

Eastern Washington Stormwater Effectiveness Studies

Technical Evaluation Report (TER)

BMP Inspection and Maintenance Responsibilities for Privately Owned Facilities

Study Classification:

Structural BMP Operational BMP Education & Outreach

Study Objective(s):

Evaluate Effectiveness Compare Effectiveness



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Prepared For:

Yakima County Public Services
128 N. 2nd St. 4th Floor Courthouse
Yakima, WA 98901
(509)720-5018

Prepared By:

Osborn Consulting, Inc.
101 South Stevens Street
Spokane, WA 99201
(509) 867-3654

QAPP and TER Publication Information

The Quality Assurance Project Plan (QAPP) and Technical Evaluation Report (TER) will be available to the public on the Yakima County Public Service webpage:

[http://www.yakimacounty.us/1732/Stormwater-Management.](http://www.yakimacounty.us/1732/Stormwater-Management)

For questions regarding the project, please contact David Haws by email david.haws@co.yakima.wa.us or phone (509) 574-2277.

TER Authors and Contact Information

Aimee S. Navickis-Brasch, PhD, PE
Osborn Consulting, Inc.
Senior Project Manager & Stormwater Engineer
101 South Stevens Street
Spokane, WA 99201
aimeen@osbornconsulting.com
509-867-3654 Ext. 301

Taylor Hoffman-Ballard, PE
Osborn Consulting, Inc.
Project Engineer
101 South Stevens Street
Spokane, WA 99201
taylorh@osbornconsulting.com
509-867-3654 Ext. 302

Kevin Flanagan, EIT
Osborn Consulting, Inc.
Project Engineer
101 South Stevens Street
Spokane, WA 99201
509-867-3654 Ext. 307

Kali Ledeboer
Osborn Consulting, Inc.
Engineering Intern
101 South Stevens Street
Spokane, WA 99201

Francisco Jimenez
Osborn Consulting, Inc.
Engineering Intern
101 South Stevens Street
Spokane, WA 99201

Document History

This study was conducted following the QAPP which can be accessed at the link on the previous page. The study started in December 2020 and the last data was collected in July 2021. The findings of the study were presented and submitted to the Technical Advisory Group (TAG) in August 2021 for review and comment. No comments were received at the time of this document. The final TER was submitted to Ecology in October 2021.

Distribution List

This section includes the distribution list for each party who will receive an Ecology-approved copy of the Proposal.

Name, Title	Organization	Contact Information: Email, Telephone
Jack Wells, Natural Resources Specialist	Yakima County	jack.wells@co.yakima.wa.us 509.574.2350
Brittany Whitfield, Senior Engineer	City of Pasco	whitfieldb@pasco-wa.gov 509.544.3080 Ext. 6418
Chuck Geissel, Public Works Technician III	Walla Walla County	cgeissel@co.walla-walla.wa.us 509.524.2729
Randy Meloy, PE Surface Water Engineer	City of Yakima	randy.meloy@yakimawa.gov 509.576.6606
Erin Barnett Code Enforcement Officer	City of Selah	EBarnett@ci.selah.wa.us 509.698.7331
Raul Sanchez Wastewater & Storm Supervisor	City of Sunnyside	rsanchez@sunnyside-wa.gov 509.836.6566
David Dominguez Civil Engineer	City of Union Gap	david.dominguez@uniongapwa.gov 509.249.9211
Andrea Jedel Municipal Stormwater Permit Manager	Department of Ecology	ajed461@ecy.wa.gov 509.575.2807
Brandi Lubliner Water Quality Project Manager	Department of Ecology	brandi.lubliner@ecy.wa.gov 360.407.7140
Doug Howie, Water Quality Project Manager	Department of Ecology	douglas.howie@ecy.wa.gov 360.407.6444
Aimee Navickis-Brasch, PhD, PE Engineering Manager	Osborn Consulting, Inc.	aimeen@osbornconsulting.com 509.867.3654 Ext. 301
Taylor Hoffman-Ballard, PE Stormwater Engineer	Osborn Consulting, Inc.	taylorh@osbornconsulting.com 509.867.3654 Ext. 302
Kevin Flanagan, EIT Project Engineer	Osborn Consulting, Inc.	kevinf@osbornconsulting.com 509.867.3654 Ext. 307

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2.0 Executive Summary

Under the National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge General Permit for discharges from Municipal Separate Storm Sewer Systems (MS4s), municipalities and other jurisdictions designated by Washington State Department of Ecology (Ecology) in Eastern Washington (EWA) that manage discharges from their MS4s are regulated by the EWA Phase II Municipal Stormwater Permit program. One of the ways that Permittees are required to manage stormwater is to limit the amount of pollutants that discharge from the MS4s by implementing operational and structural Best Management Practices (BMPs) for publicly owned and privately-owned drainage systems. Over time, the effectiveness of structural BMPs can become compromised unless the BMP is properly maintained. Permittees are required to ensure maintenance is performed as required by the NPDES permit so that structural BMPs operate and provide the intended runoff treatment and flow control functions.

Difficulties can arise for Permittees when they try to identify and correct operational and maintenance problems with structural BMPs on private property. While this problem is clearly documented in related literature, few studies were located that describe strategies related to inspection, maintenance, and enforcement of structural BMPs on private property. Of the studies located, none reported on the effectiveness of those strategies.

The goal of the study was to identify and evaluate commonly used inspection, maintenance, and enforcement strategies of privately owned stormwater BMPs. The strategies identified focused on who inspects and/or maintains privately owned BMPs: the permittee, BMP owner, a 3rd party, or different combinations of these groups. These strategies were evaluated based on survey and interview responses from 26 Permittees in Washington, Oregon, Idaho, and Montana. All 26 permittees responded to an online survey and interviews were conducted with 9 of the permittees to gain clarification and additional insight on their responses.

Responses from the permittees were analyzed to meet the specific study objectives. The analysis included coding responses into common themes for open ended questions and basic statistics was used to analyze responses from multiple choice questions. The effectiveness of a given strategy was evaluated based on the self-reported effectiveness of the jurisdictions program and by comparing elements of the strategy to elements identified through a literature search that appear to support a successful program. A summary of the results, organized by objective are as follows:

Study Objective #1: Identify strategies more commonly implemented and more effective.

A total of ten strategies were identified for inspection and maintenance of BMPs on private property. The most commonly implemented strategy was to assign inspection responsibilities to the Jurisdiction and to assign maintenance responsibilities to the property owner (referred to as strategy A-B in this document). A determination of which strategy was more effective could not be determined because of insufficient data to compare: strategy A-B was selected by twelve participants however only one to three participating jurisdictions selected the other nine strategies identified.

Study Objective #2: Identify which elements of strategies are more effective.

Elements are the components that make up a jurisdictions program for O&M on private property. Jurisdictions that self-reported their program as effective had more elements that align with what is reported in the literature as elements that make up a successful program compared to jurisdictions that self-reported their program as somewhat effective or not effective. However self-reported effective programs have less than half the elements found in the literature. Aside from a few elements, no elements were found to be used by all strategies all the time, and none of the benefits of strategies reported by jurisdictions aligned with the elements obtained in the literature. Moreover, data collected during the survey and interviews indicated that the jurisdictions had a diverse array of priorities and issues related to inspection, maintenance, and enforcement of BMPs on private property. This suggests that the importance of elements identified by the literature vary highly for individual jurisdictions.

Study Objective #3: Develop recommendations based on study results.

The findings related to Objective #1 and #2 indicated that the programs and priorities of each participant vary and are unique to that jurisdiction. Providing a resource with options would allow jurisdictions to select solutions that meet their unique priorities. As a result, the future action recommendations for this study include the development of a guidance manual. The manual would include a variety of methods to develop and/or improve a jurisdiction's inspection, maintenance, and enforcement programs for BMPs on private property. Jurisdictions statewide could use the manual and select the methods that best fit their strategy and priorities. Moreover, the manual would include case studies, examples, and templates that jurisdictions could apply to their own programs.

3.0 Background

3.1 *Introduction to the Operation & Maintenance Program*

The focus of this study was to evaluate procedures developed by other jurisdictions to meet inspection, maintenance, and enforcement (O&M) permit requirements for structural best management practices (BMPs) on privately-owned property. According to the 2007, 2014, and 2019 versions of the EWA Phase II Municipal Stormwater Permit (Washington State Department of Ecology, 2019), permittees are required to implement procedures for site inspection and enforcement of post-construction control measures. Specifically, permittees must implement mechanisms that allow access for permittees to inspect stormwater BMPs on private properties that discharge to the MS4. In lieu of requiring continued access, the mechanisms may require private property owners to provide annual certification by a qualified third party that adequate maintenance has been performed and the facilities are operating as designed to protect water quality (S5.B.5.b.iii). Additionally, permittees are required to implement an ordinance or other regulatory mechanisms to ensure adequate on-going long-term O&M of BMPs is approved by the permittee (S5.B.5.b.iii.c).

As a permittee, Yakima County is subject to the above-mentioned requirements of the 2019 EWA Phase II Municipal Stormwater Permit. According to Yakima County's ordinances (Yakima County, 2019) and the Yakima County Regional Stormwater Manual (Yakima County, 2010), the County's primary approach to meeting requirements for BMPs on private properties is to delegate responsibility of maintenance to the private property owner. The owner is required to create a County-approved O&M Plan in accordance with the provisions in the Yakima County Regional Stormwater Manual. This manual further outlines the required components of the O&M plan for all structural BMPs on private property including that the private property owner must maintain a copy of the O&M plan on site and follow the practices in the plan. Yakima County then conducts inspections of the structural BMPs on the property and takes enforcement actions as necessary to ensure BMPs are operated and maintained as required.

In addition to the method used by Yakima County, there are multiple strategies¹ currently employed by other permittees for inspection and maintenance of privately owned BMPs. This study stemmed from the County's goal of learning more about what other jurisdictions are doing to meet their permit requirements as well as identify which strategies and program elements are more effective. The County's goal was achieved by distributing online surveys to other permittees to identify and understand each alternate strategy used by other jurisdictions as well as elements of these programs. The surveys were also intended to evaluate the effectiveness of each strategy and the respective elements. Follow-up interviews were used to ask questions meant to clarify responses provided during the survey and ask additional general questions to further understand and evaluate the effectiveness.

¹ A strategy specifically defines who is responsible for inspection and maintenance of BMPs on private property within a jurisdiction's limits.

3.2 Problem Description

Structural stormwater BMPs can mimic the natural hydrology and reduce discharge of pollutants. However, when stormwater BMPs are not maintained properly, the benefits of implementation are reduced or are nonexistent if the BMP has failed. Stormwater volumes and pollutants that were otherwise captured by the BMP can pass through BMPs with reduced function. The financial investment made for the stormwater BMP is wasted when the BMP does not function as designed. Privately owned structural BMPs present a unique problem of ensuring long-term design-based performance because of O&M issues. Ensuring that proper maintenance occurs can be difficult due to the following complications identified in other studies (Blecken, Hunt, Al-Rubaei, Viklander, & Lord, 2015):

1. Lack of access for inspection, either due to lack of permission to enter private property or difficulty accessing the location of the BMP
2. Lack of understanding of how to inspect and maintain the BMP
3. Unclear and/or changing ownership of the property and BMP
4. Lack of incentive or sense of responsibility for the private property owner
5. Limited funding, either for the municipality or the private property owner

Moreover, no best strategy to perform inspection and maintenance of BMPs on private property has been identified. The Environmental and Water Resources Institute (EWRI) of the American Society of Civil Engineers founded the Stormwater BMP Task Committee in 2010 “*to further the current state of knowledge pertaining to operation and maintenance of structural stormwater BMPs*”, including structural BMPs on private property. Results from the EWRI Stormwater BMP Task Committee indicated that there is no consensus on the best approach for designating responsibility for maintaining privately owned BMPs (Environmental & Water Resources Institute, 2012).

3.3 Project Goals and Objectives

The goals of this effectiveness study were to identify commonly used inspection and maintenance strategies for privately owned stormwater BMPs and evaluate the effectiveness of those strategies. The effectiveness of a given strategy is evaluated based on comparing elements² of the jurisdictions strategy to elements identified through a literature search that appear to support a successful program. The results from this study inform municipalities of effective strategies for executing O&M programs that support compliance with the jurisdiction’s requirements for privately-owned structural BMPs. This could lead to the development of recommendations for a prototype O&M program or draft O&M manual that individual jurisdictions could adopt when appropriate. Alternatively, findings from the project could be used to inform an Education and Outreach (E&O) program that would improve the decision-making of municipal stormwater operators, increase the effectiveness of their programs, and reduce municipal O&M expenses.

² An element is an aspect of a strategy that helps fulfill inspection and maintenance requirements goals.

The objectives of this investigation are:

1. Identify which O&M BMP strategies are more commonly being implemented by jurisdictions and which O&M BMP strategy is overall most effective
2. Identify which elements of different O&M strategies are more effective
3. Develop recommendations for O&M strategies based on the results of this study

3.4 Project Overview

The study identified jurisdictions in Washington and the Pacific Northwest with similar O&M NPDES MS4 permit requirements. A total of 43 jurisdictions were invited to participate in the survey most of which were from areas with semi-arid climates similar to EWA and twenty-six participants completed the survey. The survey focused on questions regarding the jurisdiction's inspection, maintenance, and enforcement practices for structural BMPs located on private property. The questions were intended to identify the breadth of strategies applied by the participating jurisdiction, collect information needed to identify which strategies are more effective, and identify participants for interviews. A copy of the survey is in Appendix B. Nine survey participants were interviewed in order to clarify, develop a better understanding of the jurisdictions' strategies for inspection, maintenance, and enforcement procedures, and to evaluate the effectiveness of the strategy. Additionally, the interviews were used to develop a better understanding of the advantages and disadvantages of the jurisdiction's strategies described in their survey. The interviews lasted approximately 30-60 minutes and were conducted via phone. A copy of the interview questions is in Appendix C. The responses were coded and combined with the answers from the surveys to determine the breadth and most effective strategies.

Effectiveness of the strategy and elements of the jurisdictions program were evaluated. The strategy effectiveness was based on the self-reported effectiveness by the jurisdiction in the survey responses. The elements of the program were evaluated by first identifying the actual elements of the strategies implemented by the jurisdiction (from combined survey and interview responses). Then the jurisdictions elements were compared to elements in Table 3.1 which were identified in the literature as elements that appear to support a successful program, or they were identified a barrier without this element. A more detailed discussion about the analysis and results is included in section 6.0.

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Table 3.1 Summary of Literature: Elements that Appear to Support a Successful O&M Program

Element	Justification & Source
Ease of jurisdictions access to BMPs (for inspection or maintenance)	Lack of access for jurisdictions to inspect or maintain BMPs has been identified as a barrier to conducting O&M requirements either due to lack of permission to enter private property or difficulty accessing the location of the BMP (Blecken, Hunt, Al-Rubaei, Viklander, & Lord, 2015).
Jurisdiction has sufficient funding available to perform the required inspection, maintenance, and enforcement activities.	Limited funding for the jurisdiction has been identified as a barrier to performing required O&M activities (Blecken, Hunt, Al-Rubaei, Viklander, & Lord, 2015; Rafter, 2000).
The jurisdiction provides training for all staff that perform inspection, maintenance, and enforcement of BMPs on private property.	Lack of understanding of how to inspect and maintain BMPs has been identified as a barrier to correctly performing these activities (Blecken, Hunt, Al-Rubaei, Viklander, & Lord, 2015; Buys & Aldous, 2009). Recommendations for successfully performing these activities include a robust training program (Flynn, Linkous, & Buechter, 2012).
The jurisdiction has a written plan that defines the required O&M protocol for all BMPs such as a guidance manual.	Improper or incomplete BMP O&M guidance has been identified as a barrier to correctly performing these activities either because staff do not understand how to maintain BMPs or appropriate equipment for O&M activities is not available to the jurisdiction (Flynn, Linkous, & Buechter, 2012; Blecken, Hunt, Al-Rubaei, Viklander, & Lord, 2015).
Jurisdiction has appropriate equipment available to conduct maintenance for all BMPs	Recommendations for improving staff's understanding include developing a written O&M plan for each BMP that includes a punch list of required O&M activities as well as photos of failing BMPs (Richardson, 2019).
The jurisdiction provides O&M protocol and/or education materials to BMP owners in languages other than English	Researchers have reported that barriers to the public understanding the impact of stormwater and relevant policies may relate to not understanding the education materials because the written material is too technical, or they speak languages other than English. Recommendations for addressing this issue include providing material in multiple languages, including photos and illustrations in materials, face to face meetings with the public, and developing written materials using technical terms that can be understood by the general public (Herron, Stepenuck, & Green, 2009)
BMP owners can demonstrate compliance with the jurisdiction's requirements	
Jurisdiction provides incentives to BMP owners to encourage them to conduct required maintenance	
Jurisdiction has mechanisms in place to penalize or fine BMP owner for not demonstrating the owner is compliant with requirements	Researchers have reported that barriers for BMP owners to perform required O&M activities include: lack of funding as well as a lack of incentive or sense of responsibility (Blecken, Hunt, Al-Rubaei, Viklander, & Lord, 2015; Doll & Lindsey, 1999; Rafter, 2000; Aldous & Buys, 2009)
BMP owners are willing to pay for required maintenance.	
When ownership changes, the jurisdiction has a process for communicating all BMP responsibilities to the new property owner	Unclear and/or changing ownership of the property and BMP has been identified as a barrier to BMP owners conducting the required O&M activities (Blecken, Hunt, Al-Rubaei, Viklander, & Lord, 2015; Aldous & Buys, 2009).

Element	Justification & Source
Inspection and maintenance documentation is up to date and complete for all BMPs on private property	A defined maintenance tracking program & data base for storing information appears to support success of the jurisdictions staff understanding and completing required documentation as well as provided required BMP O&M activities (Flynn, Linkous, & Buechter, 2012; Flynn, Linkous, & Buechter, 2012). Apps with a punch list of required activities have also been successful at improving jurisdictions tracking program (Richardson, 2019).
The jurisdiction has a documentation process for tracking inspection and maintenance activities that is consistent, complete, and easy to use.	

