be used to support the project objectives.

Specify whether the study anticipates the use of computer modeling to achieve the study goals. If so, provide a brief description of the model being proposed, how the model will be used, and what data will be used to calibrate the model. (*Section 14.0 will be used to provide the details of the modeling being proposed and its value*).

4.5 *Tasks Required to Conduct Study*

Proposal – It is only necessary to provide the relevant information for the primary tasks.

This section defines the tasks and subtasks needed to complete the study (similar to a condensed scope of work). This should include a general description of the work associated with each task including the objective that the task achieves and the anticipated deliverables. Recommend using a table to keep section brief.

4.6 *Potential Constraints*

Proposal – Provide a description based on the information known about the study.

This section describes conditions that may impact the project schedule, budget, or scope and the steps that will be taken to reduce the impact of these conditions. Examples of constraints include climatic conditions, vandalism, availability of staff, equipment malfunction, study funding sources, limited access to the test-site, etc.

5.0 Organization and Schedule

The purpose of this section is to describe who is responsible for completing the tasks, when the tasks will be completed, and how the study will be funded.

5.1 Key Project Team Members: Roles and Responsibilities

Proposal – At a minimum include the Lead Entity, Participating Entities, Partner Entities, and the Ecology Reviewer.

Include key members of the project team, decision-makers, and/or stakeholders (i.e. lead and participating entities, project manager, test site owner/manager, analytical laboratory contacts, field personnel, third-party reviewer(s), etc.) and describe who is going to do what for the project.

Key Team Members	Role	Responsibility
Name Organization Phone Number Email	Lead Entity	Define
Name Organization Phone Number Email	Participating Entity	Define
Name Organization Phone Number Email	Partner Entity	Define
Name Organization Phone Number Email	Ecology Reviewer	Define
Name Organization Phone Number Email	Proposal Author	Define
Name Organization Phone Number Email	QAPP Author	Define
Name Organization Phone Number Email	Key Team Member Project Role	Define

5.2 *Project Schedule*

Proposal - Include the task duration, permit deadlines, and estimated time to complete the study.

This section defines the schedule for the proposed study. Organize the schedule into a table format that includes the same tasks and sub-tasks as listed in section 4.5, the expected start-end dates, deliverables, and deadlines for deliverables.

5.3 *Budget and Funding Sources*

Proposal – Provide an estimated budget for the study broken down by the primary tasks (in Section 4.5). Identify potential funding sources if known or indicate funding needs and any plans for obtaining study funds.

This section defines the project budget for the implementation phase of the study and identifies the study funding sources. Organize the budget into a table and separate the budget by study tasks and subtasks. Include items such as labor for sample/data collection, lab analyses fees, equipment purchase and assembly, test-site construction, any specialized contracting needed. Describe how the study will be funded and/or indicate if additional funding is needed to complete the study.

6.0 Quality Objectives

Proposal - Section 6.0 is not required for Proposal however, the section header should be left as a placeholder along with the following note “This section will be completed for the QAPP.”

This section of the QAPP provides a roadmap of the QA/QC plan that will be employed throughout the experimental design and during the project. The information contained in this section is intended to provide the user with an overview of section contents and to address conditions specific to the EWA Effectiveness Studies for Structural BMPs. Consult the **Ecology TAPE Guidance Document** [1] for detailed guidance on developing this section (see Preparing a QAPP, Quality Objectives).

The goal of a QAPP is to ensure that the data collected during the study is scientifically and legally defensible [1]. The QAPP documents how quality assurance (QA) and quality control (QC) will be applied to a research project to assure that the results obtained are of the type and quality needed and expected. The QA/QC plan is embedded throughout the QAPP and emphasizes how the data quality indicators (DQIs) and respective measurement performance criteria (MPCs) are addressed during a project. DQIs are qualitative and quantitative measures that characterize the aspects of quality data [2]. DQIs are goals for data quality, specifically defined for each study, with the intent of minimizing error and improving the accuracy of the data. DQIs guide the development of the experimental design as well as the process of creating and analyzing data [3]. The DQIs are as follows: **Precision, Bias, Representativeness, Completeness, Comparability, and Sensitivity** [4]. Once established, the DQIs provide the basis for the MPCs which are the acceptance criteria for the DQIs that specifies how good the data must be to meet the project objectives. Table 6.1 provides a summary of the DQIs along with potential approaches for addressing the DQIs and writing MPCs with an emphasis on Structural BMP studies. Studies that include analytical testing should consult the Quality Objectives section in the Ecology TAPE Guidance Document for additional guidance [1].

This section should include a brief written description that addresses how QA/QC is addressed throughout the QAPP. This may include:

- Identify and describe the various types of data that will be created during this study and the intended purpose of each type of data (i.e. how the data will be used to meet the project objectives)
- For each type of data, briefly describe the process that will be used to measure the data including any equipment or instruments that will be used
- For each type of data, describe how the applicable DQIs are addressed in the experimental design as well as during the process of collecting and analyzing data
- For each applicable DQI, specify the MPCs that will be used to determine if the data is usable for meeting for project objectives
- Indicate the QC procedures that will be followed to minimize error and reference the applicable section(s) that define the QC procedures (see Section 10.0 Quality Control)

- Indicate the audits that will be performed to verify conformance to the QAPP and reference applicable sections that define the audit procedures (see Section 12.0 Audits)
- Describe the process that the study will employ to verify the quality of the data and assess the usability of each type of data (see 12.0 Data Verification and Usability Assessment)

Table 6.1 Summary of the Data Quality Indicators (DQIs) and Measurement Performance Criteria (MPC) for Structural BMP Studies

Data Quality Indicator (DQI)	Potential Approaches for Addressing DQI in Studies	Potential Approaches for Writing Measurement Performance Criteria (MPCs)
<p>Bias – A systematic error that results in sample values that are consistently distorted in one particular direction from the “true” or known value [2, 5, 6]. Bias can result from improper data collection, poorly calibrated analytical or sampling equipment, or limitations or errors in analytical methods and techniques [1].</p>	<ul style="list-style-type: none"> • Calibrate instruments using reference materials or buffer solutions • Follow manufacturers’ recommendations for equipment and/or instrument maintenance • Define and consistently follow SOPs for collecting samples and measuring data • For studies with analytical testing: analyze spiked matrix samples 	<p>Bias is quantified by comparing the measured value to the known value. For example:</p> <ul style="list-style-type: none"> • For analytical testing: use bias calculation defined in TAPE to determine whether acceptable criteria are met • Define minimum acceptable limits for calibration checks
<p>Precision – A measure of agreement among repeated measurements of the same property taken under identical or substantially similar conditions [2, 5]. Data is considered precise when the measured values are consistently the same and imprecise when the measured values are consistently different [5]. Random error is a common cause of imprecise data and is always present because of normal variability in the many factors that affect measurement results. For example variability in sampling or data collection procedures and/or variations of the actual concentrations in the media being sampled [1].</p>	<ul style="list-style-type: none"> • Collection procedures are appropriate for the type of data and samples collected • SOPs are defined and consistently followed for collecting samples and measuring data • Use the same instrument or measurement procedure to make repeated measurements on the same sample (duplicate field or lab samples) • For studies with analytical testing: two different labs conduct the same test on a sample that has been split (split samples) 	<p>Precision is quantified by repetition: repeating the analysis, measurement, procedure, etc. with the same sample or samples and calculating the range or standard deviation of the values. Precision may also be expressed as a percentage of the mean of the measurements, such as relative range or relative standard deviation (coefficient of variation) [6]. For example:</p> <ul style="list-style-type: none"> • Define in relation to relative percent difference (RPD) between two measured values and the acceptable percent recovery range
<p>Representativeness – A qualitative term that expresses the degree to which the data accurately and precisely represents the conditions being evaluated [6]. Common variables considered when determining the degree of representativeness include the selected sampling locations, sampling frequency and duration, and sampling methods [1].</p>	<ul style="list-style-type: none"> • Select sampling and data collection events that represent a range of conditions expected at the site with respect to rainfall volume and intensity or dry periods. Reference the Ecology TAPE Guidance Document to define DQIs related to <i>collecting samples that represent the range of water quality conditions expected during storm flow conditions</i>: study duration, storm event guidelines (Table 5), minimum sample size, sample collection requirements (Table 6 & 7), etc. • Proper installation of equipment 	<p>Evaluate whether measurements are made and physical samples collected in a manner that the resulting data appropriately reflects the condition being measured or studied. For example:</p> <ul style="list-style-type: none"> • TAPE requirements, for study duration, storm event guidelines, minimum sample size, sample collection requirements, etc., are followed • Install equipment per manufacturer

Data Quality Indicator (DQI)	Approaches for Addressing DQI in Studies	Approaches for Writing Measurement Performance Criteria (MPCs)
<p>Completeness - The amount of valid data needed to be obtained during the study to meet the project objectives [4].</p>	<ul style="list-style-type: none"> ● Collect a minimum of 12 samples to evaluate the BMP effectiveness; additional samples maybe required for new/modified BMP studies ● Define procedures for handling missing data ● Use appropriate coding for missing data ● Report missing data with the results ● Results should include consideration for how missing data could limit the comparability of the data set ● Conduct routine equipment maintenance ● Implement corrective action plans immediately 	<p>Compare the number of valid measurements completed (samples collected or samples analyzed) with those established by the project's MPCs [6]. For example:</p> <ul style="list-style-type: none"> ● The number of valid samples collected is equal to or greater than the acceptable sample size defined in by the DQI ● Define maximum data gaps (i.e. missing or inaccurate data that cannot be corrected using available calibration data)
<p>Comparability - A qualitative term that expresses the measure of confidence that one dataset can be compared to another and can be combined or contrasted for the decision(s) to be made. Data are comparable if sample collection techniques, measurement procedures, analytical methods, and reporting are equivalent for samples within a sample set, and meet acceptance criteria between sample sets. <u>For studies with the goal of comparing the effectiveness of practices, this DQI will need to be addressed specifically with respect to this goal.</u></p>	<ul style="list-style-type: none"> ● Define the process and provide justification for selecting the test-site ● Define the process and provide justification for selecting the sample size for every type of data collected ● Define and justify the process applied to compare datasets between different studies ● Use standard and consistent sample and data collection procedures ● Use standard testing methods (analytical testing) 	<p>There is no quantitative MPC for comparability; use qualitative measures instead [7] such as compare sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and QA protocols [6].</p>
<p>Sensitivity - denotes the rate at which the analytical response (e.g., absorbance, volume, meter reading) varies with the concentration of the parameter being determined. In a specialized sense, it has the same meaning as the detection limit [1]. The capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest.</p>	<ul style="list-style-type: none"> ● Determine the minimum concentration or attribute that can be measured by a method (method detection limit), by an instrument (instrument detection limit), or by a laboratory (quantitation limit) ● Select testing methods that have detection limits well above the reference level of the variable of interest [4, 6]. ● Select instruments capable of accurately measuring the different levels of the variable of interest expected during the study 	<ul style="list-style-type: none"> ● Specify the minimum detection limit for the concentration or attribute being measured ● Define how data measured below the detection limit will be handled ● Verify the detection limit is equal or greater than that specified by the DQI

7.0 Experimental Design

The purpose of this section is to describe the experimental design that will be used to evaluate (and/or compare) the BMP effectiveness. This section also provides the basis for why the experimental design was selected (which may include a literature search). The information contained in this section is intended to provide the user with an overview of the section contents and address conditions specific to the EWA Effectiveness Studies for Structural BMPs. Consult the **Ecology TAPE Guidance Document [1]** for detailed guidance on developing this section (see Preparing a QAPP, Experimental Design).

This section should also describe how the applicable **DQIs** are addressed. Include references to **MPCs** defined in Section 6.

7.1 Study Design Overview

Proposal – Provide a summary of the conceptual study design.

This section provides an overview of the experimental design (level of detail expected is similar to an executive summary). This section introduces the reader to the study design and the primary elements of the study. This should address the primary experimental design elements including (if applicable):

- Monitoring site
- BMP treatment and flow system sizing
- Precipitation monitoring
- Flow monitoring
- Water quality sampling
- Sediment sampling

7.2 Test-Site(s) Selection Process

Proposal – Describe the proposed selection process and criteria. If the sites have been selected, provide information about the actual process and criteria.

This section provides a detailed description of the test-site(s) along with the justification for selecting the sites. This should include:

- Identify the site location(s)
- Provide a detailed description of the process and criteria for selecting the test-site(s) including the assessment for determining the suitability of the site for a monitoring
- Include maps, photos, and/or drawings (refer to section 4.3) as well examples of the tools/methods used for selection

- Define the variables that will influence selection and summarize the variables in tables. Variables will vary depending on the specific study goals. Examples include geographical area, land use classification, average daily traffic, accessibility to sites, soil conditions, influent pollutant concentrations, receiving waters, etc.
- Provide a justification for selecting the sites
- Access and other field crew safety considerations are common criteria when selecting a test site or sites

7.3 *The Structural BMP System Sizing*

Proposal – Provide a summary of the conceptual BMP sizing

This section describes how the BMP was sized for the selected monitoring site. Reference the **Ecology TAPE Guidance Document [1]**, the Experimental Design section, for guidance on developing this section.

Effectiveness and Develop Modified BMP Studies – This section should be completed using the BMP design criteria defined in an Ecology approved stormwater manual. Include a reference to the manual.

Develop Modified BMP – Describe any modifications to the existing Ecology approved BMP design criteria

7.4 *Type of Data Being Collected*

This section identifies the various types of data that will be collected and defines the intended purpose for each type of data. Recommend using tables to keep the section brief. Suggestions for this section include:

- For each data type identify the location for its collection, the anticipated frequency of its collection and the number of samples expected to be collected. Reference Table 8 in the **TAPE Guidance Document [1]** for a list of the required water quality parameters based on the desired runoff treatment (i.e. basic, dissolved metals, phosphorus, and oils)
- Include a schematic of the site(s) that identifies the limits of the contributing watershed including locations where each type of sample and/or data will be collected (consider adding map that shows the location for any relevant equipment)
- Provide justification for the selecting the sample size for every type of data, specifically address that the anticipated number of samples for each type of data is complete or expected to satisfy the project objectives

Effectiveness and Develop Modified BMP Studies – This section should be completed following the Ecology approved BMP design criteria. Include a reference to the manual.

Develop Modified BMP – Describe any modifications to the existing Ecology approved BMP design criteria.

7.5 *Precipitation Monitoring*

Proposal – Provide a summary of the conceptual precipitation monitoring system

This section describes the precipitation monitoring system including the location and equipment. Reference the **Ecology TAPE Guidance Document**, the Experimental Design Section, for guidance on developing this section.

7.6 *Water Quality Sampling*

Proposal – Provide a summary of the conceptual water quality sampling system

This section describes the monitoring locations and equipment, sampling methodology, monitoring parameters, and the monitoring duration for water sampling. Reference the **Ecology TAPE Guidance Document**, the Experimental Design Section, for guidance on developing this section.

7.7 *Sediment Sampling*

Proposal – Provide a summary of the conceptual sediment sampling system

This section describes the monitoring locations and equipment, sampling methodology, and the monitoring duration for sediment sampling. Reference the **Ecology TAPE Guidance Document**, the Experimental Design Section, for guidance on developing this section.

8.0 Sampling Procedures

Proposal - Section 8.0 is not required. Leave the section and any subsection headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section defines the field sampling procedures for collecting each of the various types of data. Defining these procedures and following them consistently will minimize errors and support the quality and representativeness of the collected samples. The information contained in this section is intended to provide the user with an overview of the section requirements and address conditions specific to the EWA Effectiveness Studies. The **Ecology TAPE Guidance Document** [1] and **QAPP Guidance Document** [4] should be consulted for specific details about developing this section.

This section should also describe how the applicable **DQIs** are addressed. Include references to **MPCs** defined in Section 6.

8.1 Standard Operating Procedures

This section includes the standard operating procedures (SOPs) (or reference published procedures or standard methods) that will be used in the field during the study to collect samples. SOPs developed for the study should define how to conduct an activity in sufficient detail such that the activity could be replicated by an individual unfamiliar with the project (i.e. a third party). SOPs should include the frequency and location(s) of the activity. SOPs Structural BMP studies may include:

- Precipitation Monitoring
- Flow Monitoring
- Water Quality Sampling
- Sediment Sampling
- Inspection of the test-site and installed equipment for damage or vandalism

8.2 Containers, Preservation Methods, Holding Times

This section only applies to studies that include analytical testing for water or sediment samples.

Provide a table that lists the required containers, sample size, preservation, and holding times for each parameter. Requirements for these items should be coordinated with the laboratory that will be conducting the analytical testing.