3.5 Target Population & Sample Size

The target population of this study was NPDES MS4 permittees in Washington and other jurisdictions who have similar O&M requirements for owner-operators of privately owned structural BMPs. Preference was given to potential jurisdictions located in semi-arid areas, particularly the Columbia Basin (Oregon and Idaho) and Pacific Northwest (Montana). The target population consisted of permittees or non-permitted jurisdictions, specifically stormwater managers, who are required to inspect and enforce maintenance of privately owned structural BMPs. Participants within the target population were identified through the US Environmental Protection Agency (US EPA), Ecology, or other regulatory agency contacts as well as recommendations from stormwater managers and practitioners. Participants were assigned identification codes to maintain confidentiality of their responses. A summary of the participants (identified by code) is included in Appendix A.

Forty-six participants were identified and committed to participating in the study. However, only 26 responded to the survey with only 24 answering all of the questions. The initial sample size ($n=46$) was assumed to be a sufficient sample size, as only four potential strategies were identified at the beginning of the study. Following the survey, six additional potential strategies were identified from participant responses for a total of 10 strategies. The combination of actual sample size and increase in the number of strategies contributed to having insufficient data needed to compare effectiveness of potential strategies, further described in Section 6.1. The target and actual sample size are further discussed in Section 4.2.3 and Appendix D.1.

4.0 Data Collection Procedures

4.1 Types of Data Collected

Data collection for this project extended from January 2021 to July 2021 using surveys and individual interviews of some participants. Table 4.1 provides a summary of the types of data collected including the method used to collect the data and total number of participants for each type. Appendices A, B and C of this report contain summarized data collected during the study.

Table 4.1 Summary of the Types of Data Collected

Data Type	How Data Will Be Collected	Total # of Participants
List of Jurisdictions	Department of Ecology, US EPA list of contacts, stormwater managers & practitioners	46
Contact information for Study Participants	Contact through jurisdictions	46
Jurisdictions' O&M requirements	Survey Question	26 ¹
Survey Responses	Online survey of participants	26 ²
Interview Responses	Responses provided in phone interviews were coded	9

¹ O&M requirements were collected for jurisdictions which responded to the survey.

² Two of the surveys collected were incomplete. The data from those surveys was included to supplement data on the most commonly used strategies as well as effective and non-effective elements of those strategies (see Appendix D.1)

4.2 Sample Collection Process

4.2.1 SOP Overview

Data for the study were collected following the standard operating procedures (SOPs) defined in the study QAPP. The procedures are summarized in this section along with information about the audit and monitoring equipment. More detailed information regarding each SOP can be found in the Section 8.0 of the study QAPP.

- Survey Dissemination & Follow-Up – Procedures outline how to distribute the survey and collect responses.
- Interview Administration – Procedures outline how to select participants and conduct the interviews.

4.2.2 Audit Overview

An audit was conducted by a participating entity as part of the data quality assessment to verify whether staff followed the SOPs and data management plan procedures during the study. Any deviations in the SOPs from those in the study QAPP are summarized in the audit findings (Appendix D.2) and detailed in the summary of deviations from the QAPP (Appendix D.3). Deviations primarily involved adjustments to SOPs and data management plan procedures to meet study objectives while maintaining data quality.

4.2.3 Study Instrument Overview

The instruments developed for the study included a survey and interview. The intent of the survey was to identify the breadth of strategies applied by the jurisdictions, identify the most commonly applied strategies, and meet QA/QC requirements in Section 6.0 of the QAPP. A 30-question SurveyMonkey® survey was developed (see Appendix B) to meet the intent and contained open answer and multiple-choice questions. The questions collected information on types of strategies and which permittees used elements which had been identified by the literature as important to a successful program. Respondents were also asked to self-rate their program in terms of effectiveness and provide challenges and benefits associated with their program.

The survey was also designed to obtain a desired response rate of 30 respondents (see Section 8.1.1 of study QAPP). Language which was clear and concise for the participants was used, and the survey was pilot tested to ensure questions were interpreted consistently. Participants who responded to the survey were assigned an identification code, in order to maintain confidentiality of the responses and limit concerns about responses being disseminated. Targeted reminders were also used to improve response rates. After the survey was sent out, weekly or more frequent reminders were sent to those who had not completed the survey. Responses were associated with participant identification codes and recorded in Excel, along with documentation of those who agreed to participate in the study but did not respond.

The intent of the interview was to address questions which had arisen from the survey responses, develop a deeper understanding of the strategies used, and collect data needed to evaluate the effectiveness of the strategies. Using the collected survey responses, 11 participants who indicated they would be willing to be interviewed and self-rated their strategies as effective or selected a high number of elements identified by the literature as important were selected to participate in the interview process. A general list of questions was developed (see Appendix C) as well as questions specific to each participant. The general questions were developed to better understand the strategies used as well as what elements appeared to be most effective in implementing those strategies. The questions specific to the participant were developed to provide additional insight into the survey responses collected. To increase participation, interviews were scheduled in advance and reminders were sent out to those who did not initially schedule a date and time. All interviews were conducted over the phone and not recorded. The interviewer took detailed notes of the responses provided by the participant which were transcribed into Excel and associated with the same participant identification code used during the survey. Following the interviews, survey and interview data was combined to better understand strategies used and effectiveness of those strategies.

5.0 Data Quality Assessment

A data quality assessment was performed to determine whether data collected during the study met Data Quality Indicators (DQIs) and Measurement Performance Criteria (MPCs) that were defined in the study QAPP. DQIs are qualitative and quantitative measures that characterize the aspects of quality data. MPCs are the acceptance criteria for DQIs which specify the standard for data that meets the project's data quality objectives. In order to assess whether MPCs were met, a data verification (process to evaluate quality of the data) and data usability assessment (process to determine if data can be used to meet study objectives) were conducted. The following sections summarize the results of the data verification and data usability assessment. The results of whether MPCs were met for each DQI is summarized in Appendix D.1.

5.1 Data Verification

Table 5.1 summarizes the results of the data verification, which addresses each component of the data verification process listed in Section 12.1 of the study QAPP. No data quality issues were observed during the data verification.

Table 5.1 Data Verification Summary

Component	Result
Review all the data records to ensure they are consistent, correct and complete, with no errors or omissions	No errors or omissions were observed. Jurisdictions indicated they were knowledgeable about their program or directed the research team to other staff. Any missing data was noted with “DNF” (see Appendices D.1, D.3).
Review the results from the QC section ¹	See Appendix D.1, D.3. No corrective actions were needed during the study.
Review the results from the audit (of SOPs, data management plan procedures)	See Appendix D.3; SOPs were followed or modified if needed to meet study objectives and maintain data quality.
Examine data to determine if MPC's listed in Table 6.1 of the study QAPP were met ¹	See Appendix D.1; MPCs were met. It is important to note that the survey response goal and interview participant goal in the study QAPP were 30 and 10-15, respectively. Based on literature provided in Appendix D.1, it expected that the 26 survey responses and 9 interviews are sufficient.
Verify participant responses are consistent	Data records were found to be consistent between survey and interview responses.
Verify peer debriefing was used to validate coding	Peer debriefing was used to validate coding; coding was finalized after the peer debriefing group mutually agreed upon the coding.

¹ There is a fair amount of overlap between these two components in the study QAPP. Both have been included to be consistent with the data verification procedures in the study QAPP.

5.2 Data Usability Assessment

Table 5.2 summarizes the results of the data usability assessment, which addresses each component of the process listed in Section 12.2 of the study QAPP. If data were flagged as part of the data verification, audit, or other quality checks, it would be removed from the dataset analyzed to meet study objectives. However, no data was flagged due to quality issues, and as a result no data was removed from the dataset to meet the study objectives.

Table 5.2 Data Usability Assessment Summary

Component	Result
Review the results from data verification	No data was flagged for quality issues.
Review results from the audit	No data was flagged due to audit findings.
Requirements related to inspection, maintenance, and enforcement are similar between participants	Each participant in the study is subject to a permit which requires permittees to employ a strategy or program to inspect, maintain, and enforce maintenance at BMPs on private property (See Table A-2, Appendix A). No participants were flagged for having significantly different requirements.
Verify interviewee is certain that their responses represent their jurisdictions program	Jurisdictions directed the research team to the most appropriate staff for the interviews. Interviewees were confident in their responses. No data was flagged.
Determine if MPCs listed in Table 6.1 of the study QAPP were met	No data was flagged due to not meeting MPCs.

6.0 Results & Discussion

This section presents the results of the study and is organized by study objective. The data presented is combined data, specifically combined results from the survey and interview responses. The raw data from the study, including survey and interview responses is included in Appendices B and C. The data analysis methods are described in the QAPP.

6.1 *Objective #1: Identify strategies more commonly implemented and more effective*

To understand which strategies were most commonly implemented by jurisdictions in the target population, a question in the survey asked participants to identify the strategy used within their jurisdiction. Interview responses were used to further clarify the strategy used. Table 6.1 lists the strategies that were identified by the participants. Table 6.1 and Figure 6.1 also list the number of participants who selected each strategy.

Table 6.1 Potential Strategies

Strategy Code	Number of Respondents	Strategy to Inspect BMPs	Strategy to Maintain BMPs
A-B	12	Permittee inspects BMPs (A)	Property owner maintains BMPs (B)
B-B	3	Property owner inspects BMPs (B)	Property owner maintains BMPs (B)
C-C	2	Property owner is required by permittee to hire 3 rd party or contractor to inspect BMPs (C)	Property owner is required by permittee to hire 3 rd party or contractor to maintain BMPs and provide proof to permittee (C)
D-E	1	Property owner is given the option to provide permittee access to inspect or hire 3 rd party to inspect BMPs (D)	Property owner is given the option to provide access to the permittee for maintenance or hire a 3 rd party to maintain BMPs (E)
D-B	2	Property owner is given the option to provide permittee access to inspect or hire 3 rd party to inspect BMPs (D)	Property owner maintains BMPs (B)
F-B	1	Property owner inspects; permittee independently inspects (F)	Property owner maintains BMPs (B)
H-G	1	Property owner or 3 rd party inspects (H)	Property owner or 3 rd party maintains (G)
I-B	2	Property owner or 3 rd party inspects; permittee independently inspects (I)	Property owner maintains BMPs (B)
N/A-B	1	Program under development at time of the study (N/A)	Property owner maintains BMPs (B)
N/A-N/A	1	Program under development at time of the study (N/A)	Program under development at time of the study (N/A)

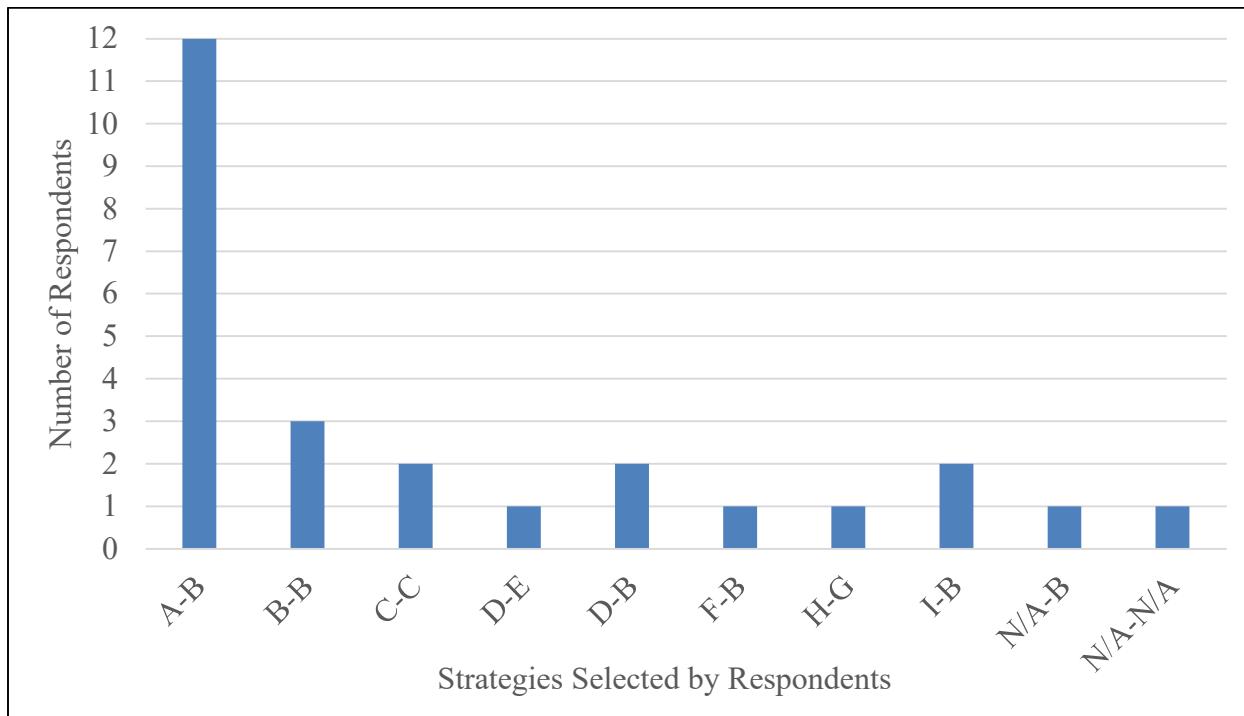


Figure 6.1 Most Common Strategies Selected

As shown in Table 6.1 and Figure 6.1, the most common strategy reported was the permittee is responsible for inspecting and the property owner is responsible for maintaining (A-B). Moreover, there was a high number (19 in total) of respondents who reported that the strategy for maintaining BMPs on private property was to require the property owner to be responsible for maintenance (B). The remaining combined strategies for inspection and maintenance were selected by 1-3 participants each. The significantly lower number of respondents who selected the remaining strategies affected the ability to compare the effectiveness of those strategies because there was insufficient data for the comparison.

One of the questions included in the survey asked participants to self-rate the effectiveness of their program, in an effort to understand the effectiveness of each strategy. The self-rating was then coded into either “effective”, “somewhat effective”, or “not effective”. Effective was associated with a value of 3, somewhat effective was associated with a value of 2, and not effective was associated with a value of 1. Figure 6.2 shows the results of the self-rating reported by each participant, grouped by inspection and maintenance strategy. In the figure, each “x” denotes a response, each circle denotes the mean rating for that strategy, and each blue bar illustrates the range of self-ratings for that strategy. As shown in the figure, several strategies were rated by one or more individuals as “effective”. Of those strategies, three are only represented by one data point, whereas strategy A-B is represented by twelve data points³, and on average scored an average of 2.7, indicating most of the jurisdictions who use that strategy rate it as effective. Moreover, the lower-rated strategies were only represented by 1-3 data points. A determination of which strategy was more effective was not possible because each strategy

³ See Appendix D.1 for details on sample size.

other than A-B was selected by one to three participating jurisdictions, providing insufficient data to compare the effectiveness of A-B to other strategies.

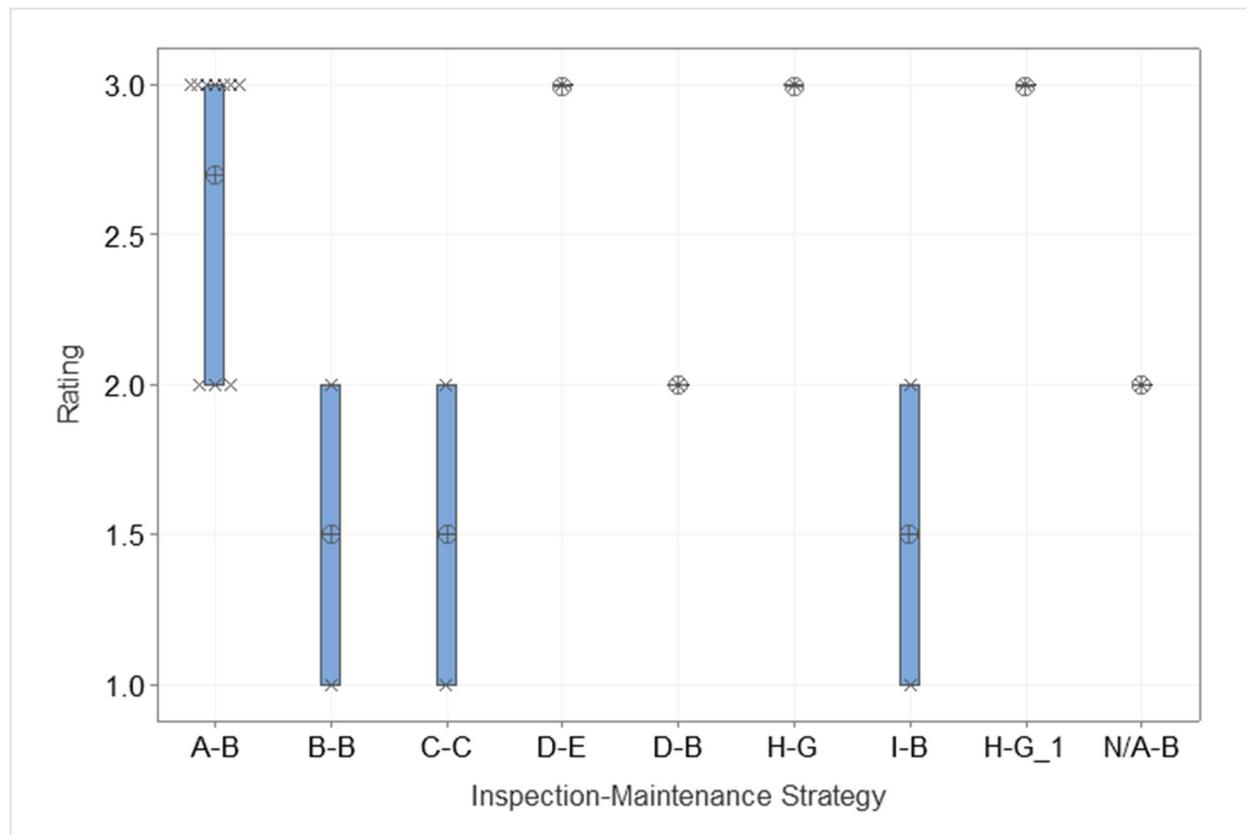


Figure 6.2 Permittee-Reported Effectiveness

6.2 *Objective #2: Identify which elements of strategies are more effective*

Jurisdictions provided information about the different elements that make up their program for inspection and maintenance of BMPs on private properties. The elements provided were evaluated to determine whether a particular combination of elements rather than a particular strategy support a successful program (based on self-reported effectiveness). The elements were initially identified in the literature as elements that appear to make up a successful program (Table 3.1). To evaluate the elements, participants responded to survey and interview questions about each element that their jurisdiction is using. Table 6.2 summarizes the responses to the survey questions, specifically how frequently elements were used or met by jurisdictions. Responses are organized by jurisdictions that: (1) self-rated their programs as effective, (2) all ten strategies identified (regardless of effectiveness self-reported rating), (3) only strategy A-B, and (4) strategies other than A-B. Jurisdictions who self-rated their programs as effective employed more elements at a higher frequency than the entire group on average. However, these jurisdictions employed less than half of the elements, which were identified as important elements to a successful O&M program. For example, complete documentation and records are assumed to be necessary elements for a successful program, but approximately half of the self-rated effective programs met those elements. This suggests that the importance of elements identified by the literature vary highly for individual jurisdictions. Moreover, elements which are employed according to the survey did not always correspond with what was reported during the

interviews. In the survey, being able to penalize or fine a private property owner for non-compliance was an element selected by most jurisdictions. When asked about enforcement during the interviews however, most participants reported that E&O was used to achieve compliance before enforcement was used and all participants reported that enforcement was used somewhat rarely. Responses to survey and interview questions therefore suggested that no one element is more effective across the board for jurisdictions.

As part of the survey and interview open-ended questions, participants were asked to describe primary benefits to their strategy. The responses to the open-answer question were coded and the coded responses are summarized in Figure 6.3. A total of eleven codes were identified and each which are defined in Table 6.3. The coded responses in the figure are also organized by each participant's self-rating of their program, to better understand differences between the groups. The ratings included effective, somewhat effective, and not effective. The coded responses shown in Figure 6.3 were then compared to elements identified in the literature (Table 3.1) to determine if they were consistent which would suggest that a specific combination of elements make up an effective program as opposed to a specific strategy. However, the benefit responses did not correspond with the elements in the literature. Moreover, the number of respondents who mentioned each benefit ranged from 1-4 across eleven codes, which suggests that despite the similarity in strategies for a number of participants, the benefits still vary widely by jurisdiction. A similar question, related to primary challenges associated with a jurisdiction's strategy, showed a similar distribution of responses (see Figure 6.4 and Table 6.4). No clear pattern was observed through the responses to the question regarding primary benefits to the strategy, and as a result no additional potential effective elements were identified through the responses.

Through interview questions, additional information was gathered about specific elements, such as implementation of an E&O program. A summary of interview data collected can be found in Appendix C. Figures 6.5 and 6.6 summarize the description of the E&O program provided by the interviewee and summarize desired changes to the E&O program, respectively. The data included in the figures is coded and each of the 10-11 codes collected about 1-4 responses. Moreover, similar categories were reported for the description of the E&O program (Figure 6.5) and the desired changes to the E&O program (Figure 6.6). The variation observed in the interview questions as well as the survey responses indicated that no one element was more effective than others, as jurisdictions differ greatly from one another in terms of program elements and details beyond the strategy.

Table 6.2 Elements of Successful Programs by Self-Rating and Strategy

Elements of Successful Programs	Self-Rated Most Effective	All Strategies	A-B	Others (Except A-B)
Jurisdiction has access to BMPs	73%	50%	70%	36%
Sufficient Funding	82%	63%	90%	45%
Staff Training	82%	75%	100%	57%
O&M Protocol for BMPs	55%	33%	60%	14%
O&M Protocol and/or E&O for BMP owner	27%	21%	30%	29%
Protocol and/or E&O in languages other than English	0%	0%	0%	0%
Notify new BMP owner of responsibilities	27%	29%	30%	29%
Appropriate equipment for maintenance	86%	75%	100%	56%
Appropriate equipment for inspection	100%	86%	100%	73%
BMP owners comply with paying for maintenance	67%	41%	56%	25%
BMP owners comply with paying for inspection	33%	43%	50%	40%
Documentation Complete	50%	32%	50%	18%
Documentation Easy to Use	50%	35%	33%	36%
Documentation Consistent	70%	55%	56%	55%
Records Complete	50%	50%	50%	40%
Records Up-to-Date	60%	39%	38%	50%
Jurisdiction Offers Incentives for Compliance	0%	17%	0%	29%
Jurisdiction has Penalties for Non-Compliance	82%	71%	70%	71%

Note: colors used in this table reflect the percentage in each cell. For values of 0-33%, cells were highlighted white. For values of 33-66%, cells were highlighted yellow. For values of 67-100%, cells were highlighted blue.

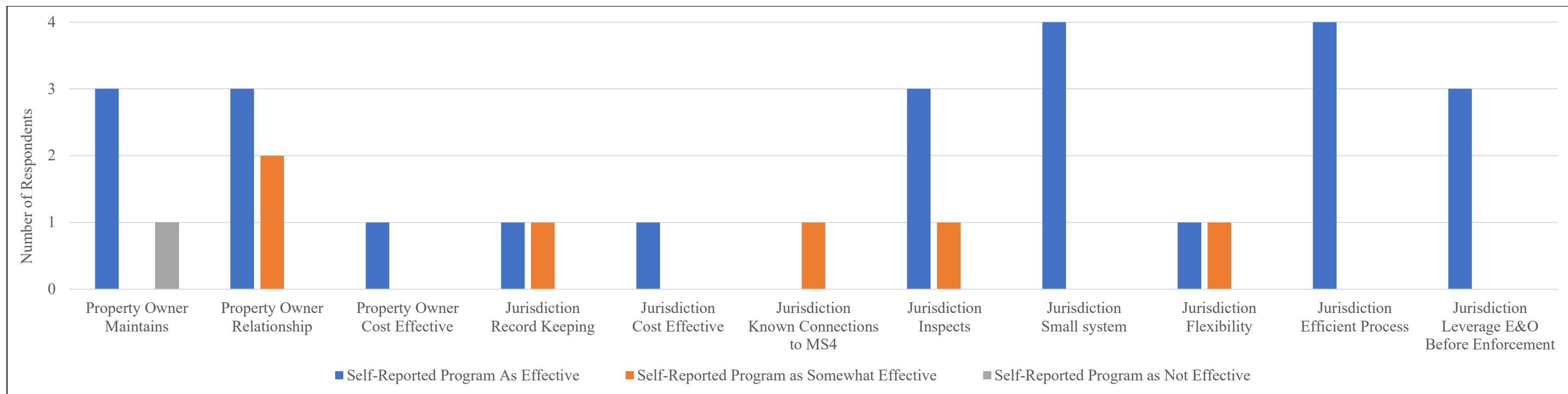


Figure 6.3 Summary of Responses to: List a primary benefit to using the selected strategy.

Table 6.3 Definition of Codes in Figure 6.3

Code	Definition
Property Owner Maintains	The benefit in this case is that the property owner maintains and is responsible/liable for maintenance. This may translate to not needing to allocate jurisdiction staff time to maintenance, property owners being more aware of potential discharges, etc.
Property Owner Relationship	The strategy allows positive relationships to form between the property owners and jurisdiction. This may make it easier for the jurisdiction to achieve compliance or for the property owner to ask questions and meet requirements expected of them.
Property Owner Cost Effective	The strategy is cost effective for the property owner. For example, a strategy may result in maintenance costs being less for a property owner, because they are not responsible for maintenance.
Jurisdiction Recordkeeping	The strategy allows the jurisdiction to efficiently manage records. For example, inspection records may be created in the field via tablets, which automatically generates a workorder or notice to the property owner that maintenance should be performed.
Jurisdiction Cost Effective	The strategy is cost effective for the jurisdiction. For example, if the responsibility of maintenance is placed on the property owner, the jurisdiction does not need to allocate funds to perform maintenance on BMPs on private property.
Jurisdiction Known Connections to MS4	The strategy allows jurisdictions to better understand or document all connections to their MS4 from private property.
Jurisdiction Inspects	The jurisdiction can have confidence in the inspection process, either because they have standard protocol and/or have trained staff to perform inspections.
Jurisdiction Small System	Having a small system allows the jurisdiction to be able to manage inspection and/or maintenance of all BMPs; moreover if a jurisdiction receives little rainfall, a need for maintenance or issues may arise less frequently.
Jurisdiction Flexibility	The strategy allows the jurisdiction to be flexible. This may include flexibility to adjust maintenance responsibilities, which can allow for better working relationships with private property owners and higher quality maintenance.
Jurisdiction Efficient Process	The strategy is or involves an efficient process for the jurisdiction. For example, a jurisdiction may use GIS or other software to streamline documentation and scheduling of maintenance. Another example involves using the same staff to inspect BMPs during construction and post-construction to be more familiar with the BMPs and how they operate.
Jurisdiction Leverage E&O (before Enforcement)	The strategy involves use of education, formal requests to comply, etc. prior to use of enforcement. Allows the jurisdiction to eventually get property owner to comply.

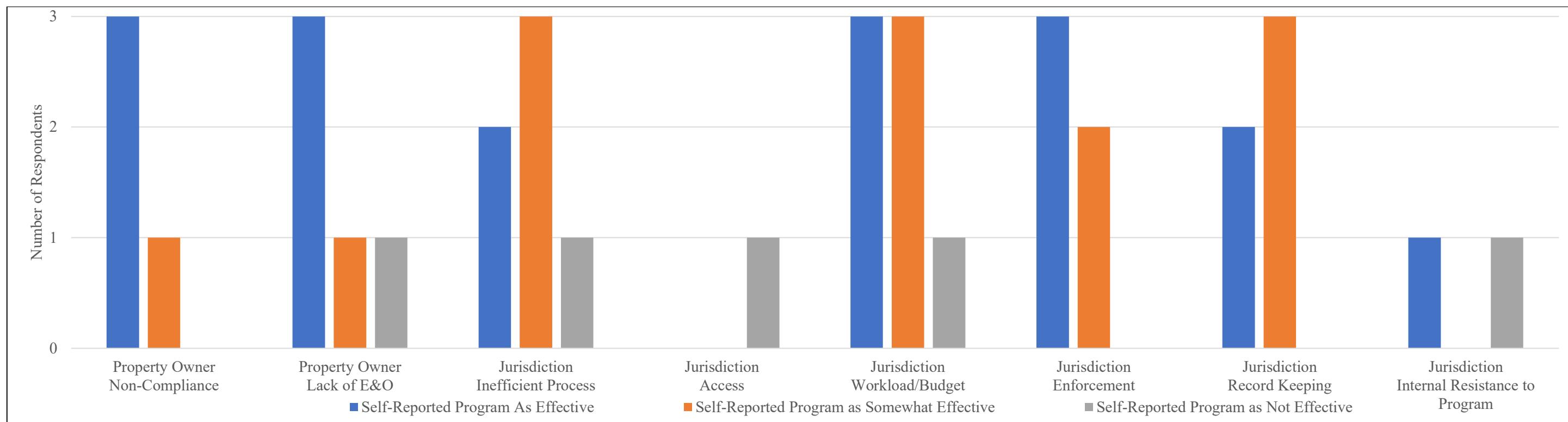


Figure 6.4 Summary of Responses to: Describe a primary challenge to using the selected strategy.

Table 6.4 Definition of Codes in Figure 6.4

Code	Definition
Property Owner Non-Compliance	Challenge is achieving property owner compliance. May include encouraging property owners to respond to requests for records, cultural resistance to compliance, getting property owners to comply with requested maintenance, etc.
Property Owner Lack of E&O	Challenge is that a lack of E&O has reached the private property owners. As a result private property owners may not understand what the BMPs are for and new property owners may not have been informed of or are aware of the BMPs.
Jurisdiction Inefficient Process	The strategy involves an inefficiency or inefficient process. This may include variable responsibilities at each site, having difficulty organizing or recording records, and inefficiencies in time management for different types of properties.
Jurisdiction Access	The jurisdiction experiences challenges with access to BMPs on private property. This may involve not having legal authority to enter private property to perform inspections of BMPs, or not having access to the responsible party.
Jurisdiction Workload/Budget	The workload is too high, equipment demands are too great, or budget is insufficient for the jurisdiction to complete required inspection or maintenance.
Jurisdiction Enforcement	It is challenging for the jurisdiction to enforce, either because weak or no enforcement ordinances are in place, or because enforcement takes a large amount of effort to perform.
Jurisdiction Record Keeping	The jurisdiction experiences challenges with recordkeeping. This may be related to keeping accurate records of responsible records despite changes in the community, having specific records recorded or uploaded into systems, etc.
Jurisdiction Internal Resistance to Program	Departments, leaders, or other staff at jurisdiction create a challenge by showing resistance to implementation of the strategy. The resistance can take the form of a desire to not enforce rules at all or consistently, a belief that the O&M program is not a high priority, or policies or procedures of the jurisdiction that limit the ability of staff to implement the strategy and O&M program.

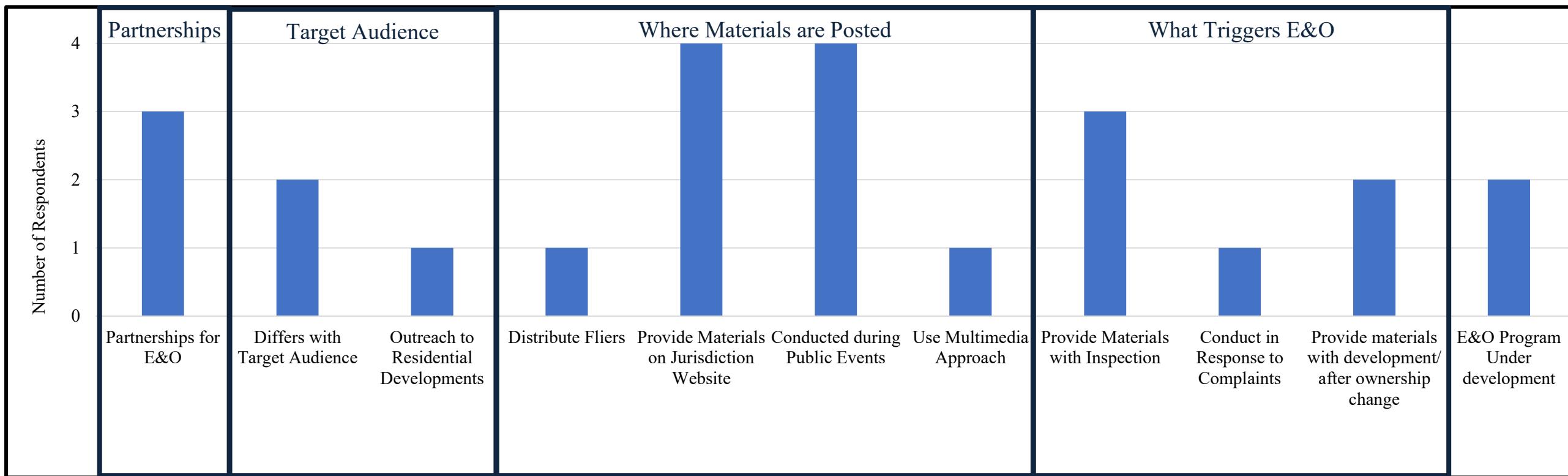


Figure 6.5 Summary of Description of E&O Program

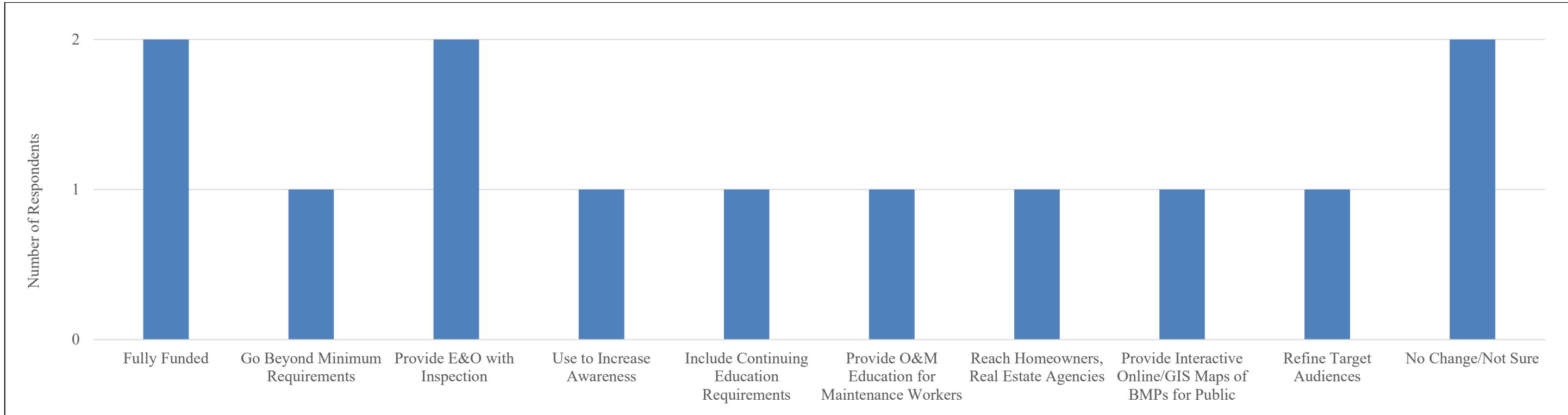


Figure 6.6 Summary of Desired Changes to E&O Program

6.3 *Objective #3: Develop recommendations based on study results*

Due to diversity of responses and lack of clear pattern in terms of effective strategies and elements, it is recommended that a guidance manual be developed that provides jurisdictions with options to assist them with developing a program that best fit their needs and priorities. The manual would contain examples, case studies, and templates which permittees could apply as needed, thereby customizing solutions for the jurisdiction. The following paragraphs describe the manual content and recommended proposed outline for the manual. A fact sheet about the manual is located in Appendix F.