8.3 *Equipment Decontamination*

This section only applies to studies that include analytical testing for water or sediment samples.

This section describes how the sampling equipment will be decontaminated between sampling events and how frequently consumable items will be replaced (unless defined in an SOP). This section should also describe procedures for disposing of any waste collected during the study.

8.4 *Sample Identification*

This section defines the protocol for labeling (identifying) samples and data collected in the field during the study. This may include:

- Identification numbers
- Location, date & time
- Sampler initials
- Parameters, etc.

8.5 *Chain of Custody*

This section only applies to studies that include analytical testing for water or sediment samples.

Provide chain of custody procedures if the collected samples will leave the possession of the sample collector prior to measuring the sample (i.e. transferring possession of the sample to a lab for analytical testing). Include copies of the chain of custody form in the appendix.

8.6 *Field Log Requirements*

This section should define the field information that will be observed and logged during the data collection phase of the study. Developing a data collection template that addresses the data to be collected for each type of data where applicable will decrease the potential for errors or omitted data during field collection. Include a copy of any data collection templates in the appendix.

Depending on applicability, items that may be on the template may include:

- Date and time
- Field staff names
- Relevant climate conditions (i.e. general conditions like raining, dry, overcast, sunny, air temperature and wind speed if known otherwise a qualitative statement regarding wind, etc.)
- Number of samples collected
- Sample description and label information
- Field measurements taken

- Field QC to verify sample identification
- Sampling equipment condition
- Instrument calibration procedures
- Weight of sediment accumulation obtained by using a calibrated scale
- Space for adding comments about activities or issues that may influence the quality of the data

9.0 Measurement Procedures

Proposal - Section 9.0 is not required. Leave the section and any subsection headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section of the QAPP focuses on identifying the methods required to measure the data collected during the study including the equipment and instruments. This may include laboratory procedures (i.e. water and sediment analytical testing) and field procedures (i.e. measuring sediment accumulation depths or in-situ water quality parameters). Choosing recognized standard testing methods or defining SOPs and following them consistently will minimize errors. The information contained in this section is intended to provide the user with an overview of the section requirements and address conditions specific to the EWA Effectiveness Studies. The **Ecology QAPP Guidance Document** [4] and **TAPE Guidance Document** [1] should be consulted for specific details when developing this section.

This section should also describe how the applicable **DQIs** are addressed. Include references to **MPCs** defined in Section 6.

9.1 *Procedures for Collecting Field Measurements*

This section describes the procedures that will be used to measure samples in the field during the study. This will include standard operating procedures (SOPs), referencing published procedures, and/or standard methods. The procedure(s) should include a definition of the parameter that will be measured and the frequency and number of measurements that will be taken. Define the quality control procedures that will be used to check the accuracy of the measurement along with the frequency of the checks (or reference the procedure in Section 10.0 Quality Control). If equipment or instruments are used in the field to measure data, include the manufacturer and model. Example of data that maybe measured in the field for Structural BMP studies include:

- Infiltration or saturated hydraulic conductivity

9.2 *Laboratory Procedures*

This section only applies to studies that include analytical testing for water or sediment samples.

This section defines the measurement procedures for all analytical testing. This section should contain information about the items noted below. Using table can help keep the section brief. Requirements for these items should be coordinated with the laboratory that will be conducting the analytical testing. This may include:

- Analyte
- Matrix
- Number of samples
- Standard testing method

- Expected Range of results
- Detection limits

9.3 *Sample Preparation Methods*

This section only applies to studies that include analytical testing for water or sediment samples.

If the sample requires some form of preparation and/or extraction, this section should describe the respective techniques.

9.4 *Special Method Requirements*

This section only applies to studies that include analytical testing for water or sediment samples.

Identify any special requirements regarding testing methods in this section. This may include analysis of very low or very high concentrations of analytes, the analysis of analyte with high levels of interference, and the use of non-standard methods.

9.5 *Lab(s) Accredited for Methods*

This section only applies to studies that include analytical testing for water or sediment samples.

Laboratories that conduct analytical testing must be accredited by Ecology for the specific sample matrix and testing method. A list of accredited labs can be found at the following web link: <http://www.ecy.wa.gov/programs/eap/labs/index.html>. The section should identify the labs along with the sample matrix, testing method, and analyte.

10.0 Quality Control

Proposal - Section 10.0 is not required. Leave the section and any subsection headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section describes the QC procedures for lab and field activities that will be employed to minimize errors. The information contained in this section is intended to provide the user with an overview of the section requirements and address conditions specific to the EWA Effectiveness Studies. This section should be developed following the **QAPP Guidance Document** [4] and the **TAPE Guidance Document** (see section titled Preparing a QAPP, Quality Control) [1].

This section should also describe how the applicable **DQIs** are addressed. Include references to **MPCs** defined in Section 6.

10.1 Field QC Required

This section defines the QC procedures that will be implemented for field activities including the schedule and frequency. Recommend using tables to keep the section brief. The QC samples all will have **MPCs** associated with them, which will need to be met to obtain data that is usable. Examples of information that maybe included for Structural BMP studies include:

- Develop and consistently follow QC procedures for SOP for sample collection (see section 8.0, Sampling Procedures)
- Develop and consistently follow sample measurement procedures, (see section 9.0, Measurement Procedures)
- Develop and consistently follow instrument and equipment calibration checks
- Create an equipment maintenance and instrumentation calibration schedule that identifies equipment, procedures, and frequency
- Develop and consistently follow record keeping procedures (see section 11.0, Data Management)
- Provide proper training to the field staff on all procedures

10.2 Laboratory QC Required

This section only applies to studies that include analytical testing for water or sediment samples.

This section defines the QC measures that the lab will employ during the study. Recommend using tables to keep the section brief. The QC samples all will have **MPCs** associated with them, which will need to be met to obtain data that is fully usable. The types of information that maybe included in this section are as follows:

- Blanks
- Duplicates

- Standard Reference Materials (SRM)
- Matrix Spikes
- Laboratory Control Samples (LCS)
- “Blind” SRMs submitted to the laboratory
- Surrogates

10.3 *Corrective Action*

This section defines the corrective action plan and procedures if the QC results indicate problems with data during the course of the project. Include in your project plan any additional procedures to be followed to correct or compensate for QC problems if they occur.

11.0 Data Management Plan Procedures

Proposal - Section 11.0 is not required. Leave the section and any subsection headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section defines the data management plans. It specifically describes how the data and other important project documents will be managed, stored, and archived during the study. These plans are developed to reduce the potential for errors during the data collection and analysis phases of the project. The information contained in this section is intended to provide the user with an overview of the section requirements and address conditions specific to the EWA Effectiveness Studies. This section should be developed following the **QAPP Guidance Document** [4] and the **TAPE Guidance Document** (see section titled Preparing a QAPP, Audits and Reports) [1].

This section should also describe how the applicable **DQIs** are addressed. Include references to MPCs defined in Section 6.

11.1 Data Recording & Reporting Requirements

This section describes the procedures for recording data in the field and compiling the data collected (transferring the data to an electronic format). This may include:

- Developing a data collection template (i.e. standard form) that specifies each type of data to be collected (include a copy of any data collection templates in the appendix). Items may include: date and time, data collectors name(s), sample identification, specific instrument measures (i.e. questions), and a space for adding comments about issues that may influence the quality of the data
- Identify potential sources of error that may occur during data recording and reporting and provide procedures for detecting and correcting these errors.
- Indicate the software programs or databases that will be used to store the data.
- Specify the duration and responsible party for archiving the data.

11.2 Electronic Transfer Requirements

This section only applies to studies that will transfer data electronically.

This section describes the project protocol for transferring data electronically during the data collection phase of the study. This may include transferring field and/or laboratory data to the user’s database.

11.3 Laboratory Data Package Requirements

This section only applies to studies that include analytical testing for water or sediment samples.

This section defines the lab data package requirements which typically includes: a detailed case narrative that discusses potential problems with the analyses, corrective actions to be taken, changes to the referenced analytical methods, QC results, a list that defines each qualifier, etc. The data package refers to records produced at the laboratory during analytical testing [8]. If analytical testing will be conducted at a laboratory, specify the requirements for the data package in this section. Note: the laboratory has a standard deliverable data package that it provides as part of the analytical testing. The user should review the standard data package during the development of the QAPP to determine if the QC data is relevant to the study and coordinate any project specific revisions or requirement with the laboratory.

11.4 Procedures for Missing Data

This section defines the project procedures for addressing missing data. This may include:

- Define procedures for handling missing data
- Use appropriate coding for missing data
- Report missing data with the results

11.5 Acceptance Criteria for Existing Data

This section only applies to projects that intend to use existing data (i.e. data not collected during this study).

This section defines the **acceptance criteria** that will be used to determine if a dataset can be compared to another and can be combined or contrasted for the decisions to be made during this study. List acceptance criteria for this data in terms of the applicable **DQIs**, particularly **Comparability**. Include references to **MPCs** defined in Section 6.

11.6 Environmental Information Management (EIM) Data Upload Procedures

This section describes how and when project data will be uploaded to EIM. Per section S8.B-9 of the MS4 permit, certain types of data collected for the effectiveness study should be entered into Ecology's EIM system before the end of the water year in which it is collected or within six (6) months of collecting the sample, whichever is later.

12.0 Audits

Proposal - Section 12.0 is not required. Leave the section and any subsection headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section describes the types of audits that will be conducted, the audit process and procedures, number of audits, frequency, and who is responsible for conducting the audits. The **QAPP Guidance Document** [4] includes two types of audits: Technical System Audit and Proficiency Testing. Both types of audits are required and should be conducted by a third party. Ideally, audits are conducted soon after work has commenced, so that corrective actions can be implemented early in the project. The information contained in this section is intended to provide the user with an overview of the section requirements and address conditions specific to EWA Effectiveness Studies. This section should be developed following the **QAPP Guidance Document** [4] and **TAPE Guidance Documents** [1].

This section should also describe how the applicable **DQIs** are addressed. Include references to **MPCs** defined in Section 6.

Effectiveness Studies – Audits are recommended and maybe conducted by the Project Manager.

Develop Modified BMP – Audits are required and maybe conducted by the Project Manager.

12.1 *Technical System Audits*

This section identifies the technical system audits that will be conducted during the study including the procedures for conducting the audit and identifying the party responsible for conducting each audit. Technical System Audits are qualitative audits performed to verify that the study is conducted in conformance to the QA Project Plan. This may include:

- Define the procedures for conducting each audit
- Verify the field staff are following the SOPs for sample collection
- Verify equipment and instruments are being maintained and/or calibrated per the manufacturers requirements
- Verify the data management procedures are followed including field data recording

12.2 *Proficiency Testing*

This section only applies to studies that include analytical testing for water or sediment samples

This section defines the proficiency testing audits that will be conducted during the study. Proficiency testing is a quantitative determination of an analyte in a blind standard to evaluate the proficiency of the analyst or laboratory. See the **QAPP Guidance Document** for guidance in developing this section.

13.0 Data Verification and Usability Assessment

Proposal – Identify the data that will be verified

The section defines the process that the project will employ to evaluate the quality of the data and the usability of the data for meeting the project objectives. More specifically, to determine whether the **MPCs** were met for the applicable **DQIs**. The information contained in this section is intended to provide the user with an overview of the section requirements and address conditions specific to the EWA Effectiveness Studies. Consult the **Ecology QAPP Guidance Document** [4] and **TAPE Guidance Document** [1] details on developing this section.

This section should also describe how the applicable **DQIs** are addressed. Include references to **MPCs** defined in Section 6.

13.1 Field Data Verification

This section describes the process that will be employed to evaluate the quality of the data created in the field and identify responsible party for verifying the data. Ideally, data verification is performed by a person other than the one generating the data.

The field data verification process may include:

- Reviewing all the data records to ensure they are consistent, correct and complete, with no errors or omissions
- Review data records to verify the entries are consistent, correct, and complete
- Review the results from the QC section
- Review the results from the Audit section
- Describe how data below the lower reporting limit or detection limit will be handled
- Describe how the sampling system design and data will be evaluated to determine if the design has been adequate

13.2 Laboratory Data Verification

This section only applies to studies that include analytical testing for water or sediment samples.

This section describes the methods that will be employed to verify the laboratory data and identify responsible party for verifying the data. Ideally, data verification is performed by a person other than the one generating the data.

13.3 Data Usability Assessment

This section describes the procedures that will be used to establish the usability of the data for meeting the project objectives. This typically includes assessing whether the **MPCs** for each **DQI** have been met. Generally, if the **MPCs** have been met, then data should be of sufficient

quality to be usable for meeting project objectives. If the **MPCs** have not been met, the user will need to decide if the data is still usable (and provide justification) or reject the data.

14.0 Data Analysis Methods

Proposal – Define what data will be analyzed and the types of analysis will be conducted analyzing the data (i.e. normality testing, hypothesis testing, removal efficiency, etc.)

This section defines the process and methods the project will use to analyze the data and address the study goals outlined in Section 4.0 as well as describe how the data will be presented in the final report.

14.1 Data Analysis Methods

This section describes the process and methods that will be employed to analyze the data. Suggestions for this section include:

- A summary of the process that will be used to analyze the data
- How the effectiveness of each BMP will be evaluated and/or compared
- For each type of data, describe any testing that will be conducted to determine if the data is normally distributed (if applicable)
- A summary of hypothesis testing process and methods that will be used to analyze the data including the null and alternative hypothesis that will be evaluated
- A summary of any statistical calculations that will be used to analyze the data, if applicable include the confidence interval, p-value, and/or level of statistical power
- Determine the average pollutant removal efficiency
- Provide verification that: the analysis method is appropriate for the dataset, there is a sufficient number of samples for the method to be accurate, and that what statistical level of confidence will likely be achieved in the results
- Define the process and methods for evaluating the BMP for meeting the Ecology performance goals for treatment: basic, dissolved metals, phosphorus, and oils. Reference the **TAPE Guidance Document** [1] for additional details.

Effectiveness Studies – It is not necessary to evaluate the BMP for meeting the Ecology treatment performance goals. Instead report the average removal efficiency from 12 storm events at the 95% confidence interval.

14.2 Data Presentation

This section describes how the data will be presented (i.e. tables, charts, and/or graphs) in the final reports to illustrate trends, relationships, and anomalies.

15.0 Reporting

This section describes how the study findings will be reported and disseminated.

15.1 Final Reporting

Proposal - Section 15.1 is not required. Leave the section header, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section should identify the reports that are required for the project and the party responsible for preparing the reports. Reports required by the MS4 permit include:

- Annual Reports (S8.B8) – describe the interim results and status of the study
- Final Report (S8.B10) – report the final results of the study and the recommendations for future actions based on the findings. For the QAPP, provide an outline that identifies the proposed final report contents (see Table 15.1 for an example). The final report should be developed following the requirements specified in the **Ecology TAPE Guidance Document** section ‘Preparing a Technical Evaluation Report (TER)’ [1].
- Fact Sheet or other method (i.e. videos) that summarizes the key points of the study along with the study findings. These documents are typically 2 to 4 pages in length.

Table 15.1 Proposed Effectiveness Study Report Content

Final Report Sections	Effectiveness Studies	Develop Modified BMP	Develop New BMP ²
0.0 Cover Letter	✓	✓	✓
1.0 Executive Summary	✓	✓	✓
2.0 Introduction	See Note 1	See Note 1	✓
3.0 Technology Description	See Note 1	See Note 1	✓
4.0 Sampling Procedures	See Note 1	See Note 1	✓
5.0 Data Summaries and Analysis	✓	✓	✓
6.0 Operation and Maintenance (O&M) Information	✓	See Note 2	✓
7.0 Discussion	✓	✓	✓
8.0 Conclusions	✓	✓	✓
9.0 Future Action Recommendations	✓	✓	✓
10.0 Appendices	✓	✓	✓
11.0 Third-Party Review		See Note 3	✓

1. Reference the approved QAPP for these sections. Indicate any changes made to the study since the QAPP was approved.
2. Provide a summary of the original BMPs O&M information as defined in the applicable stormwater manual (and reference the manual) and describe any differences in the O&M information for the modified BMP.
3. Jurisdiction must convene a Board of External Reviewers (BER): three to five individuals (two of whom should be from Ecology) with technical skills necessary to provide a peer review of the TER.

15.2 *Dissemination of Project Documents*

Proposal – For each document, describe the proposed process for dissemination

The purpose of this section is to describe how the project findings (QAPP, final report, fact sheets/videos) will be disseminated to the public including where the electronic documents will be stored and accessible to the public (i.e. web sites).