Scope of Work

The Manual content will be developed utilizing a combination of sources, including information collected during the Yakima County Effectiveness Study; from a literature search of journal articles and municipal documents; and through interviews with Permittees from Washington or states with similar permit requirements. A Technical Advisory Committee (TAC) will play an integral role in shaping the Manual vision to support the development of a useful resource for Permittees to identify solutions that support permit compliance and best align with their jurisdiction's goals. An online training program will be developed that provides an overview of the Manual content, guidance for how to use the Manual, and discussion/examples regarding the different ways jurisdictions are meeting NPDES MS4 permit requirements for structural BMPs that are privately owned.

Proposed Manual Outline

The proposed Manual content will identify effective strategies, describe how they can support the overall program success and permit compliance, and provide case studies of the different ways Permittees are implementing these strategies, as well as their lessons learned. The Appendix will include examples and templates that Permittees can use or modify to develop and/or improve their jurisdictions program.

Topics anticipated to be addressed in the Manual include:

- **Chapter 1 Introduction:** Intended manual use and audience, relevant permit requirements, why the manual was developed, manual organization.
- **Chapter 2 Inspection and Maintenance Strategies:** Overview of different inspection and maintenance strategies; challenges/benefits of each.
- **Chapter 3 Staffing and Funding Challenges/Solutions:** Options for funding and staffing, identifying and justifying funding/staffing needs, creative approaches: doing more with less.
- **Chapter 4 Required Documentation and Record Keeping:** Methods for Jurisdictions and BMP Owner, forms/schedules, streamlining options.
- **Chapter 5 Who Owns the BMP:** Different types of BMP owners, where responsibilities are documented, managing unclear/changing ownership.

- **Chapter 6 Ordinances & Covenants:** Types and examples of ordinances and covenants; how they support compliance.
- **Chapter 7 Incentives Mechanisms:** Description of incentive types, examples.
- **Chapter 8 Penalty Mechanisms:** Description of penalty types, examples.
- **Chapter 9 Training and E&O:** Target audiences, types of materials and methods for delivering materials, tailoring materials to audiences, examples.

7.0 Conclusions and Future Action Recommendations

The intent of this study was to identify commonly used inspection and maintenance strategies for privately owned stormwater BMPs and evaluate the effectiveness of those strategies. Participants for the study included jurisdictions in Washington and other areas with similar O&M NPDES MS4 permit requirements, specifically within the Columbia Basin. A survey was provided to participating jurisdictions regarding their inspection, maintenance, and enforcement practices for structural BMPs located on private property. The intent of the survey was to identify the breadth of strategies applied by the participating jurisdiction, collect information needed to identify which strategies are more effective, and identify participants for interviews. Participating jurisdictions whose responses required further clarification were selected for a follow-up interview.

Nine survey participants were interviewed in order to clarify responses; develop a better understanding of the jurisdictions' strategies for inspection, maintenance, and enforcement procedures; and to evaluate the effectiveness of the strategy. Additionally, the interviews were used to develop a better understanding of the advantages and disadvantages of the jurisdiction's strategies described in their survey. The responses were coded and combined with the answers from the surveys to determine the breadth and most effective strategies. The following paragraphs summarize the combined results of the survey and interview, in terms of each objective needed to meet the study goal.

Objective #1 Identify which strategies are more commonly implemented and more effective

The most commonly implemented strategy to inspect, maintain, and enforce maintenance of BMPs on private property was that the jurisdiction was responsible for inspection of the BMPs and the private property owner was responsible for maintenance of the BMPs (strategy A-B). A determination of which strategy was more effective could not be determined because of insufficient data to compare: strategy A-B was selected by twelve participants however only one to three participating jurisdictions selected the other nine strategies identified.

Objective #2 Identify which elements of strategies are more effective

Jurisdictions that self-reported their program as effective had more elements that align with what is reported in the literature as elements that make up a successful program compared to jurisdictions that self-reported their program as somewhat effective or not effective. However self-reported effective programs have less than half the elements found in the literature. Aside from a few elements, no elements were found to be used by all strategies all the time, and none of the benefits of strategies reported by jurisdictions aligned with the elements obtained in the literature. Moreover, data collected during the survey and interviews indicated that the jurisdictions had a diverse array of priorities and issues related to inspection, maintenance, and enforcement of BMPs on private property. This suggests that the importance of elements identified by the literature varies highly for individual jurisdictions.

Objective #3 Develop recommendations based on study results (future action recommendations)

The findings related to Objective #1 and #2 indicated that the programs and priorities of each participant vary and are unique to that jurisdiction. Providing a resource with options would

allow jurisdictions to select solutions that meet their unique priorities. As a result, the future action recommendations for this study include the development of a guidance manual. The manual would include a variety of methods to develop and/or improve a jurisdiction's inspection, maintenance, and enforcement programs for BMPs on private property. Jurisdictions statewide could use the manual and select the methods that best fit their strategy and priorities. Moreover, the manual would include case studies, examples, and templates that jurisdictions could apply to their own programs. A summary of manual contents is included in Section 6.3.

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9.0 Appendices

Appendix A. Participant Summary

Table A-1 Summary of Study Participants

Participant ID	NPDES Phase I or II	Population	WA	ID/OR/MT
2	II	25,000-50,000	X	
3	II	100,001-250,000	X	
24	II	>250,001	X	
29	II	100,001-250,000		X
31	II	50,000-100,000		X
35	II	50,000-100,000	X	
41	II	50,000-100,000		X
43	II	50,000-100,000		X
49	II	<10,000	X	
61	II	50,000-100,000		X
67	II	<10,000	X	
76	II	10,000-25,000	X	
80	II	25,501-50,000		X
83	II	10,000-25,000	X	
86	II	25,000-50,000	X	
87	II	10,000-25,000		X
89	II	50,000-100,000	X	
97	II	100,001-250,000		X
100	II	25,501-50,000	X	
62	II	10,000-25,000	X	
72	II	10,000-25,000		X
1	II	10,000-25,000	X	
15	II	10,000-25,000		X
23	II	50,000-100,000	X	
40	II	10,000-25,000	X	
59	UIC	50,000-100,000		X
73	II	50,000-100,000	X	
81	I	>250,001		X
92	II	100,001-250,000		X
96	II	25,501-50,000	X	
8	II	25,501-50,000		X
18	II	>250,001		X
21	II	50,001-100,000		X
28	II	25,501-50,000		X
34	II	<10,000		X
42	II	50,000-100,000		X
44	II	50,000-100,000		X
48	II	50,000-100,000		X
68	II	<10,000	X	
71	II	50,000-100,000		X
75	II	25,501-50,000		X
85	II	25,501-50,000		X
91	II	10,000-25,000	X	
SUM			19	24

Orange cells denote who responded to the survey only.

Green cells denote who responded to the survey and participated in the interviews.

Table A-2 Summary of Participant Permit Requirements

Permit	Section
EWA Phase II General Permit	S5.B.5.b.iii
MT Phase II General Permit	5.c.vii-ix
EPA (Idaho) NPDES Stormwater MS4 Permit ¹	3.4.5-6
OR Phase II General Permit ²	Schedule A, 3.d-e.vi
WWA Phase II General Permit	S5.C.7.b

¹ Includes one individual permit, which includes the requirement to conduct O&M on permanent stormwater controls on private property in II.B.2.e-f.

² Includes one individual permit, which includes the requirement to conduct O&M on permanent stormwater controls on private property in II.B.4.e.ii.2.

Appendix B. Survey Data Summary

9.0 Appendices

Appendix A. Participant Summary

Table A-1 Summary of Study Participants

Participant ID	NPDES Phase I or II	Population	WA	ID/OR/MT
2	II	25,000-50,000	X	
3	II	100,001-250,000	X	
24	II	>250,001	X	
29	II	100,001-250,000		X
31	II	50,000-100,000		X
35	II	50,000-100,000	X	
41	II	50,000-100,000		X
43	II	50,000-100,000		X
49	II	<10,000	X	
61	II	50,000-100,000		X
67	II	<10,000	X	
76	II	10,000-25,000	X	
80	II	25,501-50,000		X
83	II	10,000-25,000	X	
86	II	25,000-50,000	X	
87	II	10,000-25,000		X
89	II	50,000-100,000	X	
97	II	100,001-250,000		X
100	II	25,501-50,000	X	
62	II	10,000-25,000	X	
72	II	10,000-25,000		X
1	II	10,000-25,000	X	
15	II	10,000-25,000		X
23	II	50,000-100,000	X	
40	II	10,000-25,000	X	
59	UIC	50,000-100,000		X
73	II	50,000-100,000	X	
81	I	>250,001		X
92	II	100,001-250,000		X
96	II	25,501-50,000	X	
8	II	25,501-50,000		X
18	II	>250,001		X
21	II	50,001-100,000		X
28	II	25,501-50,000		X
34	II	<10,000		X
42	II	50,000-100,000		X
44	II	50,000-100,000		X
48	II	50,000-100,000		X
68	II	<10,000	X	
71	II	50,000-100,000		X
75	II	25,501-50,000		X
85	II	25,501-50,000		X
91	II	10,000-25,000	X	
SUM			19	24

Orange cells denote who responded to the survey only.

Green cells denote who responded to the survey and participated in the interviews.

Table A-2 Summary of Participant Permit Requirements

Permit	Section
EWA Phase II General Permit	S5.B.5.b.iii
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EPA (Idaho) NPDES Stormwater MS4 Permit ¹	3.4.5-6
OR Phase II General Permit ²	Schedule A, 3.d-e.vi
WWA Phase II General Permit	S5.C.7.b

¹ Includes one individual permit, which includes the requirement to conduct O&M on permanent stormwater controls on private property in II.B.2.e-f.

² Includes one individual permit, which includes the requirement to conduct O&M on permanent stormwater controls on private property in II.B.4.e.ii.2.

Appendix B. Survey Data Summary

Yakima County Effectiveness Study: BMP Inspection and Maintenance Responsibilities Survey

Thank you for participating in the Yakima County survey. This survey is a component of the BMP Inspection and Maintenance Responsibilities for Privately Owned Facilities Effectiveness Study. Information gathered in this survey will be used to help identify effective strategies for operation and maintenance of privately-owned structural BMPs. Please provide responses pertaining to BMPs that discharge to your jurisdiction's MS4. Following the study, results will be shared with the participants regarding which strategies were identified as more effective, which can be used to inform or improve programs.

Participant information will be coded by the consultant for this study and information released in reports will not be identifiable.

This survey will take 20-30 minutes to complete.

Yakima County Effectiveness Study: BMP Inspection and Maintenance Responsibilities Survey

The following questions are intended to provide basic information about the respondent.

1. Contact Information

Note: This information is only being collected to contact you for future interviews.

Name of Person Completing
the Survey

Title

Jurisdiction

Email Address

Phone Number

2. This question is intended to confirm that you are knowledgeable about the inspection, operation, and maintenance practices for BMPs on private property used by your organization.

- I am knowledgeable regarding the practices used by my jurisdiction to inspect, maintain, and enforce maintenance of BMPs on private property. If I am uncertain about a response to a question, I will consult someone within my jurisdiction who is knowledgeable.
- I am **not** knowledgeable regarding the practices used by my jurisdiction to inspect, maintain, and enforce maintenance of BMPs on private property.

3. If you checked that you are **not knowledgeable about BMPs on private property, please describe your role within the jurisdiction, specifically indicating your role related to BMP Inspection and Maintenance responsibilities for privately owned facilities.**

4. Are you willing to participate in a future interview to discuss BMP Inspection and Maintenance on private property?

- Yes
- No

Yakima County Effectiveness Study: BMP Inspection and Maintenance Responsibilities Survey

The following questions are intended to collect information about your jurisdiction.

5. Select the permit that applies to your jurisdiction. For permits other than Washington State, please provide a weblink to your permit and note the section numbers of the permit or requirements that apply to inspection, maintenance, and enforcement of BMPs on private property.

- A - Eastern Washington NPDES MS4 Phase II
- B - Western Washington NPDES MS4 Phase II
- C - Western Washington NPDES MS4 Phase I
- D - For NPDES MS4 permits other than Washington State or jurisdictions that have not been issued a NPDES MS4 permit, please provide a weblink to your permit/requirements, and note the section numbers of the permit or requirements that apply to inspection, maintenance, and enforcement of BMPs on private property.

6. Estimate the number of BMPs located on private properties within the permitted limits of your jurisdiction that discharge to a municipal separate storm sewer system (MS4). For non-permitted jurisdictions, note the number of BMPs located on private property.

- A - 0-300 BMPs
- B - 300-600 BMPs
- C - 600-1000 BMPs
- D - If greater than 1000 BMPs, please estimate how many below:

7. Provide the estimated 2020 population within the permitted limits of your jurisdiction.

Yakima County Effectiveness Study: BMP Inspection and Maintenance Responsibilities Survey

The following questions are intended to identify the strategies used by the jurisdiction to inspect and maintain structural BMPs on private property as required by your NPDES MS4 permit.

8. Select the method that best describes your jurisdiction's strategy to inspect structural stormwater BMPs on private property. Use the comment box following the question as needed to clarify your response.

- A - Permittee/jurisdiction inspects BMP(s)
- B - Property owner inspects BMP(s)
- C - Property owner is required by permittee/jurisdiction to hire third party or contractor to inspect BMP(s)
- D - Property owner is given the option to provide access to the permittee/jurisdiction for inspection or to hire a third party or contractor to inspect BMP(s)
- E - Other, please describe in the box provided below

If you have additional comments or responded with *Other*, please use the box below.

9. Select the method that best describes your jurisdiction's strategy to maintain structural stormwater BMPs on private property. Use the comment box following the question as needed to clarify your response.

- A - Permittee/jurisdiction maintains BMP(s)
- B - Property owner maintains BMP(s)
- C - Property owner is required by permittee/jurisdiction to hire third party or contractor to maintain BMP(s). Permittee/jurisdiction requires proof of inspection and maintenance
- D - Property owner is required by permittee/jurisdiction to hire a third party or contractor to maintain BMP(s) and provide proof of maintenance
- E - Property owner is given the option to provide access to the permittee/jurisdiction for maintenance or to hire a third party or contractor to maintain BMP(s)
- F - Other, please describe in the box provided below

If you have additional comments or responded with *Other*, please use the box below.

10. How many years have you been using the strategies selected above?

11. How effective do you understand your jurisdiction's BMP inspection and maintenance program to be, and why?

12. Describe in 1-2 sentences a primary challenge with using the selected strategies.

13. Describe in 1-2 sentences a primary benefit to using the selected strategies.

Yakima County Effectiveness Study: BMP Inspection and Maintenance Responsibilities Survey

The following questions are intended to be a self-assessment of your jurisdiction's strategy identified in the previous question. If element(s) not listed are part of your jurisdiction's strategy, please describe the element(s) in the comment box including how the element(s) rates (high, medium, or low). Alternatively, the comment box maybe used to explain the effectiveness rating for specific elements.

14. Does your jurisdiction have access to BMPs on private property?

- A - All BMPs are accessible
- B - More than half of BMPs are accessible
- C - Less than half of BMPs are accessible
- D - None of the BMPs are accessible

Additional comments

15. Does your jurisdiction have funding to perform the required inspection, maintenance, and enforcement activities?

- A - More than enough funding is available
- B - Enough funding is available
- C - Insufficient funding is available
- D - No funding is available

Additional comments

16. Is training provided for staff performing inspection, maintenance, and enforcement activities?

- A - All staff are trained
- B - More than half of the staff are trained
- C - Less than half of the staff are trained
- D - No training is provided to staff

Additional comments

17. Does your jurisdiction have a written plan that defines the O&M protocol for BMPs?

- A - An O&M protocol has been developed for all BMPs
- B - An O&M protocol has been developed for more than half of BMPs
- C - An O&M protocol has been developed for less than half of BMPs
- D - No O&M protocol has been developed for any BMPs

Additional Comments

18. Does the jurisdiction provide BMP owners with O&M protocol written with terminology that can be easily understood by the general public and/or does the jurisdiction have a program to educate BMP owners about their O&M responsibilities?

- A - Protocol can be easily understood by the general public or jurisdiction has program to educate BMP owners
- B - Somewhere between A and C
- C - Protocol is the same as what is provided to the jurisdiction's staff
- D - The Jurisdiction does not have an O&M protocol or related education program

Additional comments

19. Is O&M protocol provided in languages other than English?

- A - O&M Protocol is provided in 3 or more other languages (including English)
- B - O&M Protocol is provided in 2 languages (including English)
- C - O&M Protocol is provided only in English
- D - No O&M Protocol has been developed

Additional comments

20. When ownership changes, does your jurisdiction have a process for communicating O&M responsibilities to the new BMP owner?

- A - Communication provided to all new BMP owners
- B - Communication provided to more than half of new BMP owners
- C - Communication provided to less than half of new BMP owners
- D - No communication is provided to new BMP owners

Additional comments

21. Does your jurisdiction have the appropriate equipment available to conduct maintenance of BMPs on private property?

- A - Jurisdiction has the appropriate equipment needed to maintain all BMPs
- B - Jurisdiction has the appropriate equipment needed to maintain more than half of BMPs
- C - Jurisdiction has the appropriate equipment to maintain less than half of BMPs
- D - Jurisdiction does not have appropriate equipment to maintain any BMPs
- E - N/A

Additional comments

22. Does your jurisdiction have the appropriate equipment available to conduct an inspection of BMPs on private property?

- A - Jurisdiction has the appropriate equipment needed to inspect all BMPs
- B - Jurisdiction has the appropriate equipment to inspect more than half of BMPs
- C - Jurisdiction has the appropriate equipment to inspect less than half of BMPs
- D - Jurisdiction does not have appropriate equipment to inspect any BMPs
- E - N/A

Additional comments

23. Does your jurisdiction train staff to conduct inspection and maintenance of BMPs on private property?

- A - Jurisdiction trains all staff
- B - Jurisdiction trains over half of the staff
- C - Jurisdiction trains less than half of the staff
- D - Jurisdiction does not train staff
- E - N/A

Additional comments

24. How often do BMP owners in your jurisdiction comply with paying for required maintenance?

- A - All BMP owners comply
- B - More than half of BMP owners comply
- C - Less than half of BMP owners comply
- D - No BMP owners comply
- E - N/A

Additional comments

25. How often do BMP owners in your jurisdiction comply with paying for required inspection?

- A - All BMP owners comply
- B - More than half of BMP owners comply
- C - Less than half of BMP owners comply
- D - No BMP owners comply
- E - N/A

Additional comments

26. Select the items that best describe your jurisdiction's documentation process for tracking inspection and maintenance activities.

	Always	Mostly	Sometimes	Never
Complete	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy to Use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consistant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If Jurisdiction does not have a documentation process, please explain below

27. Select the items that best describe your jurisdiction's inspection and maintenance records for BMPs on private property.

	Always	Mostly	Somewhat	Never
Up to Date	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Complete	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If Jurisdiction does not have inspection and maintenance records for BMPs on private property, please indicate so below

Yakima County Effectiveness Study: BMP Inspection and Maintenance Responsibilities Survey

The following questions are intended to provide additional information about the jurisdiction's strategies for inspection and maintenance of structural BMPs on private property.

28. Define the existing source of funding for inspection and maintenance of BMPs on private property.

- A - Property owner pays third party
- B - Property owner pays permittee/jurisdiction
- C - Mix of options A & B
- D - Stormwater utility fees
- E - Other, please describe in the box provided below

If you have any additional comments or responded with *Other*, please use the box below.

Yakima County Effectiveness Study: BMP Inspection and Maintenance Responsibilities Survey

The following are open-answer questions. Please provide responses in the boxes below.

29. Does your jurisdiction offer incentives to private property owners to inspect or maintain structural BMPs on their property?

No

Yes (Please Describe)

30. Does your jurisdiction have a way to penalize or fine a BMP owner for not demonstrating they are compliant with the requirements?

No

Yes (Please Describe)

31. How would your jurisdiction improve or change your program?

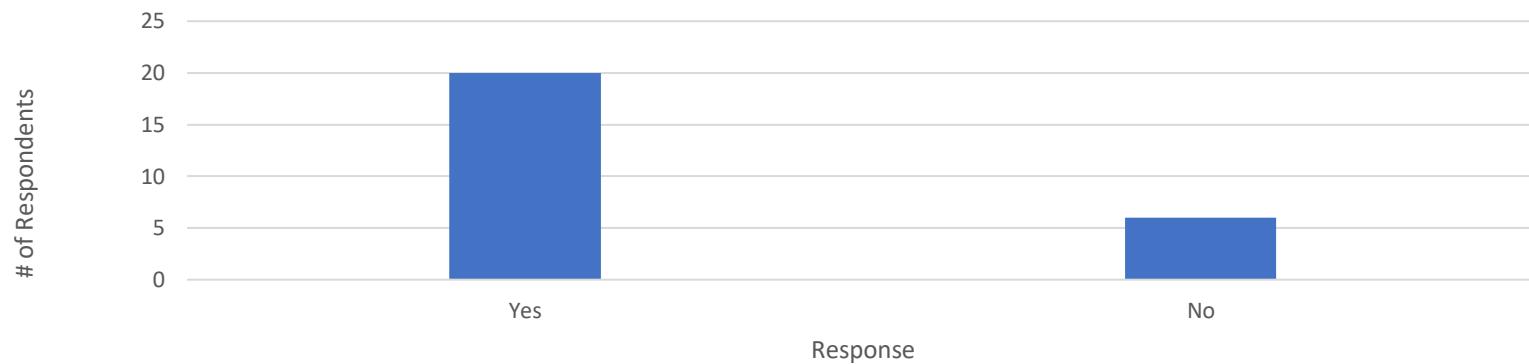
Yakima County Effectiveness Study: BMP Inspection and Maintenance Responsibilities Survey

Thank you!

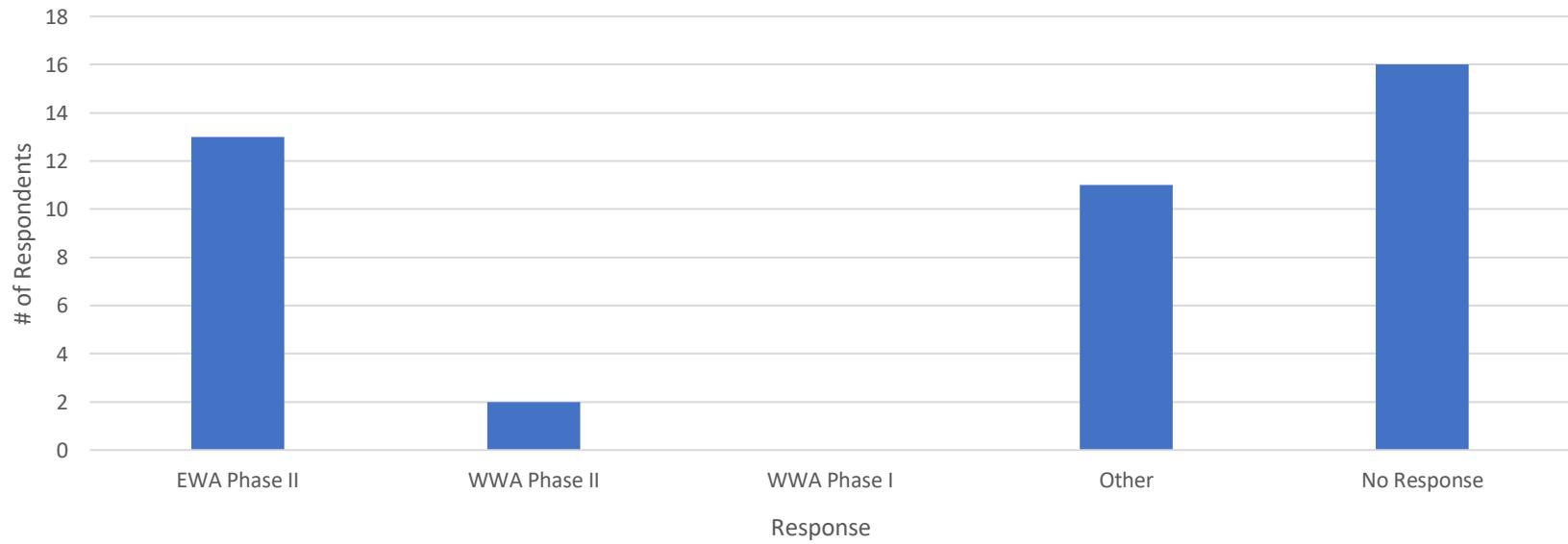
Thank you for taking the time to complete this survey. Please stay tuned for potential follow-up interviews.

Survey Responses for All Strategies

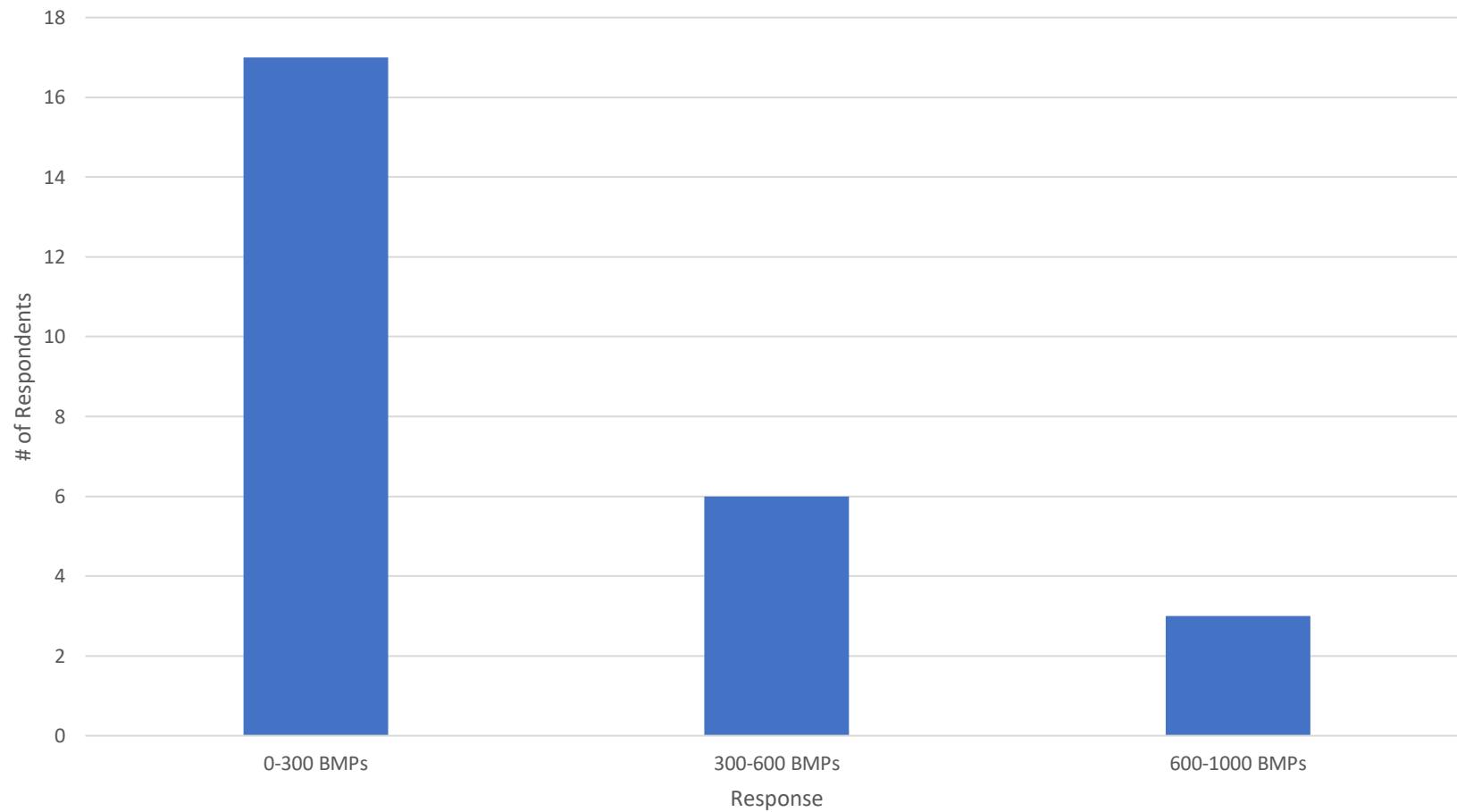
4. Are you willing to participate in a future interview to discuss BMP Inspection and Maintenance on private property?



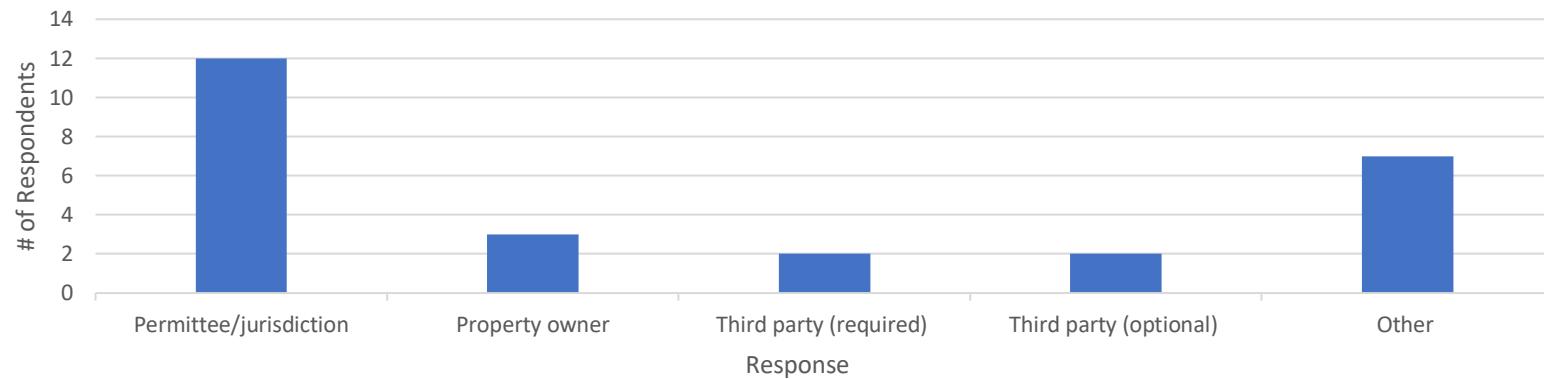
5. Select the permit that applies to your jurisdiction.



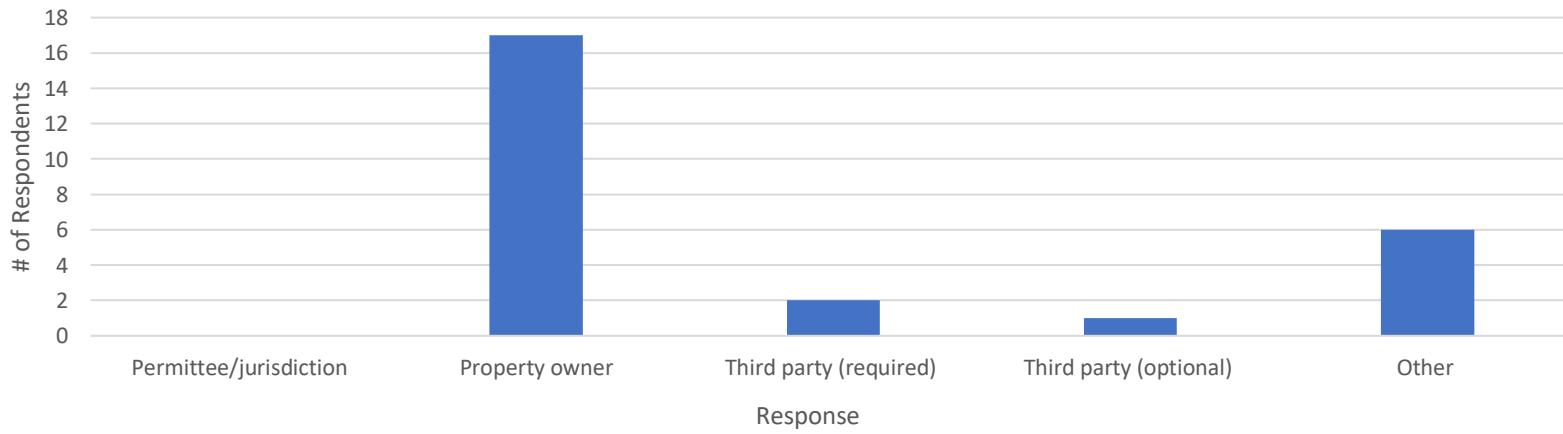
6. Estimate the number of BMPs located on private properties within the permitted limits of your jurisdiction that discharge to a municipal separate storm sewer system (MS4). For non-permitted jurisdictions, note the number of BMPs located on private property.



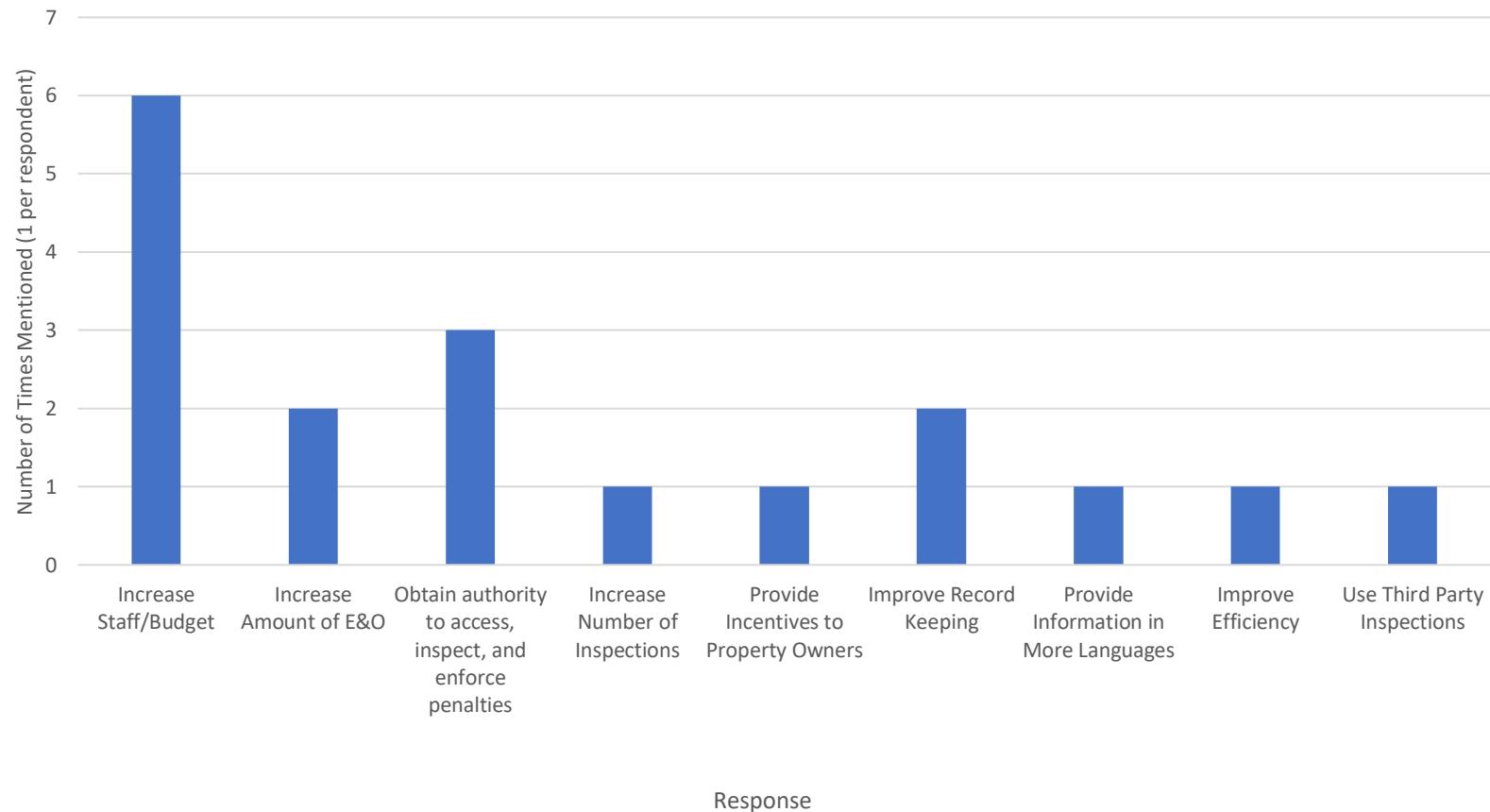
8. Select the method that best describes your jurisdiction's strategy to inspect structural stormwater BMPs on private property.