16.0 References

In almost every case, the authors have referred to studies, reports, SOP's and the scientific literature in the preparation of this document. These references should be documented in this section using a consistent citation format (APA, MLA, etc.). Citation should be included in the body of the text where appropriate and do not include sources in this section that are not referred to in the text. This is a *reference* section and not a resources section (i.e. a section where you list everything you reviewed or found through a literature search when preparing the report).

17.0 Appendices

The appendices should include all supporting information for the items described in the body of the QAPP. Examples of possible appendices include:

1. Standard Operating Procedures (SOP)
2. Example Data Collection Form(s)
3. Equipment Specification Sheets
4. Instrument Specification Sheets
5. Auditing Forms
6. Example Chain of Custody Form(s)
7. Plan Sheets, Maps, sketches, etc.

QAPP Template Appendix A – Overview of Differences in Study Requirements

Study Elements	Evaluate Practice Effectiveness	Develop Modified BMP	Develop New BMP
TAPE Application	No application required	No application required	Application required - Jurisdictions are exempt from TAPE fees
Define BMP Materials ¹	<ul style="list-style-type: none"> • Verify BMP material properties and quantities are consistent with the BMP design guidance. • Determine BMP material properties using manufacturer provided specifications or through material testing • For BMPs that contain compost, define material source. • For BMPs that contain topsoil, define material source. 	Same as Effectiveness plus: <ul style="list-style-type: none"> • Define BMP design criteria material modifications 	Same as Effectiveness plus: <ul style="list-style-type: none"> • Define BMP material properties and quantities proposed for new BMP design criteria
Study Duration	1.5 maintenance cycles or 2 wet seasons	Same as Effectiveness Study	Same as Effectiveness Study
Water Quality Testing ¹	Test influent & effluent for the pollutants concentrations the BMP is approved to provide runoff treatment for.	Test influent & effluent for the following: <ul style="list-style-type: none"> • Pollutants BMP is approved to provide runoff treatment for plus the additional required parameters² • Test for the required screening parameters 3 times during the study² 	Same as Modified BMP plus: <ul style="list-style-type: none"> • Evaluate the treatment performance at the peak and average flow rate using field monitoring information only
Sample Size	Collect samples from a minimum of 12 natural rainfall events (maximum of 35) that meet the qualifying conditions ³ .	Collect samples from a minimum of 12 and maximum of 35 natural rainfall events that meet the qualifying conditions ³ .	Same as Modified BMP plus: <ul style="list-style-type: none"> • Collect samples from 50% to 125% of the design flow rate using field monitoring information only
Design Flow Rate	<ul style="list-style-type: none"> • Define Design Flow Rate specified in the BMP design criteria • Measure the influent and effluent flow rate as defined in the TAPE requirements 	Same as Effectiveness Study	<ul style="list-style-type: none"> • Define design flow rate for proposed BMP design criteria • Measure initial flow rate using standard methods (i.e. Modified ASTM D2434) • Measure the influent and effluent flow rate as defined in the TAPE requirements
Audits	<ul style="list-style-type: none"> • Technical system audits and proficiency audits <u>are recommended</u> • Audits maybe conducted by the Project Manager 	<ul style="list-style-type: none"> • Technical system audits and proficiency audits <u>are required</u> • Audits maybe conducted by the Project Manager 	Same as Modified BMP except: <ul style="list-style-type: none"> • Audits shall be conducted by a 3rd party

Study Elements	Evaluate Practice Effectiveness	Develop Modified BMP	Develop New BMP
Data Analysis	<ul style="list-style-type: none"> Evaluate if difference between influent and effluent pollutant concentrations is statically significant and indicate the confidence interval. Determine average pollutant removal efficiency. Bootstrap Method is recommended to determine efficiency and associated confidence interval. 	<ul style="list-style-type: none"> Hypothesis testing: statistically significant difference between influent and effluent pollutant concentrations to a 95% confidence interval and 80% power Evaluate BMP using Ecology treatment performance goal⁴: 95% confidence interval for removal of pollutants the BMP is approved and/or proposed to provide runoff treatment for. Use Bootstrap Method to determine removal efficiency at 95% confidence interval. 	Same as Modified BMPs
Final Report	<ul style="list-style-type: none"> Final report should contains elements defined in S8.B10 of the NPDES permit Use TAPE TER requirements as a guide for developing report⁵ QAPP may substitute for relevant sections including: introduction, technology description, and sample procedures 	<ul style="list-style-type: none"> Use TAPE TER requirements as a guide for developing report⁵ QAPP may substitute for relevant sections including: introduction, technology description, and sample procedures 	Follow TAPE TER requirements ⁵
Document Review Process	<ul style="list-style-type: none"> Ecology reviews/approves QAPP Ecology reviews final report (<i>no requirements for Ecology approval defined in permit</i>) 	Jurisdiction must convene a Board of External Reviewers (BER): 3-5 individuals (2 from Ecology) with technical skills necessary to provide a peer review of the QAPP and TER.	QAPP & TER Review by Board of External Reviewers (BER)

- All water quality and material testing should be conducted at an Ecology Accredited Laboratory. Reference the following link for a full list of laboratories:
<https://fortress.wa.gov/ecy/laboratorysearch/>
- See TAPE Guidance document, Table 8 for a list of the required parameters and required screening parameters
- Qualifying conditions include but are not limited to: minimum rainfall depth and duration, minimum time between rainfall events, and range of influent pollutant concentration. See TAPE guidance document for more details, specifically Tables 2, 5-7.
- The Ecology treatment performance goals define the pollutant removal efficiency for the BMP: 80% TSS, 60% dissolved Zinc, 30% dissolved Copper, 50% Total Phosphorus, and < 10mg/L of Total Petroleum Hydrocarbons (TPH). The specific requirements are in Table 2 of the TAPE guidance document.
- TAPE Technical Evaluation Report (TER) guidance is define on page 35 of the **TAPE Guidance Document**.

QAPP Template References

1. Ecology, *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies*. 2011: Olympia.
2. EPA, *Guidance on Systematic Planning Using the Data Quality Objectives Process*. 2006: Washington, D.C. p. 120.
3. Guba, E.G., *Criteria for assessing the trustworthiness of naturalistic inquiries*. ECTJ, 1981. **29**(2): p. 75-91.
4. Ecology, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*. 2004, Washington State Department of Ecology: Olympia, WA.
5. Erickson, A.J., P.T. Weiss, and J.S. Gulliver, *Optimizing Stormwater Treatment Practices*.
6. United States Environmental Protection Agency, E., *Guidance for Quality Assurance Project Plans*. 2002, United States Environmental Protection Agency: Washington, DC.
7. *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies*. 2011: Olympia.
8. EPA, *Guidance on Environmental Data Verification and Data Validation*, in *U.S. Environmental Protection Agency Quality System Series*. 2002: Washington, DC.

Appendix 5 – Operational BMP QAPP Template

Eastern Washington Stormwater Effectiveness Studies

Detailed Study Design Proposal & Quality Assurance Project Plan (QAPP) Template

Study Title

Study Classification: *(select one)*

- Structural BMP Operational BMP Education & Outreach

Study Objective(s): *(indicate all that apply)*

- Evaluate Effectiveness Compare Effectiveness

Optional: Insert Graphic/Image/Photograph

Prepared For:

Contact Name

Lead Entity Jurisdiction

Department

Address

City, Washington, Zip Code

Phone Number

Art Jenkins **(Proposal Only)**

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Date

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Template Instructions

Brown text located throughout this document provides the QAPP Template user (user) with instructions and guidance for developing the section. **Text highlighted in yellow** should be replaced with the information that is relevant to the specific study. All brown instructional text and highlights should be replaced or deleted before the Detailed Study Design Proposal (**Proposal**) or the Quality Assurance Project Plan (**QAPP**) is finalized and submitted to Ecology for review. It may be appropriate to enter “**Not applicable**” for some sections with an explanation.

The template identifies the information expected in the QAPP. When the information expected in the Proposal is different than the QAPP, the differences are described in a box with the notation shown below. For sections without these notations, the user should assume the content is expected in both documents.

Proposal – Indicates the information expected in the Proposal. However, users are encouraged to provide as much information and detail as known at the time the Proposal is developed.

Prior to using the QAPP Template, the user should consult the following document for additional information: [Eastern Washington Stormwater Effectiveness Studies: Introduction to the Studies and Phase 3 Quality Assurance Project Plan \(QAPP\) Templates for Structural, Operational, and Education & Outreach BMPs](http://www.spokanevalley.org/content/6836/6914/8301/10121/default.aspx). The document is published on the City of Spokane Valley’s website: <http://www.spokanevalley.org/content/6836/6914/8301/10121/default.aspx>.

Disclaimer

This QAPP Template was developed specifically for the City of Spokane Valley and the Eastern Washington (EWA) jurisdictions to provide them with guidance in preparing the Proposal and QAPP for the Effectiveness Studies as defined in the 2014-2019 EWA Phase II Municipal Stormwater NPDES Permit. The guidance was developed based on the information that was available to the author(s) at the time this document was prepared. Although every effort has been made to make this document as complete and accurate as possible, the author(s) and document reviewers have neither liability nor responsibility for any loss or damage arising from information contained in this document or from informational errors or omissions.

The user of the QAPP Template is responsible for:

- Verifying that the Proposal and QAPP documents are developed following all applicable requirements and reflect good research practices
- Providing a level of detail throughout the Proposal and QAPP that is scaled appropriate to the complexity, cost, implications, and/or importance of the study
- Coordinating with the Lead Entity to verify study scope including the study classification and goals
- Developing an Ecology approved Proposal and QAPP document

Proposal Publication Information

Insert information about where the Proposal will be stored and accessible to the public (see section 15.2). Include a weblink and/or contact information.

Proposal Author and Contact Information

Insert author and contact information here:

Name
 Organization
 Title
 Address
 City, State, Zip Code
 email address
 phone number(s)

QAPP Publication Information

Proposal - Not required. Leave the header, along with the following note “Will be completed for the QAPP”, as a place holder for the development of the QAPP.

Insert information about where the QAPP will be stored and accessible to the public (see section 15.2). Include a weblink and/or contact information.

QAPP Author and Contact Information

Proposal - Not required. Leave the header, along with the following note “Will be completed for the QAPP”, as a place holder for the development of the QAPP.

Insert author and contact information here:

Name
 Organization
 Title
 Address
 City, State, Zip Code
 email address
 phone number(s)

Signature Page

Proposal – Only the party’s responsible for the contents of the Proposal and the project must sign date this page before the study proceeds to the QAPP development phase.

This page lists signatories to the document. Each party responsible for the contents of the QAPP and the project must sign and date this page before the study proceeds to the implementation phase (i.e. conduct the study).

Approved by:

Date

Name, Primary Author, Organization

Date

Name, Lead Entity, Jurisdiction

Date

Name, Participating Entity, Jurisdiction

Date

Name, Partner Entity, Jurisdiction

Date

Art Jenkins, City of Spokane Valley Grant Project Manager (Proposal Only)

Date

Name, Ecology Contact with Approving Authority

Date

Name, Lab Director (add a line for each additional lab)

Date

Name, Title

Date

Name, Title

1.0 Table of Contents

Proposal - Include all the Proposal sections, subsection headers, figures, tables, and appendices.

The Table of Contents (TOC) provides an outline of the QAPP content and organization including section headers, subsection headers, figures, tables, and appendices. The TOC should be auto generated using a word processing program.

SIGNATURE PAGE	IV
DISTRIBUTION LIST	V
1.0 TABLE OF CONTENTS	VI
2.0 EXECUTIVE SUMMARY	VIII
3.0 INTRODUCTION AND BACKGROUND	1
3.1 INTRODUCTION TO THE OPERATIONAL BMP	1
3.2 PROBLEM DESCRIPTION	1
3.3 RESULTS OF PRIOR STUDIES	2
3.4 REGULATORY REQUIREMENTS	2
4.0 PROJECT OVERVIEW	3
4.1 STUDY GOAL	3
4.2 STUDY DESCRIPTION AND OBJECTIVES:	3
4.3 STUDY LOCATION	3
4.4 DATA NEEDED TO MEET OBJECTIVES	4
4.5 TASKS REQUIRED TO CONDUCT STUDY	4
4.6 POTENTIAL CONSTRAINTS	4
5.0 ORGANIZATION AND SCHEDULE	5
5.1 KEY PROJECT TEAM MEMBERS: ROLES AND RESPONSIBILITIES	5
5.2 PROJECT SCHEDULE	6
5.3 BUDGET AND FUNDING SOURCES	6
6.0 QUALITY OBJECTIVES	7
7.0 EXPERIMENTAL DESIGN	11
7.1 STUDY DESIGN OVERVIEW	11
7.2 TEST-SITE(S) SELECTION PROCESS	11
7.3 OPERATIONAL BMP FUNCTION	12
7.4 TYPE OF DATA BEING COLLECTED	12
7.5 SAMPLE COLLECTION PROCESS AND DESIGN(S)	13
8.0 SAMPLING PROCEDURES	14
8.1 STANDARD OPERATING PROCEDURES	14
8.2 CONTAINERS, PRESERVATION METHODS, HOLDING TIMES	14
8.3 EQUIPMENT DECONTAMINATION	15
8.4 SAMPLE IDENTIFICATION	15
8.5 CHAIN OF CUSTODY	15
8.6 FIELD LOG REQUIREMENTS	15

9.0	MEASUREMENT PROCEDURES	17
9.1	PROCEDURES FOR COLLECTING FIELD MEASUREMENTS.....	17
9.2	LABORATORY PROCEDURES	17
9.3	SAMPLE PREPARATION METHODS	18
9.4	SPECIAL METHOD REQUIREMENTS	18
9.5	LAB(S) ACCREDITED FOR METHODS	18
10.0	QUALITY CONTROL	19
10.1	FIELD QC REQUIRED.....	19
10.2	LABORATORY QC REQUIRED.....	20
10.3	CORRECTIVE ACTION.....	20
11.0	DATA MANAGEMENT PLAN PROCEDURES	21
11.1	DATA RECORDING & REPORTING REQUIREMENTS.....	21
11.2	ELECTRONIC TRANSFER REQUIREMENTS	21
11.3	LABORATORY DATA PACKAGE REQUIREMENTS.....	21
11.4	PROCEDURES FOR MISSING DATA	22
11.5	ACCEPTANCE CRITERIA FOR EXISTING DATA.....	22
11.6	ENVIRONMENTAL INFORMATION MANAGEMENT (EIM) DATA UPLOAD PROCEDURES.....	22
12.0	AUDITS	23
12.1	TECHNICAL SYSTEM AUDITS	23
12.2	PROFICIENCY TESTING.....	24
13.0	DATA VERIFICATION AND USABILITY ASSESSMENT	25
13.1	FIELD DATA VERIFICATION	25
13.2	LABORATORY DATA VERIFICATION	25
13.3	DATA USABILITY ASSESSMENT.....	25
14.0	DATA ANALYSIS METHODS	26
14.1	DATA ANALYSIS METHODS.....	26
14.2	DATA PRESENTATION	26
15.0	REPORTING	27
15.1	FINAL REPORTING.....	27
15.2	DISSEMINATION OF PROJECT DOCUMENTS.....	27
16.0	REFERENCES	28
17.0	APPENDICES	29

2.0 Executive Summary

Proposal - Section 2.0 is not required. Leave the section, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

The executive summary is a brief (300-500 word) and non-technical summary of the project that is typically written for a more general audience and includes the “key” elements of the study. This may include:

- Description of the BMP(s) that is the focus of the study
- The study goals and objectives
- How those objectives will be accomplished
- Estimated duration of the study
- The location of the test-site(s)
- The anticipated study outcomes and modifications the permittee expects to make to their stormwater management program using the study findings

3.0 Introduction and Background

After reading this section, the reader should understand: the Operational BMP(s) that is the focus of this study, the reason(s) why the study is being conducted including results from prior studies, and the Stormwater Management Program conditions in the Eastern Washington (EWA) NPDES Municipal permit the study addresses.