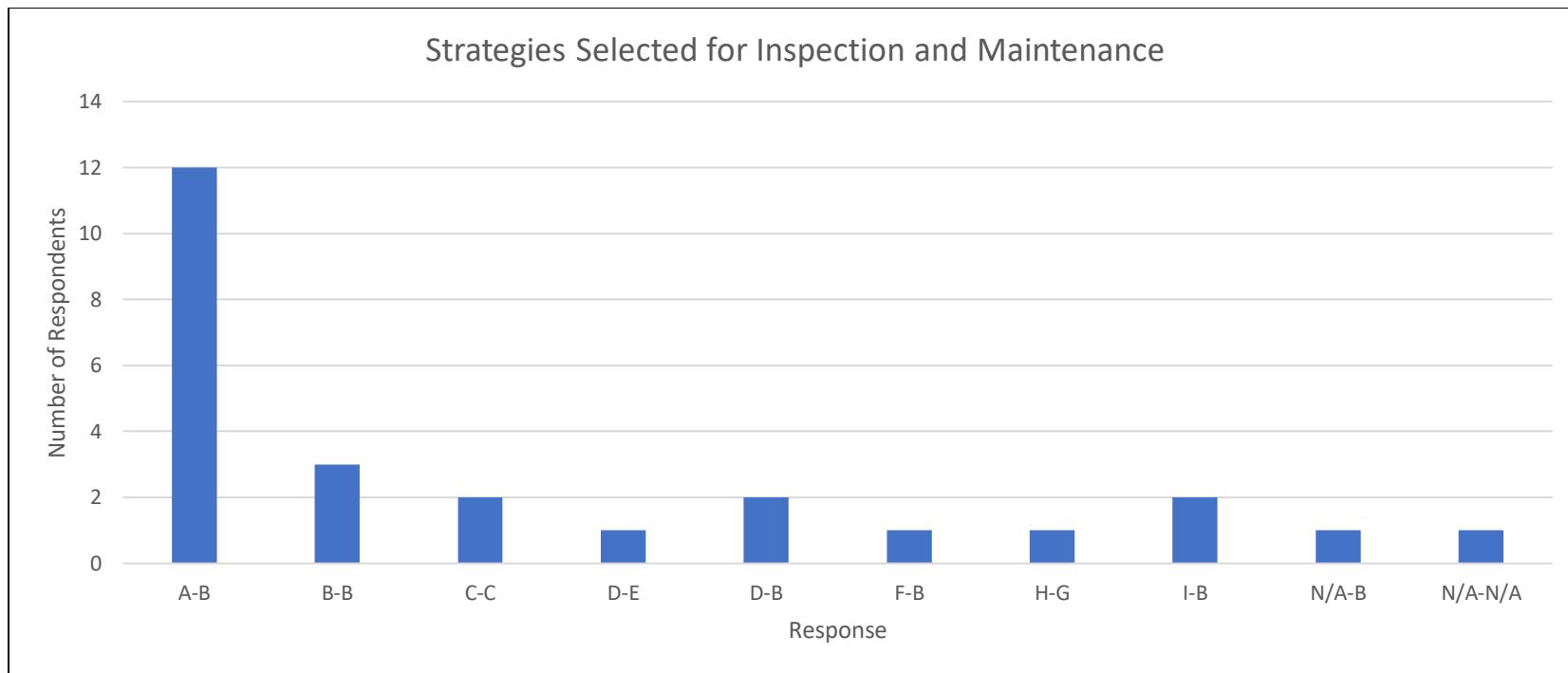


9. Select the method that best describes your jurisdiction's strategy to maintain structural stormwater BMPs on private property.



Ways to Change or Improve the Program





Responses	Responses
A - Permittee inspects BMP(s).	A - Permittee/jurisdiction maintains BMP(s)
B - Property owner inspects BMP(s).	B - Property owner maintains BMP(s)
C - Property owner is required by permittee to hire 3 rd party or contractor to inspect BMP(s).	C - Property owner is required by permittee/jurisdiction to hire third party or contractor to maintain BMP(s). Permittee/jurisdiction requires proof of inspection and maintenance
D - Property owner option: provide permittee access to inspection BMP(s) or hire 3 rd party.	E - Property owner is given the option to provide access to the permittee/jurisdiction for maintenance or to hire a third party or contractor to maintain BMP(s)
F - Property Owner inspects. Permittee independently inspects.	G - Property Owner or Third Party maintains
H - Property Owner or 3 rd Party inspects.	
I - Property Owner or 3 rd party inspects. Permittee independently inspects.	
N/A - Program Under Development	N/A - Program Under Development

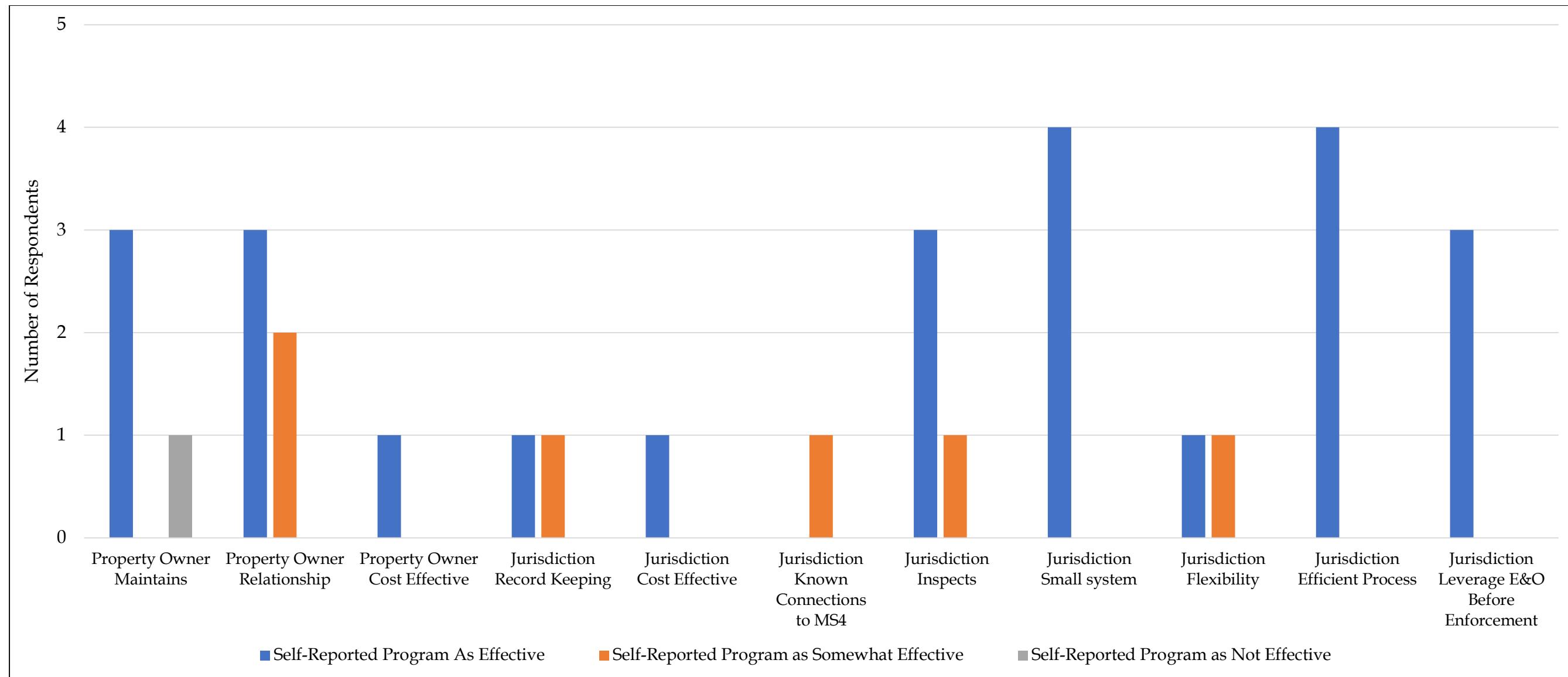


Table 6.3 Definition of Codes in Figure 6.3

Code	Definition
Property Owner Maintains	The benefit in this case is that the property owner maintains and is responsible/liable for maintenance. This may translate to not needing to allocate jurisdiction staff time to maintenance, property owners being more aware of potential discharges, etc.
Property Owner Relationship	The strategy allows positive relationships to form between the property owners and jurisdiction. This may make it easier for the jurisdiction to achieve compliance or for the property owner to ask questions and meet requirements expected of them.
Property Owner Cost Effective	The strategy is cost effective for the property owner. For example, a strategy may result in maintenance costs being less for a property owner, because they are not responsible for maintenance.
Jurisdiction Recordkeeping	The strategy allows the jurisdiction to efficiently manage records. For example, inspection records may be created in the field via tablets, which automatically generates a workorder or notice to the property owner that maintenance should be performed.
Jurisdiction Cost Effective	The strategy is cost effective for the jurisdiction. For example, if the responsibility of maintenance is placed on the property owner, the jurisdiction does not need to allocate funds to perform maintenance on BMPs on private property.
Jurisdiction Known Connections to MS4	The strategy allows jurisdictions to better understand or document all connections to their MS4 from private property.
Jurisdiction Inspects	The jurisdiction can have confidence in the inspection process, either because they have standard protocol and/or have trained staff to perform inspections.
Jurisdiction Small System	Having a small system allows the jurisdiction to be able to manage inspection and/or maintenance of all BMPs; moreover if a jurisdiction receives little rainfall, a need for maintenance or issues may arise less frequently.
Jurisdiction Flexibility	The strategy allows the jurisdiction to be flexible. This may include flexibility to adjust maintenance responsibilities, which can allow for better working relationships with private property owners and higher quality maintenance.
Jurisdiction Efficient Process	The strategy is or involves an efficient process for the jurisdiction. For example, a jurisdiction may use GIS or other software to streamline documentation and scheduling of maintenance. Another example involves using the same staff to inspect BMPs during construction and post-construction to be more familiar with the BMPs and how they operate.
Jurisdiction Leverage E&O (before Enforcement)	The strategy involves use of education, formal requests to comply, etc. prior to use of enforcement. Allows the jurisdiction to eventually get property owner to comply.

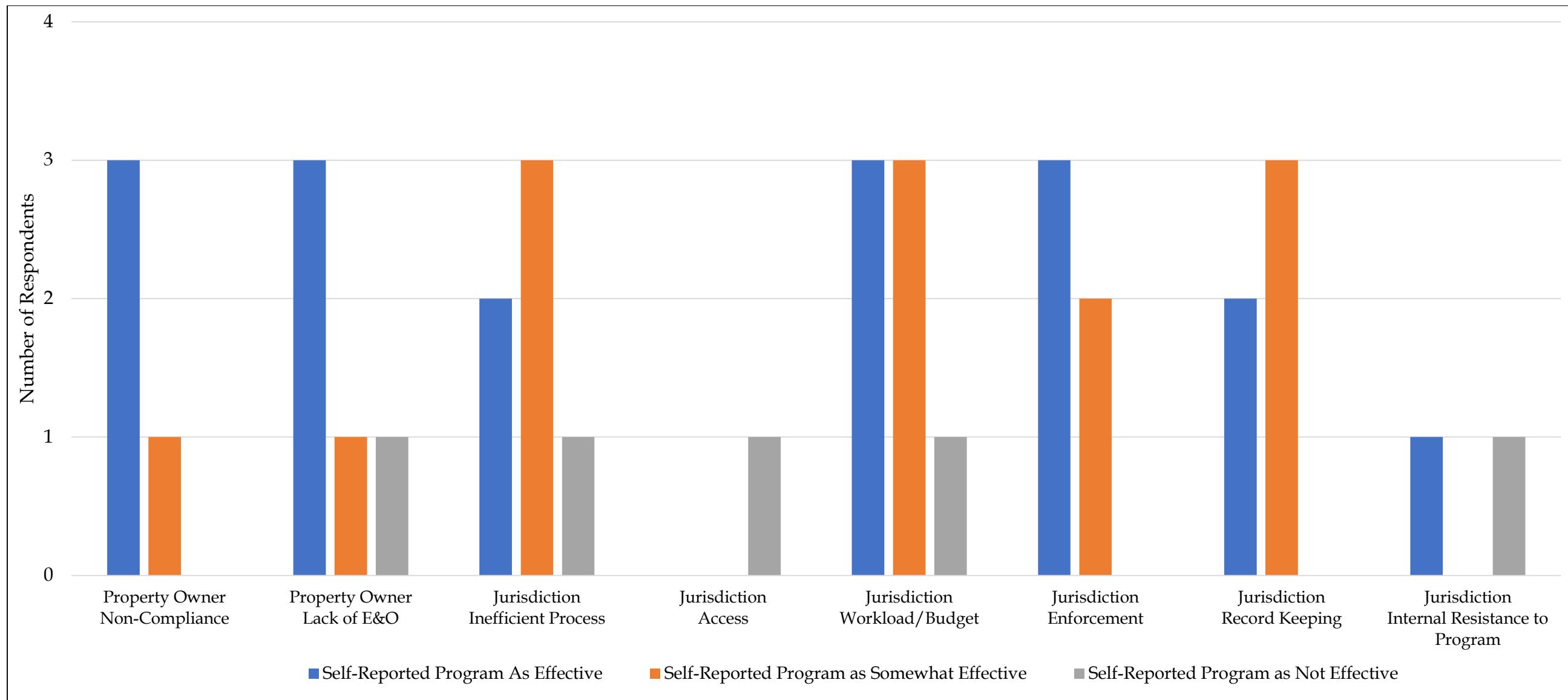
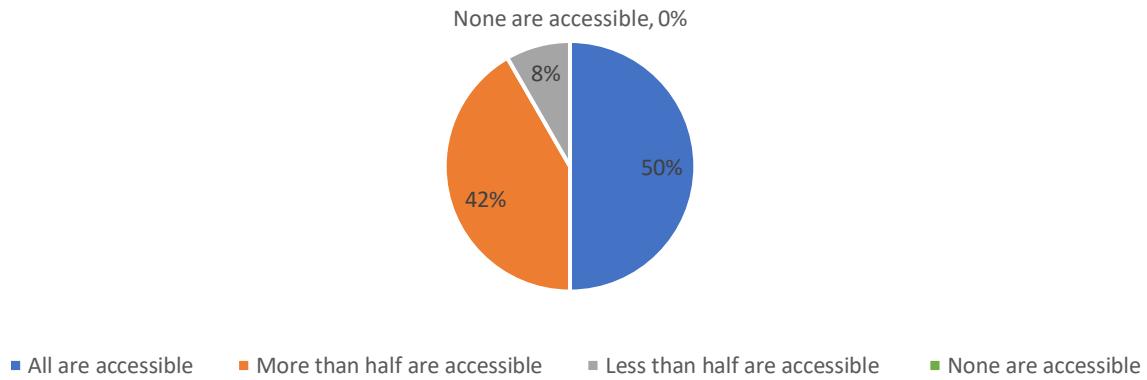


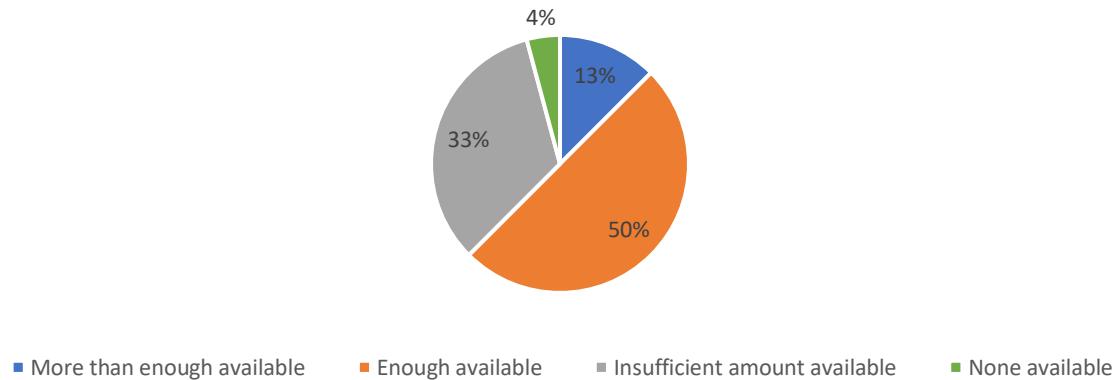
Table 6.4 Definition of Codes in Figure 6.4

Code	Definition
Property Owner Non-Compliance	Challenge is achieving property owner compliance. May include encouraging property owners to respond to requests for records, cultural resistance to compliance, getting property owners to comply with requested maintenance, etc.
Property Owner Lack of E&O	Challenge is that a lack of E&O has reached the private property owners. As a result private property owners may not understand what the BMPs are for and new property owners may not have been informed of or are aware of the BMPs.
Jurisdiction Inefficient Process	The strategy involves an inefficiency or inefficient process. This may include variable responsibilities at each site, having difficulty organizing or recording records, and inefficiencies in time management for different types of properties.
Jurisdiction Access	The jurisdiction experiences challenges with access to BMPs on private property. This may involve not having legal authority to enter private property to perform inspections of BMPs, or not having access to the responsible party.
Jurisdiction Workload/Budget	The workload is too high, equipment demands are too great, or budget is insufficient for the jurisdiction to complete required inspection or maintenance.
Jurisdiction Enforcement	It is challenging for the jurisdiction to enforce, either because weak or no enforcement ordinances are in place, or because enforcement takes a large amount of effort to perform.
Jurisdiction Record Keeping	The jurisdiction experiences challenges with recordkeeping. This may be related to keeping accurate records of responsible records despite changes in the community, having specific records recorded or uploaded into systems, etc.
Jurisdiction Internal Resistance to Program	Departments, leaders, or other staff at jurisdiction create a challenge by showing resistance to implementation of the strategy. The resistance can take the form of a desire to not enforce rules at all or consistently, a belief that the O&M program is not a high priority, or policies or procedures of the jurisdiction that limit the ability of staff to implement the strategy and O&M program.

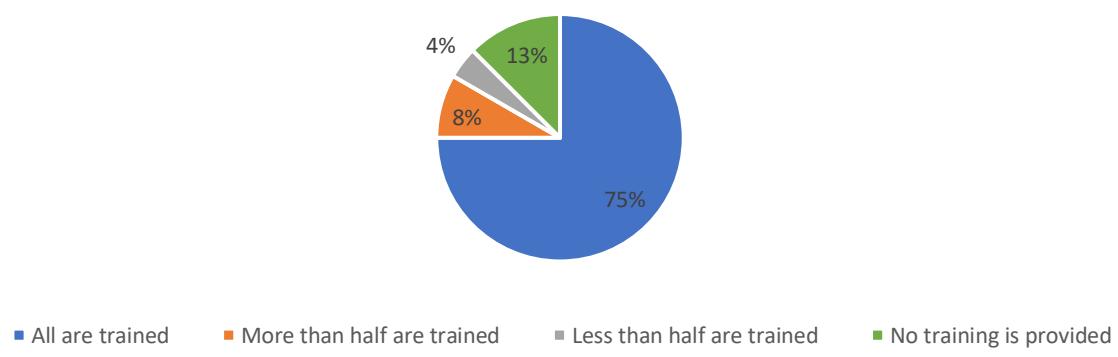
14. Does your jurisdiction have access to BMPs on private property?



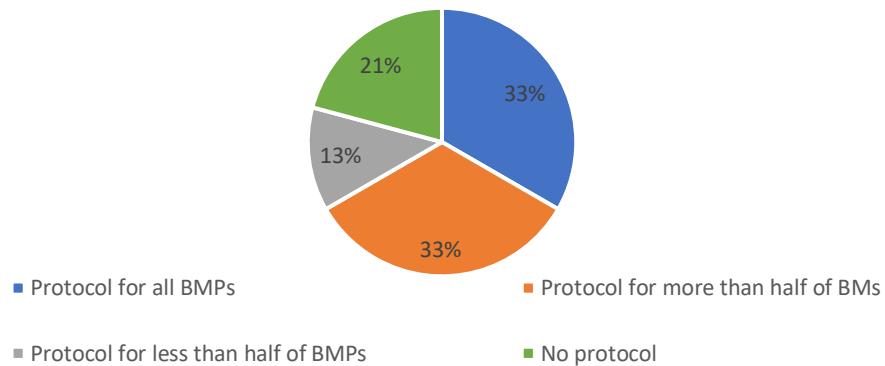
15. Does your jurisdiction have funding to perform the required inspection, maintenance, and enforcement activities?



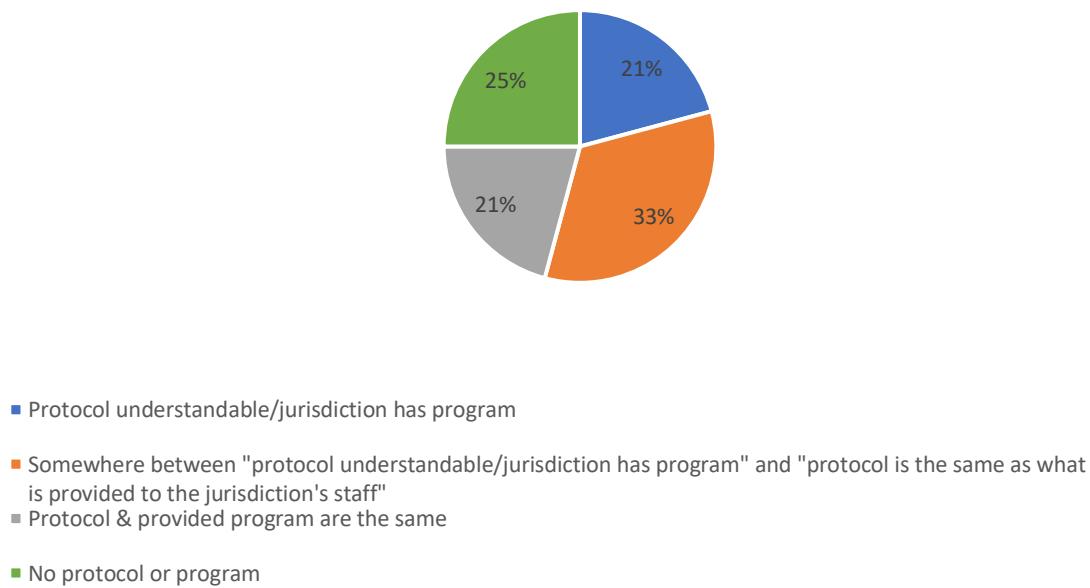
16. Is training provided for staff performing inspection, maintenance, and enforcement activities?



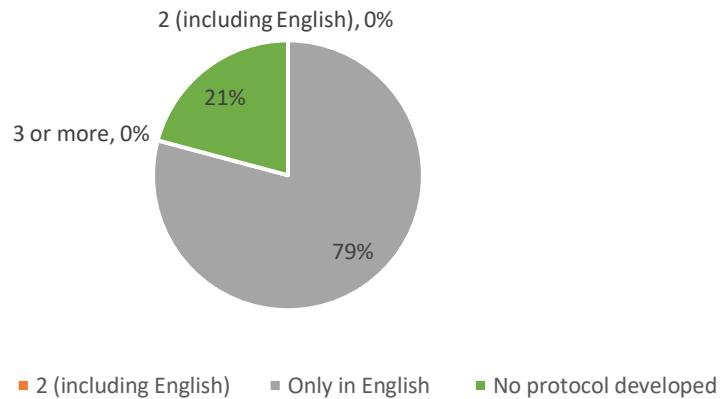
17. Does your jurisdiction have a written plan that defines the O&M protocol for BMPs?



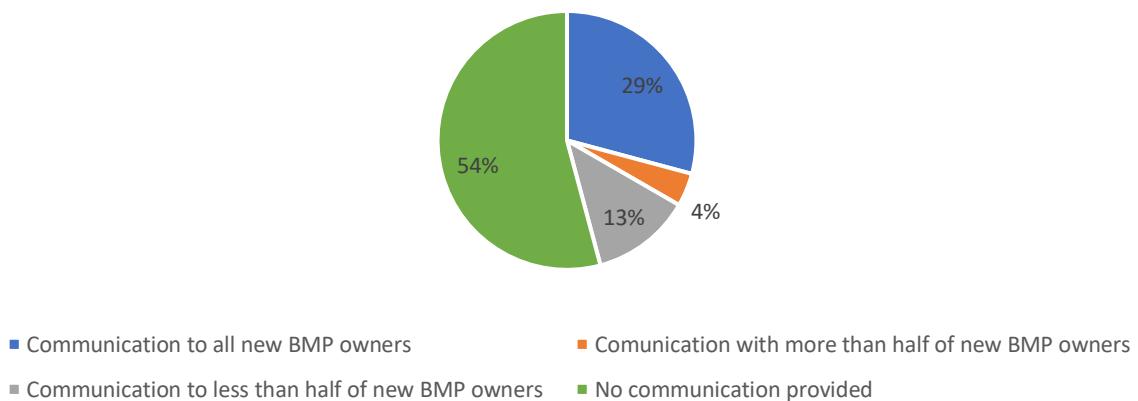
18. Does the jurisdiction provide BMP owners with O&M protocol written with terminology that can be easily understood by the general public and/or does the jurisdiction have a program to educate BMP owners about their O&M responsibilities?



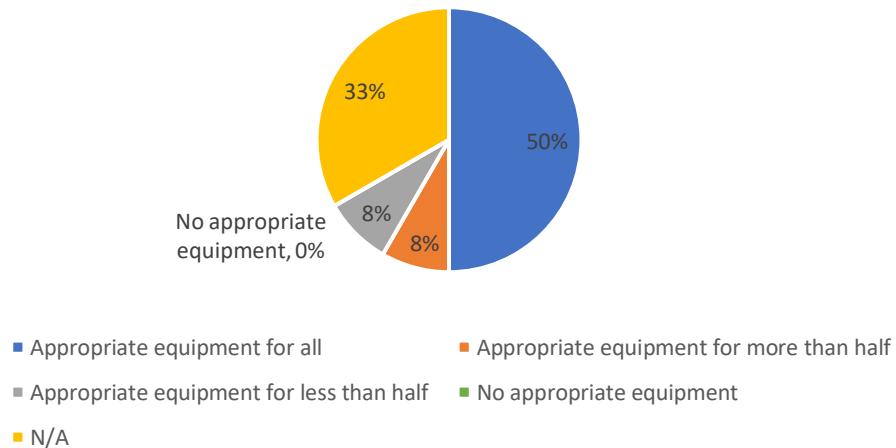
19. Is O&M protocol provided in languages other than English?



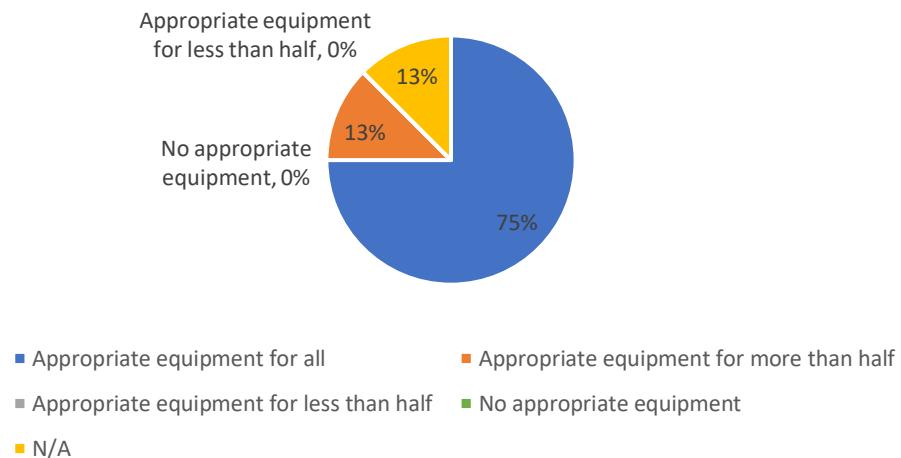
20. When ownership changes, does your jurisdiction have a process for communicating O&M responsibilities to the new BMP owner?



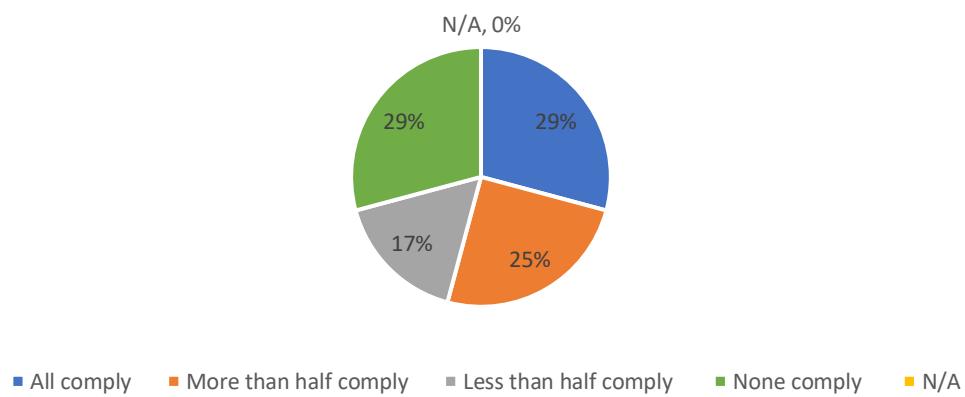
21. Does your jurisdiction have the appropriate equipment available to conduct maintenance of BMPs on private property?



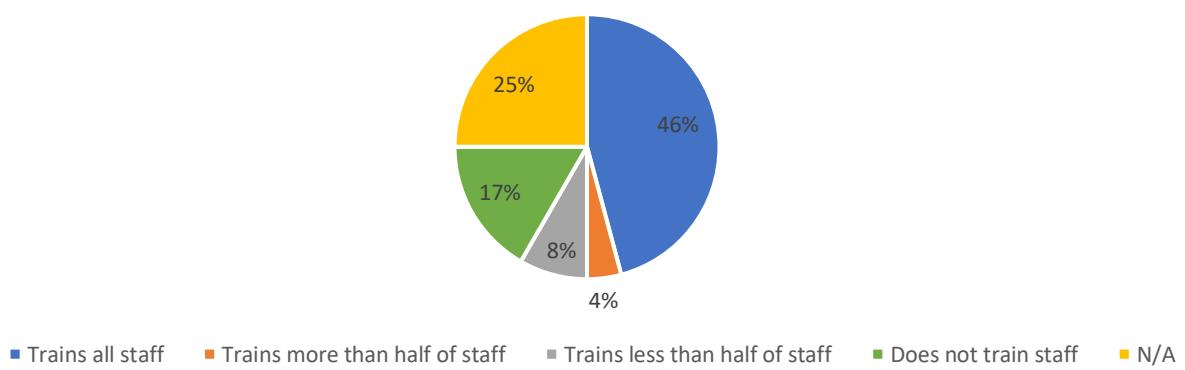
22. Does your jurisdiction have the appropriate equipment available to conduct an inspection of BMPs on private property?



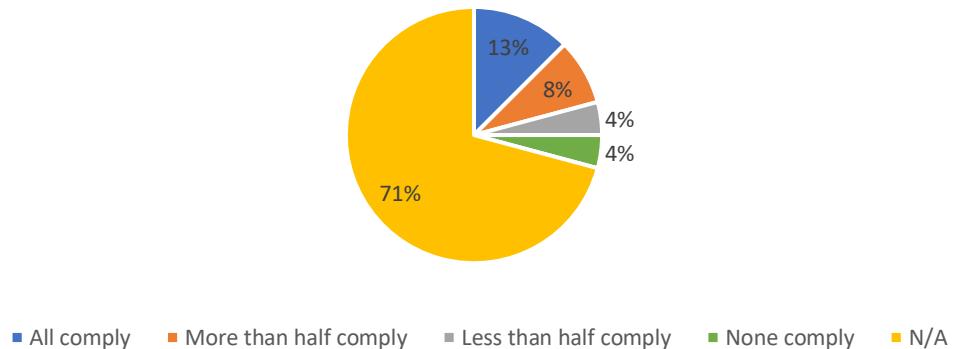
24. How often do BMP owners in your jurisdiction comply with paying for required maintenance?



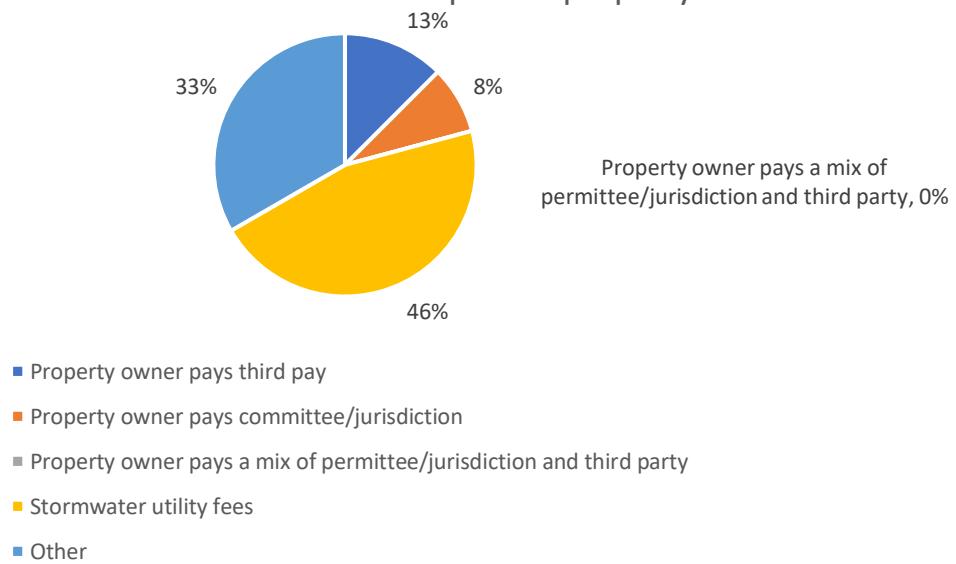
23. Does your jurisdiction train staff to conduct inspection and maintenance of BMPs on private property?



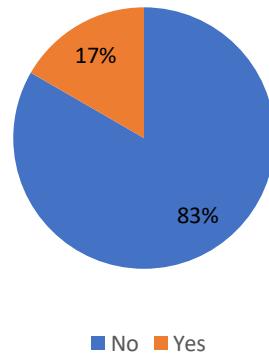
25. How often do BMP owners in your jurisdiction comply with paying for required inspection?



28. Define the existing source of funding for inspection and maintenance of BMPs on private property.

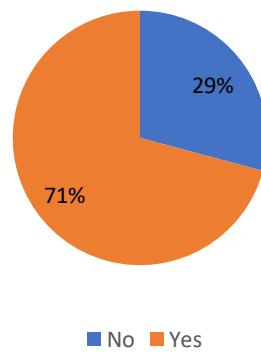


29. Does your jurisdiction offer incentives to private property owners to inspect or maintain structural BMPs on their property?



■ No ■ Yes

30. Does your jurisdiction have a way to penalize or fine a BMP owner for not demonstrating they are compliant with the requirements?