3.1 Introduction to the Operational BMP

Proposal – at a minimum provide a general description for items listed; if possible provide detailed description (as much details as known at the time of proposal development)

This section provides a brief description of the Operational BMP(s) that is the focus of this study (i.e. what it is, how it typically functions, what it's supposed to do, etc.). (*A detailed description will be provided in Section 7.0*). Suggestions for this section include:

- Identify the BMP(s) name and provide a brief description of the jurisdictions typical BMP(s) operating procedures including frequency of operation, seasons of operation, etc.
- Indicate if the Operational BMP(s) is existing or proposed
- Provide general information about the equipment used to conduct the practice (i.e. type, model, manufacturer, etc.)
- Describe how the Operational BMP is intended to protect water quality and identify the targeted pollutants of concern

3.2 Problem Description

This section explains the reason(s) why the proposed effectiveness study is needed (i.e. this section should answer the question: what is the problem and why does problem need to be solved) and provide a basis for the identified problem. Suggestions for this section include:

- MS4 permit requirement to evaluate effectiveness of Operational BMP
- Limitations or challenges with the current practice (i.e. high cost, labor intensive for maintenance crew, etc.)
- Practice is not suitable for regional conditions (i.e. climatic conditions)
- Unknown or presumed information about the practice effectiveness

Provide a basis for the identified problem (i.e. justification that this is really a problem). This may include:

- History of relevant problems with the BMP and/or test-site
- A literature search from related studies
- Empirical observations made by the lead or participating entity and/or information collected from interviewing experts which may include individuals who work in the field.
- A description the conditions and how these conditions may impact the practice

3.3 *Results of Prior Studies*

Proposal - Section 3.3 is not required. Leave the section header, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section describes findings from previous studies that support the need for the study and/or the potential success of the study. Provide references for all documents that are sources of data or other information. Suggestions for this section include:

- A summary of a literature search of studies previously conducted or in progress (including relevant results) regarding the specific Structural BMP(s) that is the focus of this study
- Provide references for any reports that are sources of information or data provided.

3.4 *Regulatory Requirements*

This section identifies the specific Stormwater Management Program conditions or other conditions in the EWA NPDES Phase II Municipal Stormwater permit that the study will address. Include the relevant permit section(s) including S5.6 Municipal Operations and Maintenance.

4.0 Project Overview

The purpose of this section is to provide an overview of the entire study. If the reader only read this section, they should generally understand what the study intends to accomplish as well as how it will be accomplished (*save the details for the subsequent sections*).

4.1 Study Goal

Define all the study goal(s) (i.e. the reason(s) the study is being conducted). This should include:

- Whether the study intends to compare the effectiveness of more than one BMP and/or evaluate the effectiveness of one BMP
- Describe potential decisions that may be made as a result of this study. For example, describe modification(s) that may be made to a stormwater management program or how the study findings will be used to support implementation of future permit conditions.
- If applicable, indicate how the study could advance the regional understanding of Operational BMP(s)

4.2 Study Description and Objectives:

The section briefly describes how the study goal(s) will be accomplished (*the detailed description will be provided in Section 7.0*). This should include:

- A short description of the proposed study
- If the study has multiple phases, define the phases and identify the phase that is the focus of this study
- A list of all the study objectives (*note: an objective is a measurable statement that includes an action verb that defines how the project goal will be accomplished*)

4.3 Study Location

Proposal – At the proposal phase the test-site may not yet be selected as such it is only necessary to describe the general characteristics of the proposed test-site, indicate if control-sites will be used, and identify the number of potential sites

Identify and provide an overview of the location (test and control sites) where the study will be conducted (*the process and justification for selecting the site(s) should be described in Section 7.0*). Suggestions for this section include:

- Identify the test-site(s) locations, and if applicable the control-site(s), where the study will be conducted including the number of sites
- Briefly describe the various site characteristics (i.e. major land uses, average daily traffic, climatic conditions, etc.).

- If the study includes multiple test-sites and/or control sites; briefly, address how the sites compare (*more specific details regarding how sites should be compared are provided in Section 7.0*)
- Use maps, photos, and/or drawings to identify the location and boundaries of the test-site and control-site as well as any relevant stormwater features

4.4 *Data Needed to Meet Objectives*

This section describes the types of data and any other information that will be collected during the study, how the data will be collected, and the source of data. Indicate how the data will be used to support the project objectives.

Specify whether the study anticipates the use of computer modeling needed to achieve the study goals. If so, provide a brief description of the model being proposed, how the model will be used, and what data will be used to calibrate the model. (*Section 14.0 will be used to provide the details of the modeling being proposed and its value*).

4.5 *Tasks Required to Conduct Study*

Proposal – It is only necessary to provide the relevant information for the primary tasks

This section defines the tasks and subtasks needed to complete the study (similar to a condensed scope of work). This should include a general description of the work associated with each task including the objective that the task achieves and the anticipated deliverables. Recommend using a table to keep section brief.

4.6 *Potential Constraints*

Proposal – Provide a description based on the information known about the study

This section describes conditions that may impact the project schedule, budget, or scope and the steps that will be taken to reduce the impact of these conditions. Examples of constraints include climatic conditions, vandalism, availability of staff, equipment malfunction, study funding sources, limited access to the test-site, etc.

5.0 Organization and Schedule

The purpose of this section to describes who is responsible for completing the tasks, when the tasks will be completed, and how the study will be funded.

5.1 Key Project Team Members: Roles and Responsibilities

Proposal – At a minimum include the Lead Entity, Participating Entities, Partner Entities, the Proposal Author, and the Ecology Reviewer

Include key members of the project team, decision-makers, and/or stakeholders (i.e. lead and participating entities, project manager, test site owner/manager, analytical laboratory contacts, field personnel, third-party reviewer(s), etc.) and describe who is going to do what for the project.

Key Team Members	Role	Responsibility
Name Organization Phone Number Email	Lead Entity	Define
Name Organization Phone Number Email	Participating Entity	Define
Name Organization Phone Number Email	Partner Entity	Define
Name Organization Phone Number Email	Ecology Reviewer	Define
Name Organization Phone Number Email	Proposal Author	Define
Name Organization Phone Number Email	QAPP Author	Define
Name Organization Phone Number Email	Key Team Member Project Role	Define

5.2 *Project Schedule*

Proposal - Include the task duration, permit deadlines, and estimated time to complete the study.

This section defines the schedule for the proposed study. Organize the schedule into a table format that includes the same tasks and sub-tasks as listed in section 4.5, the expected start-end dates, deliverables, and deadlines for deliverables.

5.3 *Budget and Funding Sources*

Proposal – Provide an estimated budget for the study broken down by the primary tasks (in Section 4.5). Identify potential funding sources if known or indicate funding needs and any plans for obtaining study funds.

This section provides a budget for the implementation phase of the study and identifies how the study funding sources. Organize the budget into a table and separate the budget by study tasks and subtasks. Include items such as labor for sample/data collection, lab analyses fees, equipment purchase and assembly, test-site construction, any specialized contracting needed. Describe how the study will be funded and/or indicate if additional funding is needed to complete the study.

6.0 Quality Objectives

Proposal - Section 6.0 not required for Proposal however, the section header should be left as a placeholder along with the following note “This section will be completed for the QAPP.”

This section of the QAPP provides a roadmap of the QA/QC plan that will be employed throughout the experimental design and during the project. The information contained in this section is intended to provide the template user with an overview of the section contents and address conditions specific to Operational BMPs. Consult the **Ecology QAPP Guidance Document** [1] and **TAPE Guidance Document** [2] for detailed guidance on developing this section.

The goal of a QAPP is to ensure that the data collected during the study is scientifically and legally defensible [2]. The QAPP documents how quality assurance (QA) and quality control (QC) will be applied to a research project to assure that the results obtained are of the type and quality needed and expected. The QA/QC plan is embedded throughout the QAPP and emphasizes how the data quality indicators (DQIs) and respective measurement performance criteria (MPCs) are addressed during a project. DQIs are qualitative and quantitative measures that characterize the aspects of quality data [3]. DQIs are goals for data quality, specifically defined for each study, with the intent of minimizing error and improving the accuracy of the data. DQIs guide the development of the experimental design as well as the process of creating and analyzing data [4]. The six principle DQIs for Operational BMP studies are as follows: **Precision, Bias, Representativeness, Completeness, Comparability, and Sensitivity** [1]. Once established, the DQIs provide the basis for the MPCs which are; the acceptance criteria for the DQIs that specifies how good the data must be to meet the project objectives. Table 6.1 provides a summary of the DQIs along with potential approaches for addressing the DQIs and writing MPCs with an emphasis on Operational BMP studies. Studies that include analytical testing should consult the Quality Objectives section in the **Ecology TAPE Guidance Document** for additional guidance [2].

This section should include a brief written description that addresses how QA/QC is addressed throughout the QAPP. This may include:

- Identify and describe the various types of data that will be created during this study and the intended purpose of each type of data (i.e. how the data will be used to meet the project objectives)
- For each type of data briefly describe the process that will be used to measure the data including any equipment or instruments that will be used
- For each type of data, describe how the applicable DQIs are addressed in the experimental design as well as during the process of collecting and analyzing data
- For each applicable DQI, specify the MPCs that will be used to determine if the data is usable for meeting for project objectives
- Indicate the QC procedures that will be followed to minimize error and reference the applicable section(s) that define the QC procedures (see Section 10.0 Quality Control)

- Indicate the audits that will be performed to verify conformance to the QAPP and reference applicable sections that define the audit procedures (see Section 12.0 Audits)
- Describe the process that the study will employ to verify the quality of the data and assess the usability of each type of data (see 12.0 Data Verification and Usability Assessment)

Table 6.1 Summary of the Data Quality Indicators (DQIs) and Measurement Performance Criteria (MPC) for Operational BMP Studies

Data Quality Indicator (DQI)	Potential Approaches for Addressing DQI in Studies	Potential Approaches for Writing Measurement Performance Criteria (MPCs)
<p>Bias – A systematic error that results in sample values that are consistently distorted in one particular direction from the “true” or known value [3, 5]. Bias can result from improper data collection, poorly calibrated analytical or sampling equipment, or limitations or errors in analytical methods and techniques [2].</p>	<ul style="list-style-type: none"> • Calibrate instruments using reference materials or buffer solutions • Follow manufacturers’ recommendations for equipment maintenance (i.e. street sweepers, vector trucks, etc.) • Define and consistently follow SOPs for collecting samples and measuring data • For studies with analytical testing: analyze spiked matrix samples 	<p>Bias is quantified by comparing the measured value to the known value. For example:</p> <ul style="list-style-type: none"> • For analytical testing: use bias calculation defined in TAPE to determine whether acceptable criteria are met • Define minimum acceptable limits for calibration checks
<p>Precision – A measure of agreement among repeated measurements of the same property taken under identical or substantially similar conditions [3, 5, 6]. Data is considered precise when the measured values are consistently the same and imprecise when the measured values are consistently different [5]. Random error is a common cause of imprecise data and is always present because of normal variability in the many factors that affect measurement results. For example variability in sampling or data collection procedures and/or variations of the actual concentrations in the media being sampled [2].</p>	<ul style="list-style-type: none"> • Collection procedures are appropriate for the type of data and samples collected • SOPs are defined and consistently followed for collecting samples and measuring data • Use the same instrument or measurement procedure to make repeated measurements on the same sample (i.e. measure sediment accumulation twice preferably by two different individuals) • For studies that include analytical testing: have two labs conduct the same test on a sample (split samples) 	<p>Precision is quantified by repetition: repeating the analysis, measurement, procedure, etc. with the same sample or samples and calculating the range or standard deviation of the values. Precision may also be expressed as a percentage of the mean of the measurements, such as relative range or relative standard deviation (coefficient of variation) [6].</p>
<p>Representativeness – A qualitative term that expresses the degree to which the data accurately and precisely represents the conditions being evaluated [6]. Common variables considered when determining the degree of representativeness include the selected sampling locations, sampling frequency and duration, and sampling methods [2].</p>	<ul style="list-style-type: none"> • The study operational procedures are consistent with the typical jurisdictions operational procedures • Select sampling and data collection events that represent a range of conditions expected at the site with respect to rainfall volume and intensity or dry periods • For studies with analytical water testing, reference the Ecology TAPE Guidance Document to define DQIs related to this DQI: qualifying storms, composite vs discrete sampling, sampling duration, etc. 	<p>Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflects the condition being measured or studied. For example:</p> <ul style="list-style-type: none"> • Conduct an audit to verify equipment operational procedures for are consistently followed either by interviewing the field staff or through field observations; define MPCs based on how closely procedures are followed.

Data Quality Indicator (DQI)	Approaches for Addressing DQI in Studies	Approaches for Writing Measurement Performance Criteria (MPCs)
<p>Completeness - The amount of valid data needed to be obtained during the study to meet the project objectives [1].</p>	<ul style="list-style-type: none"> • Provide justification for sample size selected • For studies that include analytical water testing; define the acceptable sample size • Define procedures for handling missing data • Use appropriate coding for missing data • Report missing data with the results • Results should include consideration for how missing data could limit the comparability of the data set 	<p>Define the minimum number of valid measurements (samples collected and/or analyzed) [6]. For example:</p> <ul style="list-style-type: none"> • The data set is considered complete when the number of valid samples collected is equal to or greater than the sample size defined in by the DQI
<p>Comparability - A qualitative term that expresses the measure of confidence that one dataset can be compared to another and can be combined or contrasted for the decision(s) to be made. Data are comparable if sample collection techniques, measurement procedures, analytical methods, and reporting are equivalent for samples within a sample set, and meet acceptance criteria between sample sets. <u>For studies with the goal of comparing the effectiveness of practices, this DQI will need to be addressed specifically with respect to this goal.</u></p>	<ul style="list-style-type: none"> • Define the process and provide justification for selecting the test-site and control-site • Define the process and provide justification for selecting the sample size for every type of data collected • Define and justify the process applied to compare datasets between different studies • Use standard and consistent sample and data collection procedures • Use standard testing methods (analytical testing) 	<p>There is no quantitative MPC for comparability; use qualitative measures instead [6] such as compare sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and QA protocols [6].</p>
<p>Sensitivity - The capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest [6].</p>	<ul style="list-style-type: none"> • Determine the minimum concentration or attribute that can be measured by a method (method detection limit), by an instrument (instrument detection limit), or by a laboratory (quantitation limit) [7] • Select testing methods that have detection limits well above the reference level of the variable of interest [1]. • Select instruments capable of accurately measuring the different levels of the variable of interest expected during the study 	<ul style="list-style-type: none"> • Specify the minimum acceptable detection limit for the concentration or attribute being measured • Define how data measured below the detection limit will be handled • Verify the detection limit is equal or greater than that specified by the DQI

7.0 Experimental Design

The purpose of this section is to describe the experimental design that will be used to evaluate (and/or compare) the BMP effectiveness. This section also provides the basis for why the experimental design was selected and may include a literature search.

7.1 Study Design Overview

Proposal – Provide a summary of the conceptual study design

This section introduces the reader to the study design, specifically the approach to evaluating effectiveness, the justification for selecting this approach, and the primary elements of the study. Provide an overview of the study design similar to the level of detailed in an executive summary. The details of the design are included in the subsequent sections.

Note: Two common approaches for evaluating the effectiveness of operational BMPs include using paired basin or serial basin. The paired basin approach is where two almost identical sites are selected and the Operational BMP is implemented simultaneously on one site (test-site) and not the other one (control-site). Conversely, a serial basin approach is where only one test-site is selected and monitored over a period of time to establish baseline conditions and then the Operational BMP is implemented on the same test-site over another extended period of time.

7.2 Test-Site(s) Selection Process

Proposal – Describe the proposed selection process and criteria. If the sites have been selected, provide information about the actual process and criteria.

This section provides a detailed description of the test-site(s) and control-site(s) along with the justification for selecting the sites. Include maps, photos, and/or drawings (refer to section 4.3) as well examples of the tools/methods used for selection. This should include:

- Identify the site locations and provide justification for selecting the sites
- Provide a detailed description of the process and criteria for selecting the test-site(s), and if applicable the control-sites
- Define the variables that will influence selection and summarize the variables in tables. Variables will vary depending on the specific study goals. Examples include geographical area, land use classification, average daily traffic, site age and history, accessibility to sites, etc.
- When selecting paired basins, it is important to consider: the comparability of the sites; attempt to select sites with fewer variables (i.e. avoid streets with a vegetative canopy), and avoid sites with atypical activities that can influence pollutant accumulation
- Access and other field crew safety considerations are common criteria when selecting a test site or sites

This section should also describe how the applicable **DQIs** are addressed, specifically **Comparability**. Include references to **MPCs** defined in Section 6.

7.3 *Operational BMP Function*

Proposal – Provide general information for the elements identified in this section

This section describes how the Operational BMP(s) that are the focus of the effectiveness study functions and/or operates. Suggestions for this section include:

- An overview of the operational BMP procedures that the jurisdiction typically follows and/or that will be followed during the study (*include detailed procedures in Section 8.0*); include the frequency of the practice; any related inspections; seasons in which the practice will be conducted; provide a sketch/diagram of the project test-site including sample locations, etc.
- If the study operational procedures are different than the procedures the jurisdiction typically follows, explain why the procedures are different and how the differences were identified
- The type of equipment that will be used during the study; what the equipment is designed for; if provided by the manufacturer, indicate the operational performance relevant to the study (i.e. size of sediment particles the sweeper can pick up, efficiency for removing sediments unless the study is planning to determine that, etc.)

This section should also describe how the applicable **DQIs** are addressed, specifically **Representativeness**. Include references to **MPCs** defined in Section 6.

7.4 *Type of Data Being Collected*

This section identifies the various types of data that will be collected and define the intended purpose for each type of data. Recommended using tables to keep the section brief. Suggestions for this section include:

- For each data type identify the location for its collection, the anticipated frequency of its collection and the number of samples expected to be collected
- Include a schematic of the site(s) that identifies the limits of the contributing watershed including locations where each type of sample and/or data will be collected (consider adding equipment location to project site map, see Section 7.5)
- Provide justification for the selecting the sample size for every type of data, specifically address that the anticipated number of samples for each type of data is complete or expected to satisfy the project objectives

This section should also describe how the applicable **DQIs** are addressed, specifically **Completeness** of the sample size. Include references to **MPCs** defined in Section 6.

7.5 Sample Collection Process and Design(s)

Proposal – Provide the conceptual sample and data collection process(es) and design(s) for the various types of data including: a description of each process, and if applicable conceptual schematics of the various sample collection designs, and a list of the materials/equipment needed for the collection system.

This section describes the process (not the sample collection procedures) for collecting the various types of data and (if applicable) describe any system that was designed/developed for the purpose of collecting each type of data. Suggestions for this section include:

- Sample Collection Process – For each of the various types of data indicate how the data and samples will be collected (*define the procedures for collecting samples or data in Section 8.0*) including the anticipated duration of the sample collection process. Where possible include the guidelines used to ensure that the anticipated number of samples is representative or can accurately describe the condition being evaluated.
- Equipment – For each of the various types of data provide a detailed description of the equipment used to collect samples and/or data. If possible address the sensitivity and accuracy of the equipment. And when applicable include cut sheets for the equipment the in the appendix.
- Sample Collection System Design – For each of the various types of data that this is applicable to describe the sample collection system design. Provide schematic drawings (plans and profile) of the design and include a list of materials that will be used to construct the system if system construction is needed. Where possible include the guidelines used to ensure that the sample collection system design is representative, comparable, and complete.
- Drainage System Modifications – For each of the various types of data that this is applicable to describe any modifications to the existing drainage system made for the purpose of collecting data samples and provide any applicable pictures/drawings
- Maps – For each of the various types of equipment that will be installed, provide a project site map showing the locations (consider combining with any maps located in Section 7.4)

This section should also describe how the applicable **DQIs** are addressed, specifically **Representativeness** and **Sensitivity**. Include references to **MPCs** defined in Section 6.

8.0 Sampling Procedures

Proposal - Section 8.0 is not required. Leave the section and any subsection headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section defines the field sampling procedures for collecting each of the various types of data and the procedures for operating the equipment used to implement the Operational BMP (i.e. street sweepers, vactor trucks, etc.) at the test site. Defining these procedures and following them consistently will minimize errors and support the quality and representativeness of the collected samples. The information contained in this section is intended to provide the user with an overview of the section requirements and address conditions specific to Operational BMPs. The **QAPP Guidance Document** should be consulted for specific details about developing this section. For sampling procedures that include analytical testing, the user should also consult the **TAPE Guidance Document** (see the section titled Preparing a QAPP, Sampling Procedures).

This section should also describe how the applicable **DQIs** are addressed, specifically **Precision, Bias, and Representativeness**. Include references to **MPCs** defined in Section 6.

8.1 Standard Operating Procedures

This section describes the procedures that will be used in the field for sample collection and operating the equipment during the study. This will include standard operating procedures (SOPs), referencing published procedures, and/or standard methods. SOPs developed for the study should define how to conduct an activity in sufficient detail such that the activity could be replicated by an individual unfamiliar with the project (i.e. a third party). SOPs should include the frequency and location(s) of the activity. Example of SOPs the might be developed for Operational BMP studies include:

- Sample collection and handling (i.e. water and sediment)
- Operating street sweepers during the study at the test and/or control site
- Actions that will be taken to prevent operational and maintenance activities, not part of the experimental design, from inadvertently occurring at the test-site during the study
- Catch basin cleaning: removing sediment from catch basins after sample collection and/or measuring sediment accumulation
- Inspection of the test-site and installed equipment for damage or vandalism

8.2 Containers, Preservation Methods, Holding Times

This section only applies to studies that include analytical testing for water or sediment samples

Provide a table that lists the required containers, sample size, preservation, and holding times for each parameter. Requirements for these items should be coordinated with the laboratory that will be conducting the analytical testing.

8.3 *Equipment Decontamination*

This section only applies to studies that include analytical testing for water or sediment samples.

This section describes how the sampling equipment will be decontaminated between sampling events and how frequently consumable items will be replaced (unless defined in an SOP). This section should also describe procedures for disposing of any waste collected during the study (i.e. material removed from catch basins).

8.4 *Sample Identification*

This section defines the protocol for labeling (identifying) samples and data collected in the field during the study. This may include:

- identification numbers
- location, date & time
- sampler initials
- parameters, etc.

This section should also describe how the applicable **DQIs** that are addressed, specifically **Completeness**. Include references to **MPCs** defined in Section 6.

8.5 *Chain of Custody*

This section only applies to studies that include analytical testing for water or sediment samples.

Provide chain of custody procedures if the collected samples will leave the possession of the sample collector prior to measuring the sample (i.e. transferring possession of the sample to a lab for analytical testing). Include copies of the chain of custody form in the appendix.

8.6 *Field Log Requirements*

The purpose of this section is to define the field information that will be observed and logged during the data collection phase of the study. Developing a data collection template that addresses the data to be collected for each type of data will decrease the potential for errors or omitted data during field collection. Include a copy of any data collection templates in the appendix. Items that may be on a template may include:

- Date and time
- Field staff names
- Relevant climate conditions (i.e. raining, dry, overcast, sunny, air temperature and wind speed if known otherwise a qualitative statement regarding wind, etc.)
- Number of samples collected
- Sample description and label information

- Field measurements taken
- Field QC to verify sample identification
- Sampling equipment condition
- Instrument calibration checks
- Weigh of sediment accumulation
- Space for adding comments about activities or issues that may influence the quality of the data

9.0 Measurement Procedures

Proposal - Section 9.0 is not required. Leave the section and any subsection headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

Section 8.0 focused on sampling procedures, in other words how data is collected. The purpose of this section is to identify the methods required to measure the data collected during the study including the equipment and instruments. This may include laboratory procedures (i.e. water and sediment analytical testing) and field procedures (i.e. measuring sediment accumulation depths). Choosing standard recognized methods or defining SOPs and following them consistently will minimize errors. The information contained in this section is intended to provide the user with an overview of the section requirements and address conditions specific to Operational BMPs. The **QAPP Guidance Document** should be consulted for specific details when developing this section. For studies that include analytical testing, the user should also consult the **TAPE Guidance Document** (see the section titled Preparing a QAPP, Measurement Procedures).

This section should also describe how the applicable **DQIs** are addressed, specifically **Precision, Bias, and Sensitivity**. Include references to **MPCs** defined in Section 6.

9.1 Procedures for Collecting Field Measurements

This section describes the procedures that will be used to measure samples in the field during the study. This will include standard operating procedures (SOPs), referencing published procedures, and/or standard methods. The procedure(s) should include a definition of the parameter that will be measured and the frequency and number of measurements that will be taken. Define the quality control procedures that will be used to check the accuracy of the measurement along with the frequency of the checks (or reference the procedure in Section 10.0 Quality Control). If equipment or instruments are used in the field to measure data, include the manufacturer and model. Example of data that maybe measured in the field for Operational BMP studies include:

- Sediment accumulation in catch basins
- Wind speed or precipitation depth
- Sediment build-up on roadways. For example, visual inspection of roads for the purpose of characterizing sediment build-up (*SOPs may include qualitative methods for assessment*).

9.2 Laboratory Procedures

This section only applies to studies that include analytical testing for water or sediment samples.

This section defines the measurements procedures for all analytical testing. This section should contain information about the items noted below. Using table can help keep the section brief. Requirements for these items should be coordinated with the laboratory that will be conducting the analytical testing.

- Analyte
- Matrix
- Number of Samples
- Standard testing method
- Expected Range of results
- Detection limits

9.3 *Sample Preparation Methods*

This section only applies to studies that include analytical testing for water or sediment samples.

If the sample requires some form of preparation and/or extraction, this section should describe the respective techniques.

9.4 *Special Method Requirements*

This section only applies to studies that include analytical testing for water or sediment samples.

Identify any special requirements regarding testing methods in this section. This may include: analysis of very low or very high concentrations of analytes, the analysis of analyte with high levels of interference, and the use of non-standard methods.

9.5 *Lab(s) Accredited for Methods*

This section only applies to studies that include analytical testing for water or sediment samples.

Laboratory that conduct analytical testing must be accredited by Ecology for the specific sample matrix and testing method. A list of accredited labs can be found at the following weblink: <http://www.ecy.wa.gov/programs/eap/labs/index.html>. The section should identify the labs along with the sample matrix, testing method, and analyte.

10.0 Quality Control

Proposal - Section 10.0 is not required. Leave the section and any subsection headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section describes the QC procedures for lab and field activities that will be employed to minimize errors. The information contained in this section is intended to provide the user with an overview of the section requirements and address conditions specific to Operational BMPs. This section should be developed following the **QAPP Guidance Document [1]** and the **TAPE Guidance Document** (see section titled Preparing a QAPP, Quality Control) [2].

This section should also describe how the applicable **DQIs** that are addressed, specifically **Bias, Precision, Representativeness, and Comparability**. Include references to **MPCs** defined in Section 6.

10.1 Field QC Required

This section defines the QC procedures that will be implemented for field activities including the schedule and frequency. Recommended using tables to keep the section brief. The QC samples all will have MPCs associated with them, which will need to be met to obtain data that is fully usable. Examples of information that maybe included for Operational BMP studies include:

- Develop and consistently follow QC procedures for analytical testing including SOP for sample collection (see section 8.0, Sampling Procedures)
- Develop and consistently follow procedures for measuring data (i.e. sediment accumulation in catch basins and/or on the roadway), (see section 9.0, Measurement Procedures)
- Follow manufacturers equipment maintenance recommendations (i.e. street sweepers, vactor trucks, etc.); or indicate how the procedures deviate and provide justification for deviation
- Develop and consistently follow instrument calibration checks
- Create an equipment maintenance and instrumentation calibrate schedule that identifies: equipment, item, procedures, and frequency
- Develop and consistently follow record keeping procedures (see section 11.0, Data Management)
- Proper training of field staff on sampling procedures to ensure consistent and quality controlled sampling

10.2 *Laboratory QC Required*

This section only applies to studies that include analytical testing for water or sediment samples.

This section defines the QC measures that the lab will employ during the study. Recommended using tables to summarize the laboratory QC, keep the section brief. The QC samples all will have MPCs associated with them, which will need to be met to obtain data that is fully usable. The types of information that maybe included in this section are as follows:

- Blanks
- Duplicates
- Standard Reference Materials (SRM)
- Matrix Spikes
- Laboratory Control Samples (LCS)
- “Blind” SRMs submitted to the laboratory
- Surrogates

10.3 *Corrective Action*

This section defines the corrective action plan and procedures if the QC results indicate problems with data during the course of the project. Include in your project plan any additional procedures to be followed to correct or compensate for QC problems if they occur.

11.0 Data Management Plan Procedures

Proposal - Section 11.0 is not required. Leave the section and any subsection headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section defines the data management plans. It specifically describes how the data and other important project documents will be managed, stored, and archived during the study. These plans are developed to reduce the potential for errors during the data collection and analysis phases of the project. The **Ecology QAPP Guidance Document** may also provide guidance for developing this section [8].

This section should also describe how the applicable **DQIs** are addressed specifically. Include references to **MPCs** defined in Section 6.

11.1 Data Recording & Reporting Requirements

This section describes the procedures for recording data in the field and compiling the data collected (transferring the data to an electronic format). This may include:

- Developing a data collection template (i.e. standard form) that specifies each type of data to be collected (include a copy of any data collection templates in the appendix). Items may include: date and time, data collectors name(s), sample identification, specific instrument measures (i.e. questions), and a space for adding comments about issues that may influence the quality of the data
- Identify potential sources of error that may occur during data recording and reporting and provide procedures for detecting and correcting these errors.
- Indicate the software programs or databases that will be used to store the data.
- Specify the duration and responsible party for archiving the data.

11.2 Electronic Transfer Requirements

This section only applies to studies that will transfer data electronically

This section describes the project protocol for transferring data electronically during the data collection phase of the study. This may include transferring field and/or laboratory data to the user’s database.

11.3 Laboratory Data Package Requirements

This section only applies to studies that include analytical testing for water or sediment samples

This section defines the lab data package requirements which typically includes: a detailed case narrative that discusses potential problems with the analyses, corrective actions to be taken, changes to the referenced analytical methods, QC results, a list that defines each qualifier, etc.

The data package refers to records produced at the laboratory during analytical testing [6]. If analytical testing will be conducted at a laboratory, specify the requirements for the data package in this section. Note: the laboratory has a standard deliverable data package that it provides as part of the analytical testing. The user should review the standard data package during the development of the QAPP to determine if the QC data is relevant to the study and coordinate any project specific revisions or requirement with the laboratory.

11.4 Procedures for Missing Data

This section defines the project procedures for addressing missing data. This may include:

- Define procedures for handling missing data
- Use appropriate coding for missing data
- Report missing data with the results

This section should also describe how the applicable **DQIs** that are addressed, specifically **Completeness**. Include references to **MPCs** defined in Section 6.

11.5 Acceptance Criteria for Existing Data

This section only applies to projects that intend to use existing data (i.e. data not collected during this study).

This section defines the **acceptance criteria** that will be used to determine if a dataset can be compared to another and can be combined or contrasted for the decisions to be made during this study. List acceptance criteria for this data in terms of the applicable **DQIs**, particularly **Comparability**. Include references to **MPCs** defined in Section 6.

11.6 Environmental Information Management (EIM) Data Upload Procedures

This section describes how and when project data will be uploaded to EIM. Per section S8.B-9 of the MS4 permit, certain types of data collected for the effectiveness study should be entered into Ecology's EIM system before the end of the water year in which it is collected or within six months of collecting the sample, whichever is later.

12.0 Audits

Proposal - Section 12.0 is not required. Leave the section and any subsection headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section describes the types of audits that will be conducted, the audit process and procedures, number of audits, frequency, and who is responsible for conducting the audits. The **QAPP Guidance Document** includes two types of audits: Technical System Audit and Proficiency Testing. For the EWA Effectiveness Studies, both types of audits are recommended and maybe conducted by the Project Manager for the Study. Ideally, audits are conducted soon after work has commenced, so that corrective actions can be implemented early in the project. The information contained in this section is intended to provide the user with an overview of the section requirements and address conditions specific to Operational BMPs. For studies that include analytical testing, consult the developed following the **Ecology QAPP** and **TAPE Guidance Documents** for detailed guidance on developing this section.

This section should also describe how the applicable **DQIs** are addressed. Include references to **MPCs** defined in Section 6.

12.1 *Technical System Audits*

This section identifies the technical system audits that will be conducted during the study, defines the procedures for conducting the audit, and identifies the party responsible for conducting each audit. Technical System Audits are qualitative audits performed to verify that the study is conducted in conformance to the QA Project Plan. Ideally, the audit is conducted soon after work has commenced, so that corrective actions can be implemented early in the project. For the EWA Effectiveness studies, audits may be conducted by either the Project Manager or a third party.

Audit considerations for Operational BMPs may include:

- Define the procedures for conducting each audit
- Verify the field staff is following the SOPs for operating the equipment (i.e. for street sweeping and catch basin)
- Verify equipment and instruments are being maintained and/or calibrated per the manufacturers requirements
- Verify the field staff is following the SOPs for sample collection and taking measurements
- Verify the data management procedures are followed including field data recording

12.2 *Proficiency Testing*

This section only applies to studies that include analytical testing for water or sediment samples

This section defines the proficiency testing audits that will be conducted during the study. Proficiency testing is a quantitative determination of an analyte in a blind standard to evaluate the proficiency of the analyst or laboratory.

13.0 Data Verification and Usability Assessment

Proposal – Identify the data that will be verified

The section defines the process that the project will employ to evaluate the quality of the data and the usability of the data for meeting the project objectives. More specifically, to determine whether the MPCs were met for the applicable DQIs. This section should be developed following the **Ecology QAPP Guidance Document [1]** and **TAPE Guidance Document [2]**. The information contained herein is intended to provide the user with an overview of the typical section contents as well as items specific to Operational BMPs.

13.1 Field Data Verification

This section describes the process that will be employed to evaluate the quality of the data created in the field and identify responsible party for verifying the data. Ideally, data verification is performed by a person other than the one generating the data.

The field data verification process may include:

- Reviewing all the data records to ensure they are consistent, correct and complete, with no errors or omissions
- Review data records to verify the entries are consistent, correct, and complete,
- Review the results from the QC section
- Review the results from the audit section
- Describe how data below the lower reporting limit or detection limit will be handled
- Describe how the sampling system design and data will be evaluated to determine if the design has been adequate

13.2 Laboratory Data Verification

This section only applies to studies that include analytical testing for water or sediment samples.

This section describes the methods that will be employed to verify the laboratory data and identify responsible party for verifying the data. Ideally, data verification is performed by a person other than the one generating the data. Consult the **QAPP Guidance Document** for guidance on developing this section.

13.3 Data Usability Assessment

This section describes the procedures that will be used to establish the usability of the data for meeting the project objectives. This typically includes assessing whether the MPCs for have been met for each of the applicable **DQIs** have been met. Generally, if the MPCs have been met, then data should be of sufficient quality to be usable for meeting project objectives. If the MPCs have not been met, the user will need to decide if the data is still usable (and provide justification) or reject the data.

14.0 Data Analysis Methods

Proposal – Define what data will be analyzed and the types of analysis will be conducted analyzing the data (i.e. normality testing, hypothesis testing, removal efficiency, etc.)

This section defines the process and methods the project will use to analyze the data and address the study goals outlined in Section 4.0 as well as describe how the data will be presented in the final report.

14.1 Data Analysis Methods

This section describes the process and methods that will be employed to analyze the data. Suggestions for this section include:

- Summary of the process that will be used to analyze the data: how the effectiveness of each BMP will be evaluated and compared
- If applicable, describe any normality testing that will be conducted, for each type of data, to determine if the data is normally distributed (if applicable)
- Summary of hypothesis testing process and methods that will be used to analyze the data including the null and alternative hypothesis that will be evaluated
- Summary of any statistical calculations that will be used to analyze the data
- If applicable include the confidence interval, p-value, and/or level of statistical power
- Provide verification that: the analysis method is appropriate for the dataset, there is a sufficient number of samples for the method to be accurate, and that what statistical level of confidence will likely be achieved in the results
- If the study design anticipates the use of computer modeling, describe the model that is expected to be used here including the data that will be used to calibrate the model and how the potential errors in these simulated events will be statistically evaluated

14.2 Data Presentation

This section describes how the data will be presented (i.e. tables, charts, and/or graphs) in the final reports to illustrate trends, relationships, and anomalies.

15.0 Reporting

This section describes how the study findings will be reported and disseminated.

15.1 Final Reporting

Proposal - Section 15.1 is not required. Leave the section header, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section should identify the reports that are required for the project and the party responsible for preparing the reports. Reports required by the MS4 permit include:

- Annual Reports (S8.B8) – describe the interim results and status of the study
- Final Report (S8.B10) – report the final results of the study and the recommendations for future actions based on the findings. For the final report, provide an outline that identifies the contents of the final report (see Table 15.1 for proposed content).
- Fact Sheet or other method (i.e. videos) that summarizes the key points of the study along with the study findings. These documents are typically 2-4 pages in length.

Table 15.1 Proposed Effectiveness Study Report Content

Final Report Sections	Effectiveness Studies
0.0 Cover Letter	✓
1.0 Executive Summary	✓
2.0 Introduction	See Note 1
3.0 Operational BMP Description	See Note 1
4.0 Sampling Procedures	See Note 1
5.0 Data Summaries and Analysis	✓
6.0 Discussion	✓
7.0 Conclusions	✓
8.0 Future Action Recommendations	✓
9.0 Appendices	✓

1. Reference the approved QAPP for these sections. Indicate any changes made to the study since the QAPP was approved.

15.2 Dissemination of Project Documents

Proposal – For each document, describe the proposed process for dissemination.

The purpose of this section is to describe how the project findings (QAPP, final report, fact sheets/videos) will be disseminated to the public including where the electronic documents will be stored and accessible to the public (i.e. web sites).

16.0 References

In almost every case, the authors have referred to studies, reports, SOP's and the scientific literature in the preparation of this document. These references should be documented in this section using a consistent citation format (APA, MLA, etc.). Citation should be included in the body of the text where appropriate and do not include sources in this section that are not referred to in the text. This is a *reference* section and not a resources section (i.e. a section where you list everything you reviewed or found through a literature search when preparing the report).

17.0 Appendices

The appendices should include all supporting information for the items described in the body of the QAPP. Examples of possible appendices include:

- Standard Operating Procedures (SOP)
- Example Data Collection Form(s)
- Equipment Specification Sheets
- Instrument Specification Sheets
- Auditing Forms
- Example Chain of Custody Form(s)
- Plan Sheets, Maps, sketches, etc.

QAPP Template References

- 1. Ecology, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*. 2004, Washington State Department of Ecology: Olympia, WA.
- 2. Ecology, *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies*. 2011: Olympia.
- 3. EPA, *Guidance on Systematic Planning Using the Data Quality Objectives Process*. 2006: Washington, D.C. p. 120.
- 4. Guba, E.G., *Criteria for assessing the trustworthiness of naturalistic inquiries*. ECTJ, 1981. **29**(2): p. 75-91.
- 5. Erickson, A.J., P.T. Weiss, and J.S. Gulliver, *Optimizing Stormwater Treatment Practices*.
- 6. United States Environmental Protection Agency, E., *Guidance for Quality Assurance Project Plans*. 2002, United States Environmental Protection Agency: Washington, DC.
- 7. EPA, *EPA Guidance Document for Quality Assurance Project Plans*, O.o.E. Information, Editor. 2002, U.S. Environmental Protection Agency: Washington D.C. p. 111.
- 8. Ecology, *Guidance for Evaluating Emerging Stormwater Treatment Technologies - Technology Assessment Protocol - Ecology (TAPE)*. 2004, Washington State Department of Ecology: Olympia, WA.

Appendix 6 – Educational BMP QAPP Template

Eastern Washington Stormwater Effectiveness Studies

Detailed Study Design Proposal & Quality Assurance Project Plan (QAPP) Template

Study Title

Study Classification: *(select one)*

- Structural BMP Operational BMP Education & Outreach

Study Objective(s): *(indicate all that apply)*

- Evaluate Effectiveness Compare Effectiveness

Optional: Insert Graphic/Image/Photograph

Prepared For:

Contact Name

Lead Entity Jurisdiction

Department

Address

City, Washington, Zip Code

Phone Number

Art Jenkins **(Proposal Only)**

City of Spokane Valley

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Prepared By:

Organization

Address

City, Washington, Zip Code

Phone Number

Date

QAPP E&O Template Publication Information

This publication is available on the City of Spokane Valley's web page at:

<http://www.spokanevalley.org/content/6836/6914/8301/10121/default.aspx>

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Template Instructions

Brown text located throughout the QAPP Templates provides the user with instructions and guidance for developing the section. **Text highlighted in yellow** should be replaced with the information that is relevant to the specific study. All brown instructional text and highlights should be replaced or deleted before the Detailed Study Design Proposal (**Proposal**) or the Quality Assurance Project Plan (**QAPP**) is finalized and submitted to Ecology for review. It may be appropriate to enter “**Not applicable**” for some sections with an explanation.

The template identifies the information expected in the QAPP. When the information expected in the Proposal is different than the QAPP, the differences are described in a box with the notation shown below. For sections without these notations, the user should assume the content is expected in both documents.

Proposal – Indicates the information expected in the Proposal. However, users are encouraged to provide as much information and detail as known at the time the Proposal is developed.

Consult the following document for additional information regarding the EWA Effectiveness Studies and QAPP Templates: [Eastern Washington Stormwater Effectiveness Studies: Introduction to the Studies and Phase 3 Quality Assurance Project Plan \(QAPP\) Templates for Structural, Operational, and Education & Outreach BMPs](http://www.spokanevalley.org/content/6836/6914/8301/10121/default.aspx). The document is published on the City of Spokane Valley’s website at the following link:
<http://www.spokanevalley.org/content/6836/6914/8301/10121/default.aspx>.

Disclaimer

This QAPP Template was developed specifically for the City of Spokane Valley and the Eastern Washington (EWA) jurisdictions to provide them with guidance in preparing the Proposal and QAPP for the Effectiveness Studies as defined in the 2014-2019 EWA Phase II Municipal Stormwater NPDES Permit. The guidance was developed based on the information that was available to the author(s) at the time this document was prepared. Although every effort has been made to make this document as complete and accurate as possible, the author(s) and document reviewers have neither liability nor responsibility for any loss or damage arising from information contained in this document or from informational errors or omissions.

The user of the QAPP Template is responsible for:

- Verifying that the Proposal and QAPP documents are developed following all applicable requirements and reflect good research practices
- Providing a level of detail throughout the Proposal and QAPP that is scaled appropriate to the complexity, cost, implications, and/or importance of the study
- Coordinating with the Lead Entity to verify study scope including the study classification and goals
- Developing an Ecology approved Proposal and QAPP document

Proposal Publication Information

Insert information about where the Proposal will be stored and accessible to the public (see section 15.2). Include a weblink and/or contact information.

Proposal Author and Contact Information

Insert author and contact information here:

Name
Organization
Title
Address
City, State, Zip Code
email address
phone number(s)

QAPP Publication Information

Proposal - Not required. Leave the header, along with the following note “Will be completed for the QAPP”, as a place holder for the development of the QAPP

Insert information about where the QAPP will be stored and accessible to the public (see section 15.2). Include a weblink and/or contact information.

QAPP Author and Contact Information

Proposal - Not required. Leave the header, along with the following note “Will be completed for the QAPP”, as a place holder for the development of the QAPP

Insert author and contact information here:

Name
Organization
Title
Address
City, State, Zip Code
email address
phone number(s)

Signature Page

Proposal – Only the party’s responsible for the contents of the Proposal and the project must sign date this page before the study proceeds to the QAPP development phase

This page lists signatories to the document. Each party responsible for the contents of the QAPP and the project must sign and date this page before the study proceeds to the implementation phase (i.e. conduct the study).

Approved by:

Date
Name, Primary Author, Organization

Date
Name, Lead Entity, Jurisdiction

Date
Name, Participating Entity, Jurisdiction

Date
Name, Partner Entity, Jurisdiction

Date
Art Jenkins, City of Spokane Valley Grant Project Manager (Proposal Only)

Date
Name, Ecology Contact with Approving Authority

Date
Name, Title

Date
Name, Title

Distribution List

Proposal – At a minimum include: the lead entity, participating entities, Ecology, and the author of the document

List each party who will receive copies of the approved **QAPP** as well as any subsequent revisions along with their contact information. This may include those who is responsible for the QAPP development and project implementation including project managers, QA managers, representatives of other groups/agencies involved, field staff, etc.

Name, Title	Organization	Contact Information: Address, Telephone, E-mail

1.0 Table of Contents

Proposal - Include all the Proposal sections, subsection headers, figures, tables, and appendices.

The Table of Contents (TOC) provides an outline of the QAPP content and organization including section headers, subsection headers, figures, tables, and appendices. The TOC should be auto generated using a word processing program.

SIGNATURE PAGE	IV
DISTRIBUTION LIST	V
1.0 TABLE OF CONTENTS	VI
2.0 EXECUTIVE SUMMARY	VIII
3.0 BACKGROUND	IX
3.1 THE STORMWATER EDUCATION AND OUTREACH (E&O) PROGRAM.....	IX
3.2 PROBLEM DESCRIPTION	IX
3.3 RESULTS OF PRIOR STUDIES.....	X
3.4 REGULATORY REQUIREMENTS	X
4.0 PROJECT OVERVIEW	XI
4.1 STUDY GOAL.....	XI
4.2 STUDY DESCRIPTION AND OBJECTIVES:	XI
4.3 STUDY LOCATION AND/OR TARGET POPULATION	XI
4.4 DATA NEEDED TO MEET OBJECTIVES.....	XII
4.5 TASKS REQUIRED TO CONDUCT STUDY	XII
4.6 POTENTIAL CONSTRAINTS.....	XII
5.0 ORGANIZATION AND SCHEDULE	XIII
5.1 KEY PROJECT TEAM MEMBERS: ROLES AND RESPONSIBILITIES.....	XIII
5.2 PROJECT SCHEDULE	XIV
5.3 BUDGET AND FUNDING SOURCES	XIV
6.0 QUALITY OBJECTIVES	XV
7.0 EXPERIMENTAL DESIGN	18
7.1 STUDY DESIGN	18
7.2 PROCESS FOR SELECTING THE TEST-SITE AND TARGET POPULATION	18
7.3 TYPE OF DATA BEING COLLECTED	19
7.4 IMPLEMENTATION OF E&O PROGRAM COMPONENT DURING THE STUDY.....	19
7.5 OTHER E&O PROGRAMS	19
8.0 INSTRUMENT DESIGN AND DEVELOPMENT	20
8.1 INSTRUMENT DESIGN	20
8.2 PROCEDURES FOR COLLECTING DATA.....	20
8.2 INSTRUMENT VALIDATION.....	21
9.0 QUALITY CONTROL	23
9.1 STUDY QC PROCEDURES	23
9.2 CORRECTIVE ACTION	23

10.0	DATA MANAGEMENT PLAN PROCEDURES	24
10.1	DATA IDENTIFICATION.....	24
10.2	DATA RECORDING & REPORTING REQUIREMENTS.....	24
10.3	PROCEDURES FOR MISSING DATA.....	25
10.4	ACCEPTANCE CRITERIA FOR EXISTING DATA.....	25
11.0	AUDITS	26
12.0	DATA VERIFICATION AND USABILITY ASSESSMENT	27
12.1	DATA VERIFICATION.....	27
12.2	DATA USABILITY ASSESSMENT.....	27
13.0	DATA ANALYSIS METHODS	28
13.1	HYPOTHESIS TESTING.....	28
13.2	QUANTITATIVE DATA ANALYSIS METHODS.....	28
13.3	QUALITATIVE DATA ANALYSIS METHODS.....	28
13.3	DATA PRESENTATION METHODS:.....	29
14.0	REPORTING	30
14.1	FINAL REPORTING.....	30
14.2	DISSEMINATION OF PROJECT DOCUMENTS.....	30
15.0	REFERENCES	31
16.0	APPENDICES	32
	QAPP TEMPLATE APPENDIX A - SAMPLE SIZE DETERMINATION: CONSIDERATIONS & STRATEGIES	33
	QAPP TEMPLATE REFERENCES	35

2.0 Executive Summary

Proposal - Section 2.0 is not required. Leave the section, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

The executive summary is a non-technical summary of the project that is typically written for a more general audience and includes the “key” elements of the study. This may include:

- Description of the stormwater education and outreach program that is the focus of the study
- The study goals and objectives
- How those objectives will be accomplished
- Brief description of the instruments and how data will be collected and used
- The study area, target population, and estimated duration of the study
- The anticipated study outcome and modifications permittee expects to make to their stormwater management program using the study findings

3.0 Background

After reading this section, the reader should understand: the focus of the stormwater education and outreach program, the reason(s) why the study is being conducted including results from prior studies, and the stormwater management program conditions in the EWA NPDES Municipal permit the study addresses.

3.1 *The Stormwater Education and Outreach (E&O) Program*

Proposal – at a minimum provide a general description for items listed; if possible provide detailed description (as much details as known at the time of proposal development)

This section describes the stormwater E&O program(s) that is the focus of this study (i.e. what is it, why it is used, what is it intended to accomplish). If the study focus is to collect baseline data with the intent of using the data to develop a new E&O program, describe the proposed E&O program and how the data will be used to develop the program. Suggestions for this section include:

- Describe how the E&O program is typically implemented by the jurisdiction including the types educational materials that are used, the approach for distributing the materials, and outreach strategies. If applicable, include copies of the educational materials in the Appendix.
- Describe the E&O program including the learning objectives with respect to the MS4 permit requirements
- Identify the target population and/or the targeted behavior of concern
- Explain the connection between the E&O program and the target audience and/or targeted behavior of concern
- If applicable, identify the stormwater pollutants of concern relevant to the study

3.2 *Problem Description*

This section explains the reason(s) why the proposed effectiveness study is needed (i.e. this section should answer the question: what is the problem and why does problem need to be solved) and provide a basis for the identified problem. Suggestions for this section include:

- MS4 permit requirement to evaluate effectiveness of E&O program
- Limitations or challenges with the current E&O program (i.e. high cost, ineffective, etc.)
- Unknown or presumed information about the E&O program effectiveness
- Explain problems related to a behavior and/or target population

Provide a basis for the identified problem (i.e. justification that this is really a problem). This may include:

- History of relevant problems
- Literature search from related studies
- Empirical observations made by the lead or participating entity and/or information collected from interviewing experts which may include individuals who work in the field

3.3 *Results of Prior Studies*

Proposal - Section 3.3 not required. Leave the section header, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section describes findings from previous studies that support the need for the study and/or the potential success of the study. This may include:

- A summary of a literature search of studies previously conducted or in progress (including relevant results) regarding the specific Structural BMP(s) that is the focus of this study
- Provide references for any reports that are sources of information or data provided.

3.4 *Regulatory Requirements*

This section identifies the specific Stormwater Management Program conditions or other conditions in the EWA NPDES Phase II Municipal Stormwater permit that the study will address. Include the relevant permit section(s) including S5.1 Public Education and Outreach.

4.0 Project Overview

The purpose of this section is to provide an overview of the entire study. If the reader only reads this section, they should generally understand what the study intends to accomplish and how it will be accomplished.

4.1 Study Goal

Define all the study goal(s) (i.e. the reason(s) the study is being conducted). This should include:

- Whether the study intends to compare the effectiveness of more than program and/or evaluate the effectiveness of one E&O program
- Describe potential decisions that could be made as a result of this study. For example, describe modification(s) that may be made to a stormwater management program or how the study finding could be used to support implementation of future permit conditions
- If applicable, indicate how the study could advance the regional understanding of E&O programs

4.2 Study Description and Objectives:

The section briefly describes how the study goal(s) will be accomplished (*the detailed description will be provided in Section 7.0*). This should include:

- A short description of the proposed study
- If the study has multiple phases: provide a short description of each phases and specify the phase(s) that is the focus of this study
- A list of all the study objectives. An objective is a measurable statement that includes an action verb that defines how the project goal will be accomplished.

4.3 Study Location and/or Target Population

Proposal – at the proposal phase the target population and test-site might not yet be selected. It is necessary to describe the general characteristics of the proposed population and test-site, indicate whether control populations or sites will be used, the estimated sample size, and the proposed number of sites, as well as the general approach for determining the final targets.

Identify and provide an overview of the location where the study will be conducted (test and control sites) and the population the E&O program targets (*the process and justification for selecting the test-site(s) and target population will be described in Section 7.0*). Suggestions for this section include:

- Identify the number and location(s) of the test-site(s) and control-site(s)

- Provide a general description of the various test-site (and control-site) characteristics (i.e. major land uses, demographics, primary employment industries, types of businesses, etc.)
- Identify the target behavior and provide a connection to the target population(s)
- Identify and generally describe target (and control) population(s) (i.e. demographics, occupation status, profession, etc.) and the anticipated sample size
- If the study includes multiple sites and populations, briefly address how they compare (*more specific details regarding how sites and populations will be compared should be provided in Section 7.0*)
- Use maps, photos, and/or drawings to identify the boundaries of the test and control sites as well as any other relevant stormwater features

4.4 *Data Needed to Meet Objectives*

This section describes the types of data that will be collected during the study, the types of instruments that will be used to collect data, and the source of data. Indicate how the data will be used to support the project objectives.

4.5 *Tasks Required to Conduct Study*

Proposal – It is only necessary to provide the relevant information for the primary tasks.

This section defines the tasks and subtasks needed to complete the study (similar to a condensed scope of work). This should include a general description of the work associated with each task including the objective that the task achieves and the anticipated deliverables. Recommend using a table to keep section brief.

4.6 *Potential Constraints*

Proposal – Provide a description based on the information known about the study

This section describes the conditions that may impact the project schedule, budget, or scope and the steps that will be taken to reduce the impact of these conditions. Examples of constraints include availability of staff to conduct the study, insufficient funding sources, locating willing participants, etc.

5.0 Organization and Schedule

The purpose of this section is to describe who is responsible for completing the tasks, when the tasks will be completed, how much each task will cost, and how the study will be funded.

5.1 Key Project Team Members: Roles and Responsibilities

Include key members of the project team, decision-makers, and/or stakeholders (i.e. lead and participating entities, project manager, test site owner/manager, analytical laboratory contacts, field personnel, third-party reviewer(s), etc.)

Proposal – At a minimum include the Lead Entity, Participating Entities, Partner Entities, and the Ecology Reviewer

Key Team Members	Role	Responsibility
Name Organization Phone Number Email	Lead Entity	Define
Name Organization Phone Number Email	Participating Entity	Define
Name Organization Phone Number Email	Partner Entity	Define
Name Organization Phone Number Email	Ecology Reviewer	Define
Name Organization Phone Number Email	Proposal Author	Define
Name Organization Phone Number Email	QAPP Author	Define
Name Organization Phone Number Email	Key Team Member Project Role	Define

5.2 *Project Schedule*

Proposal - Include the task duration, permit deadlines, and estimated time to complete the study

This section defines the schedule for the proposed study. Organize the schedule into a table format that includes the same tasks and sub-tasks as listed in section 4.5, the expected start-end dates, deliverables, and deadlines for deliverables.

5.3 *Budget and Funding Sources*

Proposal – Provide an estimated budget for the study broken down by the primary tasks (in Section 4.5). Identify potential funding sources if known or indicate funding needs and any plans for obtaining study funds.

This section provides a budget for the implementation phase of the study and identifies the study funding sources. Organize the budget into a table and separate the budget by study tasks and subtasks. Include items such as labor for preparing and validating the instruments, collecting data, special training needs, distributing educational materials, and any specialized contracting needed (data validation and verification, social marketing firms, or other specialized services).

6.0 Quality Objectives

Proposal - Section 6.0 not required for Proposal however, the section header should be left as a placeholder along with the following note “This section will be completed for the QAPP.”

The goal of a QAPP is to ensure that the data collected during the study is scientifically and legally defensible [1]. The QAPP documents how quality assurance (QA) and quality control (QC) will be applied to a research project to assure that the results obtained are of the type and quality needed and expected. The QA/QC plan is embedded throughout the QAPP and emphasizes how the data quality indicators (DQIs) and respective measurement performance criteria (MPCs) will be applied to a project. DQIs are qualitative and quantitative measures that to characterize the aspects of quality data [2]. DQIs are goals for data quality, specifically defined for each study, that focus on minimizing error and improving the accuracy of the data. DQIs guide the development of the experimental design as well as the process of creating and analyzing data with the intent of establishing the trustworthiness [3]. Seven principle DQIs were identified for E&O programs based on common citations in the literature [3-9]. These DQIs are summarized in Table 6.1 and include: **Validity, Reliability, Objectivity, Credibility, Transferability, Completeness, and Integrity**. Once established, the DQIs provide the basis for the MPCs; the data performance or acceptance criteria that specifies how good the data must be to meet the project objectives.

The purpose of this section of the QAPP is to provide a roadmap of the QA/QC plan will be employed during the project. This section should include a brief written description that addresses how QA/QC is addressed throughout the QAPP. This may include:

- Identify and describe the various types of data that will be created during this study and the intended purpose of each type of data (i.e. how the data will be used to meet the project objectives)
- For each type of data briefly describe the process that will be used to measure the data including the type of instrument that will be used (*reference Section 8.0, Instrument Design and Development, for an overview and discussion regarding instruments*)
- For each type of data, briefly describe how the applicable DQIs are addressed in the experimental design as well as during the process of collecting and analyzing data
- For each applicable DQI, specify the MPCs that will be used to determine if the data is usable for meeting for project objectives
- Indicate the QC procedures that will be followed to reduce error and reference the applicable section(s) that define the QC procedures (see Section 9.0 Quality Control)
- Indicate the audits that will be performed to verify conformance to the QAPP and reference applicable sections that define the audit procedures (see Section 11.0 Audits)
- Describe the process that the study will employ to verify the quality of the data and assess the usability of the data (see 12.0 Data Verification and Usability Assessment)

Table 6.1 Summary of the Seven Principle Data Quality Indicators (DQIs) for E&O Studies

Data Quality Indicator (DQI)	Potential Approaches for Addressing DQI in Studies	Potential Approaches for Writing Measurement Performance Criteria (MPCs)
<p>Validity - Closeness between the measured value and the true value. An instrument is considered valid when it measures what it is purported to measure [5, 8].</p>	<ul style="list-style-type: none"> • Develop new instruments using acceptable methods such as an extensive literature search and focus groups • Write questions in language that is accessible to the target audience (i.e. 5th grade writing level) • Peer review of instrument by panel of experts • Field test to validate instruments before broad implementation • Use established instruments/questionnaire from similar studies that have already been validated 	<ul style="list-style-type: none"> • Define in terms of acceptable results from a peer review, field testing, and/or focus groups
<p>Reliability - The degree to which an instrument produces stable and consistent results on repeated measurements [5]. The level of precision or reliability, also called sampling error, is the range in which the true value of the population is estimated to be.</p>	<ul style="list-style-type: none"> • SOPs are defined and consistently followed for collecting and measuring data • Use multiple instruments to collect data (i.e. survey entire target audience and the interview small portion of audience to better understand responses) • Pilot testing instruments/questionnaire (i.e. using population(s) outside the study area) • Acceptable number of respondents • Reliability maybe verified using larger sample sizes • Test/re-test of instruments. • Inter-rater reliability of focus groups or peer review 	<ul style="list-style-type: none"> • Verify (through audits) that procedures are followed. Define MPCs in terms of acceptable audit results. • Define acceptable inter-rater reliability ratings
<p>Objectivity - Attempt to diminish or eliminate the investigators bias [7]. An objective investigator is neutral and open all sides of the argument without imposing their own bias, motivations, interested or perspectives [3, 5].</p>	<ul style="list-style-type: none"> • Remove investigator from direct contact with subjects [3] • Investigator avoids the use of prompts during interviews • Use data analysis procedures and methods that are appropriate for the types of data collected • Provide evidence that conclusions are based on findings (i.e. hypothesis testing or data coding) • SOPs are defined and consistently followed • SOPs are appropriate for study 	<ul style="list-style-type: none"> • Experimental design methods are explicated and replicable [3] • For qualitative methods, use peer debriefing to review and verify data codes and themes • Define acceptable inter-rater reliability ratings • For quantitative methods, use hypothesis testing to compare data sets at a defined confidence interval and statistical power
<p>Completeness - The amount of valid data needed to be obtained from the measurement system [4]. Data is considered complete when: the sample size is representative of the target population.</p>	<ul style="list-style-type: none"> • Sound justification is provided for sample size selected • Define procedures for handling missing data • Use appropriate coding for missing data • Report missing data with the results • Results should include consideration for how missing data could limit the transferability of the data set 	<ul style="list-style-type: none"> • Define the minimum acceptable sample size (see Appendix 1)

<p>Credibility – Credibility is often referred to as social desirability bias. This describes a type of response bias where survey respondents answer questions in a manner they believe will be viewed favorably by others. It can take the form of over-reporting "good behavior" or under-reporting "bad" or undesirable behavior [9].</p>	<ul style="list-style-type: none"> • Ask the same question with response categories in reverse order • Careful consideration of social desirability bias in the selection of instruments; how research is introduced; and how questions are worded [10]. (<i>see citation for additional information</i>) • Use multiple types of instruments and sources to collect and cross check data can assist the investigator in understanding and interpretation the response. For example, using mixed methods studies that include both qualitative and quantitative methods, comparing results from previous studies, etc. • Appropriate use of priming respondent (i.e. let them know it is okay to admit undesirable behavior) [6] 	<ul style="list-style-type: none"> • Define acceptable number of incorrect reverse order responses • Use mixed methods and define MPCs with respect to differences in responses between methods
<p>Transferability – The extent to which sample data can be transferred from a sample to a population. Datasets are considered transferable if the instruments, data sources, data collection procedures, sample selection procedures, and reporting are equivalent [1].</p>	<ul style="list-style-type: none"> • Define the process and provide justification for selecting the target audience and study area • Define the process and provide justification for selecting the sample size that is representative of the population(s) • Define and justify the process applied to for compare datasets between populations and/or study areas • Use sound sampling procedures that yield a sample representative of the population on key variables [5] • Use statistical comparisons to generalize study findings (i.e. for locations with different populations use a weighted average [11]) • Provide follow up procedures for non-respondents 	<ul style="list-style-type: none"> • Compare responses from target population to control population using hypothesis testing at a predefined confidence interval and statistical power
<p>Integrity - Integrity is concerned with minimizing errors through the process of collecting, recording, and analyzing data [5].</p>	<ul style="list-style-type: none"> • Develop and consistently follow SOPs during data collection • Develop and consistently follow data recording and reporting procedures. This may include using standard forms for data collection and reviewing the data to ensure it has been properly recorded and logged into data base. • Properly train those involved in data collection (define required training plan) • Provide assurances for maintaining respondent confidentiality (i.e. blind coding data) • Use data analysis procedures and methods that are appropriate for the types of data collected • Describe process for minimizing errors that could limit the generalizability of the study 	<ul style="list-style-type: none"> • Verify (through audits) that procedures are followed. Define MPCs in terms of acceptable audit results. • Define in terms of the training complete by staff compared to what is required in the training plan and/or define acceptable post training test results

7.0 Experimental Design

This section describes the experimental design that will be used to evaluate (and/or compare) the E&O program(s) effectiveness and/or develop an E&O program (i.e. collecting baseline data). This section also provides the basis for why the experimental design was selected and may include a literature search.

7.1 Study Design

Proposal – provide a summary of the conceptual study design including the methods, E&O program message, and target audience and/or behavior

This section describes the approach the study will follow to meet the specified objectives and provides a basis for the selected approach. (*Details regarding the instrument design and development along with the data collection procedures are provided in Section 8.0*). Suggestions for this section include:

- Discussion of how the study will evaluate the E&O program to determine if the learning objectives or strategies are achieved (i.e. how will you assess whether the target audience learned what they were supposed to learn and/or changed their behavior as a result of the program)
- Identify the E&O program message and target population and/or target behavior
- Identify and generally describe the types of instruments that will be used to measure the data, how the instruments will be administered, and the focus of the questions that will be asked
- Identify the types of data that will be collected and briefly describe how the data will be collected
- Indicate whether multiple methods will be used

This section should also describe how the applicable **DQIs** are addressed, specifically **Objectivity**. Include references to MPCs defined in Section 6.

7.2 Process for Selecting the Test-Site and Target Population

Proposal – describe the proposed selection process and criteria. If the sites and/or populations have been selected, provide information about the actual process and criteria.

This section provides a detailed description of the study area and the target population along with the justification for selecting the area and populations. Include maps, photos, and/or drawings (refer to section 4.3) as well examples of the tools/methods used for selection. Some suggestions for this section include:

- Identify the site locations and populations

- Provide a detailed description of the process and criteria for selecting the target population, test-site(s), and if applicable the control-sites and control population.
- Define the variables that will influence selection and summarize the variables in tables. Variables will vary depending on specific study goals. Examples include: the geographical area, land use classification, demographics, primary employment industries, types businesses, accessibility, etc.
- Provide a justification for selection

This section should also describe how the applicable **DQIs** are addressed, specifically **Transferability**. Include references to MPCs defined in Section 6.

7.3 *Type of Data being Collected*

This section describes the various types of data that will be collected and what the intended purpose is for each with respect to meeting the project objectives. For each data type identify the location for its collection, the anticipated frequency of collection and the number of samples expected to be collected (recommend using Tables to keep the section brief).

This section should also describe how the applicable **DQIs** are addressed, specifically **Completeness** of the sample size as representative of the target population. Include references to MPCs defined in Section 6.

7.4 *Implementation of E&O Program Component During the Study*

This section only applies if the specific E&O program component that is the subject of study will be implemented during the study and is part of the experimental design.

This section explains how the E&O program component that is the subject of this study will be implemented during the study, specifically whether it is a new or ongoing activity, and explain if there are any differences from what was described in Section 3.1.

7.5 *Other E&O Programs*

Proposal - Section 7.5 is not required. Leave the section header along with the following note "This section will be completed for the QAPP" as a place holder for the QAPP.

This section identifies and defines any other E&O programs in the study or control area that may influence the target populations' responses. This should include details regarding the process to determine if there are other E&O programs.

8.0 Instrument Design and Development

Proposal - Section 8.0 is not required. Leave the section and any section headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section describes the instrument(s) that will be used during the study along with the process used to develop and validate the instruments. If the instruments will be developed after the QAPP is complete, this section should define the process that will be followed to develop the instruments, the types of instruments proposed, and the focus of the questions that will be included.

In the context of E&O studies, instruments are a measurement device (i.e. a survey, test, observation log, focus group, etc.) used to assess what the researcher wants to know. For example, survey questions maybe designed to assess the target population’s perceptions, knowledge, attitudes, and/or behaviors regarding a specific topic. Instruments fall into two broad categories, researcher-completed (RC) and subject-completed (SC), distinguished by those that the researcher administers versus those that are completed by the participants. An example of a researcher-completed instrument would be a form completed during one on one interviews or during focus groups. An example of a subject-completed instrument is a survey questionnaires that subjects complete following specific instructions [8]. Instruments may also be classified as qualitative (i.e. open ended questions) or quantitative (i.e. multiple choice surveys). The term mixed methods apply to studies that use both qualitative and quantitative methods [12].

8.1 Instrument Design

This section describes how the instruments were designed and developed. This may include:

- Identify the instruments (surveys, interview questions, etc.) proposed to measure or compare effectiveness for an E&O program and/or assess the target population’s perceptions/knowledge/attitudes/behaviors (i.e. collect baseline data)
- Describe how/why the instruments were designed to collect data from the target population and provide a basis for the selected design (may include a summary of literature)
- Include a copy of the instrument with the survey and/or interview questions (attachment)

This section should also describe how the applicable **DQIs** are addressed, specifically **Validity**, **Reliability**, **Objectivity**, and **Credibility**. Include references to MPCs defined in Section 6.

8.2 Procedures for Collecting Data

This section defines the procedures for collecting the various types of data created during the study. Defining these procedures and following them consistently will minimize errors and support the Integrity of the collected data. Standard operating procedures (SOPs) are the procedures that define specifically how to conduct an activity. SOPs should provide sufficient

detail such that the activity is repeatable and can be reproduced by an individual (i.e. third party) unfamiliar with the project. If the SOPs will be developed after the QAPP is complete, this section should describe the general approach for collecting data and indicate when they will be developed (i.e. specify the relevant task and schedule).

This section should also describe how the applicable **DQIs** are addressed, specifically **Objectivity, Reliability, Integrity, and Transferability**. Include references to MPCs defined in Section 6.

SOPs for E&O studies may include:

- Instructions that will be provided to the participant before they take the survey
- How the instruments will be disseminated to the target population (i.e. mailer, email, web based polls, social media, list-serve, one-on-one or group interview, etc.)
- How interviews will be conducted including instructions provided to the participant before starting an interview; how to address the participant's questions during the interview; and how to address prompting and/or priming participants
- What data will be recorded (also see section 10.0 Data Recording and Management Procedures)

8.2 *Instrument Validation*

This section describes the process that will be employed to validate the instruments. After the instrument(s) have been developed, the next step is to validate the instrument. Validation is the process to verify the instrument measures what it was intended to measure and produces stable results [3]. This section may include:

- The use of established instruments from similar studies that have already been validated
- Field testing of instruments before broad implementation (i.e. focus groups, pilot testing, etc.)
- Asking the same question with response categories read in reverse order (quantitative data)
- Using peer debriefing: independent reviewers who verify codes/themes for a portion of the responses; then the reviewers compare, discuss, and modify their codes/themes until they mutually agree (qualitative).
- Defining acceptable interrater reliability ratings (for MPCs)
- Using multiple methods
- Peer review of instrument/questionnaire by panel of experts

This section should also describe how the applicable **DQIs** that are addressed, specifically **Validity, Reliability, Credibility, and Objectivity**. Include references to MPCs defined in Section 6.

9.0 Quality Control

Proposal - Section 9.0 is not required. Leave the section and any section headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

The purpose of this section is to describe the QC procedures that will be employed during the study to minimizing errors and support the integrity of the data through the process of collecting, recording, and analyzing data [5]. Recommend using tables to keep the section brief.

9.1 Study QC Procedures

For all the data that will be created during this study, explain how QC will be addressed to minimize errors (if QC procedures have been addressed in other sections, then identify the procedure with respect to the data and reference the applicable section).

This section should also describe how the applicable **DQIs** are addressed, specifically **Reliability, Integrity, and Objectivity**. Include references to MPCs defined in Section 6.

This may include:

- Properly training those involved in data collection
- Develop and consistently follow SOPs during data collection (reference section 8.0)
- Develop and consistently follow data recording and reporting procedures (reference section 10.0)
- Develop and consistently use standard forms for data collection (see section 10.0)
- Conduct Audits using third party (see section 11.0)

9.2 Corrective Action

This section defines the corrective action plan and procedures if the QC results indicate problems during the course of the project. Include in your project plan any additional procedures to be followed to correct or compensate for QC problems if they occur.

10.0 Data Management Plan Procedures

Proposal - Section 10.0 is not required. Leave the section and any section headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section defines the data management plan, specifically how the data collected and other important project documents will be managed, stored, and archived during the study. The reason data management plans are developed is to reduce the potential for errors during the data collection and analysis phases of the project; this also ensures that should an unanticipated change in Key Team Members takes place, the project can be more easily continued by a new team member.

10.1 Data Identification

This section defines the protocol for identifying data collected during the study. This may include:

- identification numbers
- location, date & time
- sampler initials
- blind coding data to respect respondent’s confidentiality, etc.

This section should also describe how the applicable **DQIs** that are addressed, specifically **Integrity**. Include references to MPCs defined in Section 6.

10.2 Data Recording & Reporting Requirements

This section describes the procedures for recording data in the field and compiling the data collected (transferring the data to an electronic format). This may include:

- Developing a data collection template (i.e. standard form) that specifies the data to be collected for each instrument (include a copy of any data collection templates in the appendix). Items that may be on the template include: date and time, data collectors name(s), Sample identification, specific instrument measures (i.e. questions), and a space for adding comments about issues that may influence the quality of the data
- Identify potential sources of error that may occur during data reporting and provide procedures for detecting and correcting these errors.
- Indicate the software programs or databases that will be used to store the data.
- Specify the duration and responsible party for archiving the data.

This section should also describe how the applicable **DQIs** that are addressed, specifically **Integrity**. Include references to **MPCs** defined in Section 6.

10.3 Procedures for Missing Data

This section defines the project procedures for addressing missing data. This section should also describe how the applicable **DQIs** that are addressed, specifically **Completeness**. Include references to **MPCs** defined in Section 6. This may include:

- Define procedures for handling missing data
- Use appropriate coding for missing data
- Report missing data with the results

10.4 Acceptance Criteria for Existing Data

This section only applies to projects that intend to use existing data (i.e. data not collected during this study).

This section defines the **acceptance criteria** that will be used to determine if a dataset can be compared to another and can be combined or contrasted for the decisions to be made during this study. List acceptance criteria for this data in terms of the applicable **DQIs**, particularly **Transferability**. Include references to **MPCs** defined in Section 6.

11.0 Audits

Proposal - Section 11.0 is not required. Leave the section and any section headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

The purpose of an audit is to verify conformance to the QA Project Plan. Audits are typically conducted soon after work has commenced, so that corrective actions can be implemented early in the project. This section describes what will be audited including the audit process and procedures, number of audits, schedule, frequency, and who is responsible for conducting the audits. For the EWA Effectiveness studies, audits may be conducted by either the Project Manager or a third party.

This section also describes how the applicable **DQIs** are addressed to ensure the usability of this data, specifically **Integrity** and **Reliability**. Include references to **MPCs** defined in Section 6.

Some audit considerations for E&O studies include:

- Verify the field staff have completed the required training and are following the SOPs for sample collection
- Verify the data management procedures are followed including recording the data in the field
- Confirm instrument validation procedures are followed
- Verify the process defined for selecting test-sites and target population was followed

12.0 Data Verification and Usability Assessment

Proposal – Identify the data that will be verified

This section defines the process that the project will employ to verify the instruments, evaluate the quality of the data, and evaluate the usability of the data for meeting the project objectives.

12.1 Data Verification

This section describes the process that will be employed to evaluate the quality of the data created during the study and identify responsible party for verifying the data. Ideally, data verification is performed by a person other than the one generating the data.

The data verification process may include:

- Review all the data records to ensure they are consistent, correct and complete, with no errors or omissions
- Review the results from the QC section
- Review the results from the audit section
- Examine data to determine if MPC's were met

12.2 Data Usability Assessment

This section describes the process and procedures that will be used to establish the usability of the data for meeting the project objectives. This should include:

- Results from the data verification
- Whether the MPCs for the project have been met. Generally, if the MPCs have been met, then data should be of sufficient quality to be usable for meeting project objectives. If the MPCs have not been met for data, the user will need to decide if the data is still usable or reject the data.

13.0 Data Analysis Methods

Proposal – Define what data will be analyzed and the types of analysis will be conducted analyzing the data (i.e. hypothesis testing, qualitative and quantitative data analysis, etc.)

This section defines the process and methods the project will use to analyze the data and address the study goals outlined in Section 4.0.

This section should address whether the **DQIs** have been met including: **Objectivity, Integrity, and Transferability**.

13.1 Hypothesis Testing

This section describes the process and methods that will be used to conduct hypothesis testing. For datasets that will be compared, (i.e. between the test-site and the control-site or between baseline and post responses), describe how the datasets will be analyzed to determine if there is a statistically significant difference. Suggestions for this section include:

- Summary of the hypothesis testing process and methods that will be used to analyze the data including the null and alternative hypothesis that will be evaluated
- Describe how/why the methods are appropriate for the types and quantity of data. This is particularly important for non-normally distributed data and ordinal data.

13.2 Quantitative Data Analysis Methods

This section describes the process and methods that will be used to analyze quantitative data. Suggestions for this section include:

- Summary of methods that will be used to analyze the data
- Summary of methods that will be used to compare data sets
- A description regarding how multiple choice surveys will be coded with a Likert scale
- Provide verification that: the analysis method is appropriate for the dataset, there is a sufficient number of samples for the method to be accurate, and that what statistical level of confidence will likely be achieved in the results

13.3 Qualitative Data Analysis Methods

This section describes the process and methods that will be used to analyze qualitative data. This typically includes [12]:

- Organizing the data into spreadsheets and categorizing the data into themes and codes
- Connecting the data to show how one concept may influence another

- Using a peer debriefing process to validate the codes and themes by having other researchers review the codes, evaluating alternative explanations, disconfirming evidence, and searching for negative cases
- Summary of methods that will be used to determine the number of similar or dissimilar responses

13.3 *Data Presentation Methods:*

The purpose of this section is to describe how the data will be presented (i.e. tables, charts, and/or graphs) in the final reports to illustrate trends, relationships, and anomalies.

14.0 Reporting

This section describes how the study findings will be reported and disseminated.

14.1 Final Reporting

Proposal - Section 14.1 is not required. Leave the section and subsection headers, along with the following note “This section will be completed for the QAPP”, as a place holder for the development of the QAPP.

This section should identify the reports that are required for the project and the party responsible for preparing the reports. Reports required by the MS4 permit include:

- Annual Reports (S8.B8) – describe the interim results and status of the study
- Final Report (S8.B10) – report the final results of the study and the recommendations for future actions based on the findings. For the final report, provide an outline that identifies the contents of the final report (see Table 12.2 for proposed content).
- Fact Sheet or other method (i.e. videos) are recommended for describing the key points of the study.

Table 12.2 Proposed Effectiveness Study Report Content

Final Report Sections	Effectiveness Studies
0.0 Cover Letter	✓
1.0 Executive Summary	✓
2.0 Introduction	See Note 1
3.0 Technology Description	See Note 1
4.0 Sampling Procedures	See Note 1
5.0 Data Summaries and Analysis	✓
6.0 Discussion	✓
7.0 Conclusions	✓
8.0 Future Action Recommendations	✓

1. Reference the approved QAPP for these sections. Indicate any changes made to the study since the QAPP was approved.

14.2 Dissemination of Project Documents

Proposal – For each document, describe the proposed process for dissemination.

This section describes how the project findings (QAPP, final report, fact sheets/videos) will be disseminated to the public including where the electronic documents will be stored and accessible to the public (i.e. web sites).

15.0 References

In almost every case, the authors have referred to studies, reports, SOP's and the scientific literature in the preparation of this document. These references should be documented in this section using a consistent citation format (APA, MLA, etc.). Citation should be included in the body of the text where appropriate and do not include sources in this section that are not referred to in the text. This is a *reference* section and not a resources section (i.e. a section where you list everything you reviewed or found through a literature search when preparing the report).

16.0 Appendices

The appendices should include all supporting information for the items described in the body of the QAPP. Examples of possible appendices include:

1. Examples of Educational Materials
2. Standard Operating Procedures (SOP)
3. Example Data Collection Form(s)
4. Auditing Forms
5. Examples of Instruments
6. Plan Sheets, Maps, sketches, etc.

QAPP Template Appendix A - Sample Size Determination: Considerations & Strategies

There is no standard sample size. Sample size is dependent on a number of variables including the research approach and goal(s), decisions that could be made a result of the study, and the available resources. This section provides an outline of *some* consideration and strategies that may assist in determining the sample size for a particular a study. For more details on the information presented in this section, consult the documents referenced in this section.

A-1.0 Considerations for Determining Sample Size for Hypothesis Testing [13]

1. **Criteria for Statistical Significance:** sample size is inversely related to the significance level
 - Probability of rejecting null hypothesis (H_0), given that H_0 is true
 - Type I error – due to sampling errors
 - α = Chance of making Type 1 error
 - $\alpha = 0.05$ (common in social sciences)
 - Probability of rejecting null hypothesis (H_0), given that H_0 is false
 - Confidence Interval (CI) or risk level
 - If $\alpha = 0.05$ then CI = 95%
2. **Level of Statistical Power:** reduce chance of type II error by taking larger sample size (statistical power increases as sample size increases)
 - Statistical Power - Probability of **NOT** rejecting H_0 , given that H_0 is false
 - Type II Error
 - Less of a concern, but cannot ignore
 - Typical Statistical Power values: 0.70 to 0.85
 - Statistical Power - Chance of making Type II error depends upon:
 - Sample Size
 - Actual Value of Parameter
3. **Statistical Analysis Strategy:** data analysis procedures (the more independent variables, the more subjects needed).
 - Data analysis procedure for testing hypothesis depend upon:
 - Research Approach – (i.e. case studies)
 - Research question of interest
 - Nature or type of variables studied
 - Analysis strategies that consider more information about subjects, require fewer subjects
 - Quantitative Independent variables require fewer subjects compared to qualitative Independent variables

- Studies with data collected pre and post require fewer subjects compared to post alone
 - Generally, 12 samples are the minimum number of samples acceptable for most statistical analysis methods [6]
4. **Effect Size** (judged to be meaningful): Degree to which the null hypothesis is false (degree of variability)
- When comparing two population means:
 - Difference is large → smaller sample size
 - Difference is small → larger sample size
 - The more heterogeneous a population → larger sample size needed
 - The more homogeneous a population → smaller sample size needed
 - Effect size in relation to assessment tool or instrument
 - New tools – more difficult to detect effect size
 - Use established tools or pilot test tools

A-2.0 Additional Strategies for Determining Sample Size [14]

1. Using a Census for Small Populations
 - Approach: Sample the entire population
 - Best for small populations, provides highest level of precision
2. Using a Sample Size of a Similar Study
 - Approach: Use the same or typical sample size as similar studies (literature search)
 - Carefully review procedures to avoid repeating study errors
3. Using Published Tables
 - Approach: Rely on published tables to provide sample size based on a given set of criteria
 - Typical Criteria: Statistical Significance, Statistical Power, Degree of Variability
4. Using Formulas to Calculate Sample Size (online calculators)
 - Approach: Calculate sample size
 - Use when combinations of different criteria are needed to select sample size
 - Add examples

QAPP Template References

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3. Guba, E.G., *Criteria for assessing the trustworthiness of naturalistic inquiries*. ECTJ, 1981. **29**(2): p. 75-91.
4. Ecology, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*. 2004, Washington State Department of Ecology: Olympia, WA.
5. Radhakrishna, R., et al., *Ensuring data quality in extension Research and evaluation studies*. Journal of Extension, 2012. **50**(3): p. n3.
6. McKenzie-Mohr, D., *Fostering sustainable behavior: An introduction to community-based social marketing*. 2013: New society publishers.
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