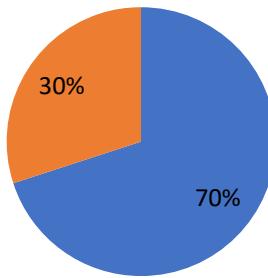
■ No ■ Yes

Survey Responses Specific to Strategy A-B

14. Does your jurisdiction have access to BMPs on private property?

C - Less than half are accessible, 0%

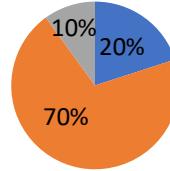
D - None are accessible, 0%



■ A - All are accessible ■ B - More than half are accessible ■ C - Less than half are accessible ■ D - None are accessible

15. Does your jurisdiction have funding to perform the required inspection, maintenance, and enforcement activities?

D - None Available , 0%



■ A - More than enough available ■ B - Enough available

■ C - Insufficient available

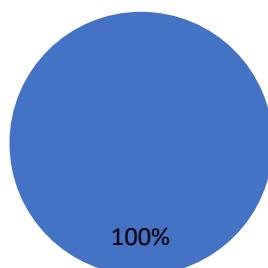
■ D - None Available

16. Is training provided for staff performing inspection, maintenance, and enforcement activities?

B - More than half trained, 0%

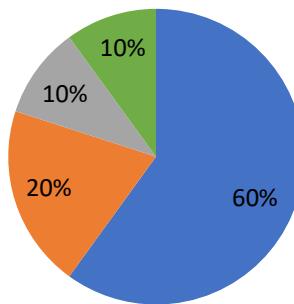
D - No training is staff, 0%

C - Less than half trained, 0%



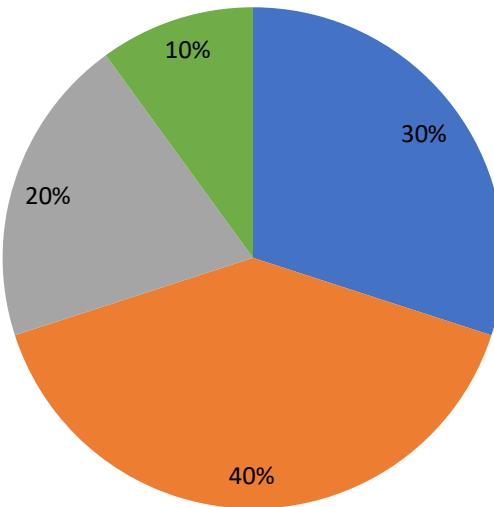
■ A - All trained ■ B - More than half trained ■ C - Less than half trained ■ D - No training is staff

17. Does your jurisdiction have a written plan that defines the O&M protocol for BMPs?



- A - Protocol for all BMPs
- B - Protocol for more than half of BMPs
- C - Protocol for less than half of BMPs
- D - No Protocol

18. Does the jurisdiction provide BMP owners with O&M protocol written with terminology that can be easily understood by the general public and/or does the jurisdiction have a program to educate BMP owners about their O&M responsibilities?

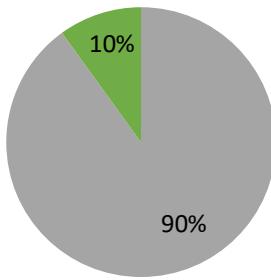


- A - Protocol understandable by public / jurisdiction has program
- B - Somewhere between easily understood and that provided by jurisdiction
- C - Protocol and provided program are the same
- D - No protocol or education program

19. Is O&M protocol provided in languages other than English?

A - 3 or more, 0%

B - 2 (including English), 0%



■ A - 3 or more ■ B - 2 (including English) ■ C - Only in English ■ D - No protocol developed

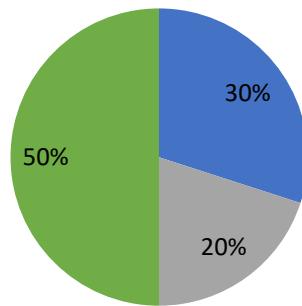
20. When ownership changes, does your jurisdiction have a process for communicating O&M responsibilities to the new BMP owner?

■ A - Communication to all new BMP owners

■ B - Communication with more than half of the new BMP owners

■ C - Communication to less than half of new BMP owners

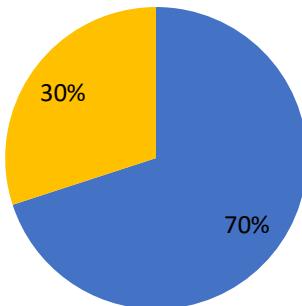
■ D - No communication provided



B - Communication with more than half of the new BMP owners, 0%

21. Does your jurisdiction have the appropriate equipment available to conduct maintenance of BMPs on private property?

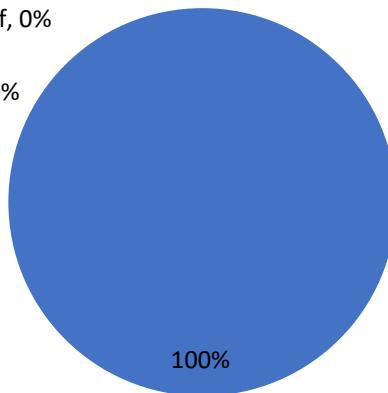
- B - Appropriate equipment for more than half, 0%
- C - Appropriate equipment for less than half, 0%
- D - No appropriate equipment , 0%



- A - Appropriate equipment for all
- B - Appropriate equipment for more than half
- C - Appropriate equipment for less than half
- D - No appropriate equipment
- E - N/A

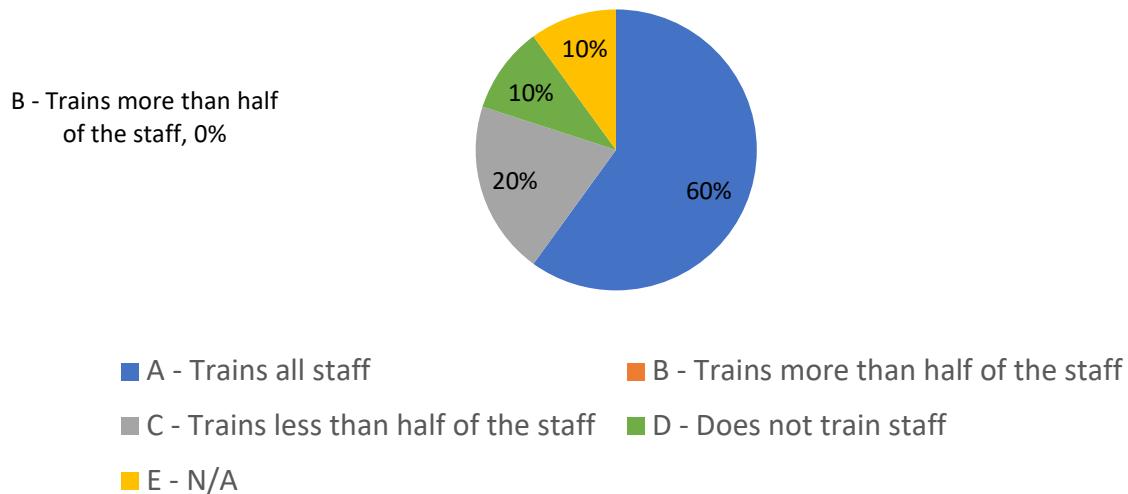
22. Does your jurisdiction have the appropriate equipment available to conduct an inspection of BMPs on private property?

- B - Appropriate equipment for more than half, 0%
- C - Appropriate equipment for less than half, 0%
- D - No appropriate equipment , 0%
- E - N/A, 0%

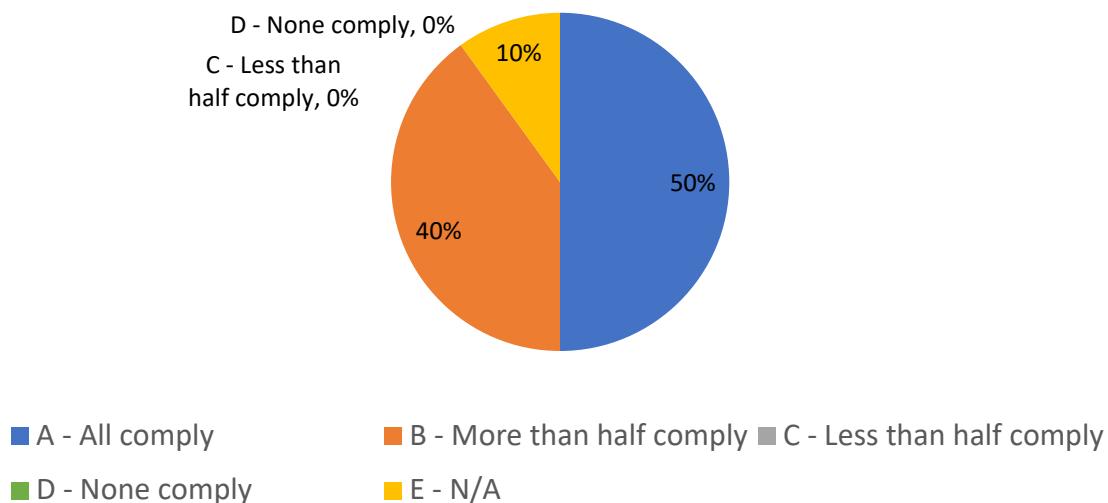


- A - Appropriate equipment for all
- B - Appropriate equipment for more than half
- C - Appropriate equipment for less than half
- D - No appropriate equipment
- E - N/A

23. Does your jurisdiction train staff to conduct inspection and maintenance of BMPs on private property?



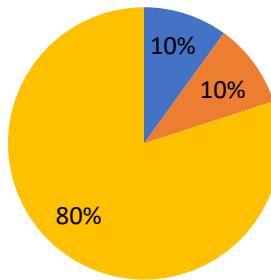
24. How often do BMP owners in your jurisdiction comply with paying for required maintenance?



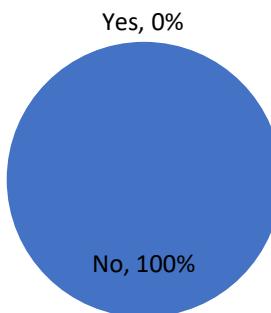
25. How often do BMP owners in your jurisdiction comply with paying for required inspection?

C - Less than half comply, 0%

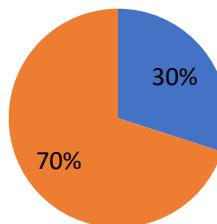
D - None comply, 0%



29. Does your jurisdiction offer incentives to private property owners to inspect or maintain structural BMPs on their property?



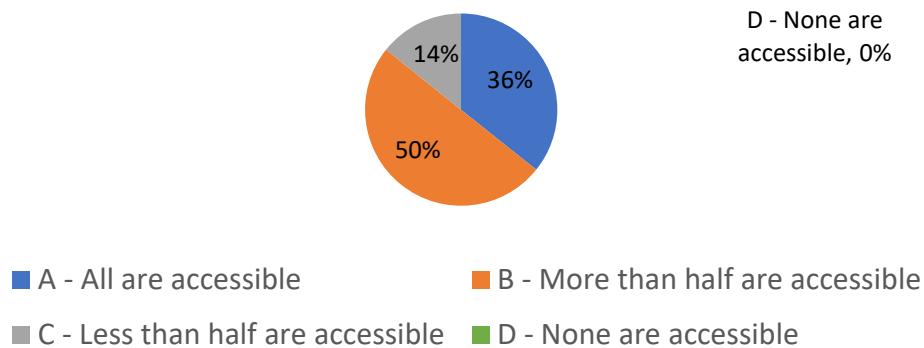
30. Does your jurisdiction have a way to penalize or fine a BMP owner for not demonstrating they are compliant with the requirements?



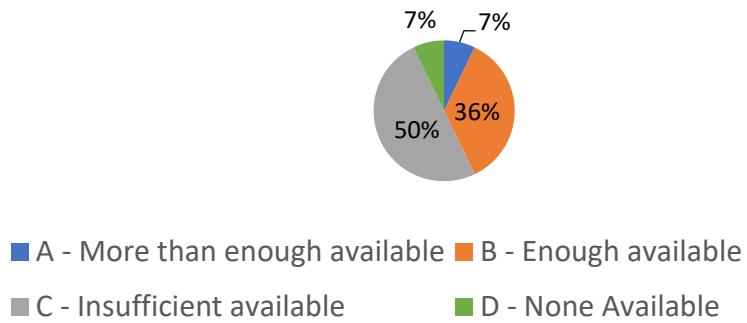
■ No ■ Yes

Survey Responses Specific to Strategies Other than A-B

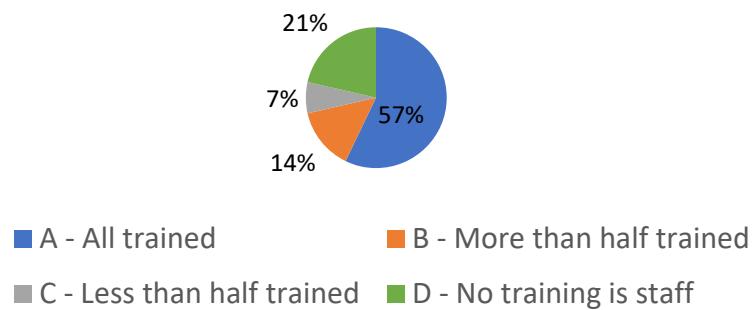
14. Does your jurisdiction have access to BMPs on private property?



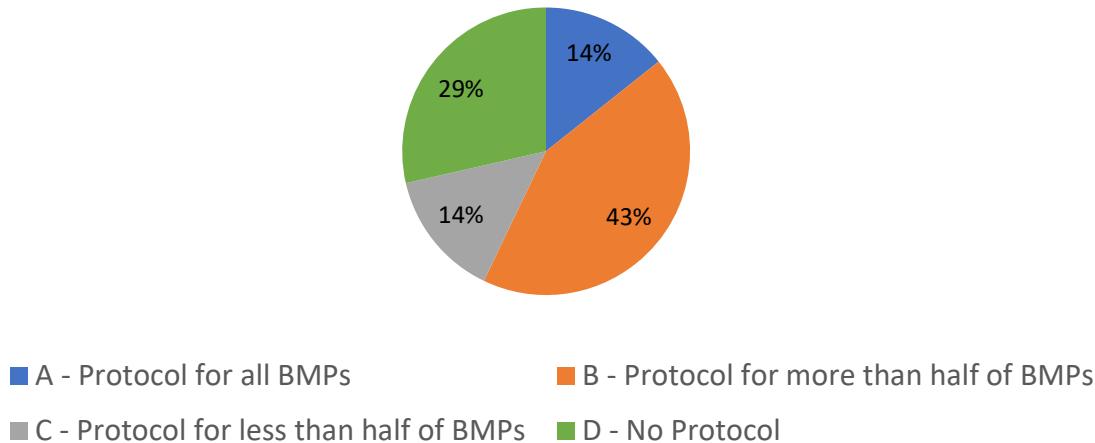
15. Does your jurisdiction have funding to perform the required inspection, maintenance, and enforcement activities?



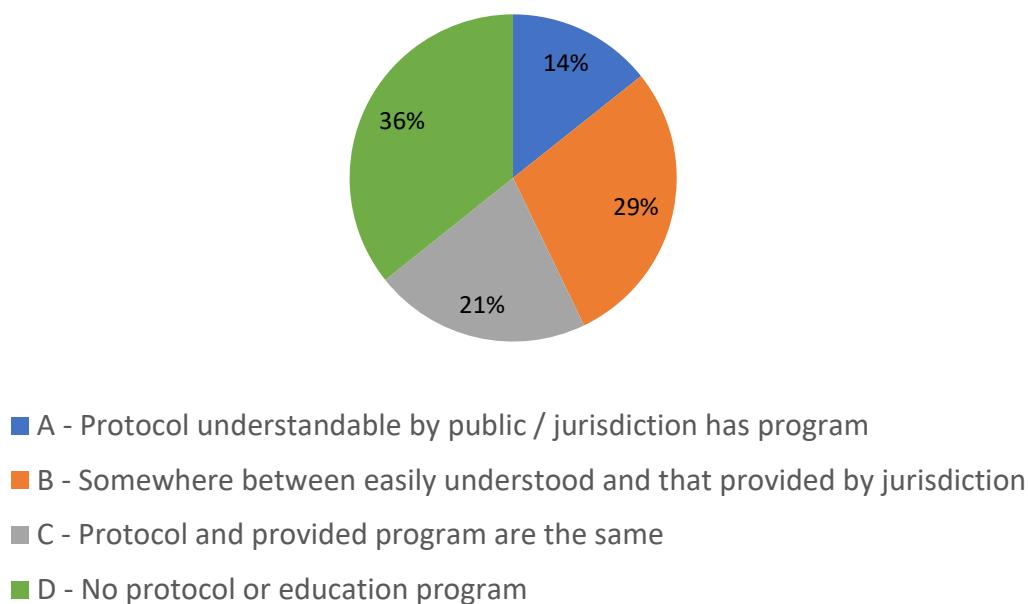
16. Is training provided for staff performing inspection, maintenance, and enforcement activities?



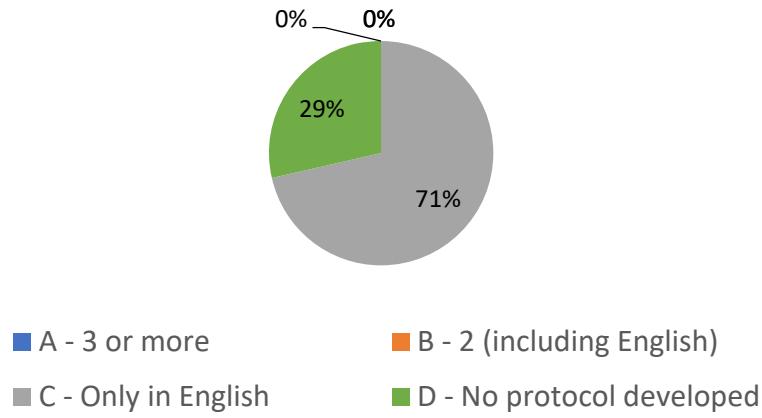
17. Does your jurisdiction have a written plan that defines the O&M protocol for BMPs?



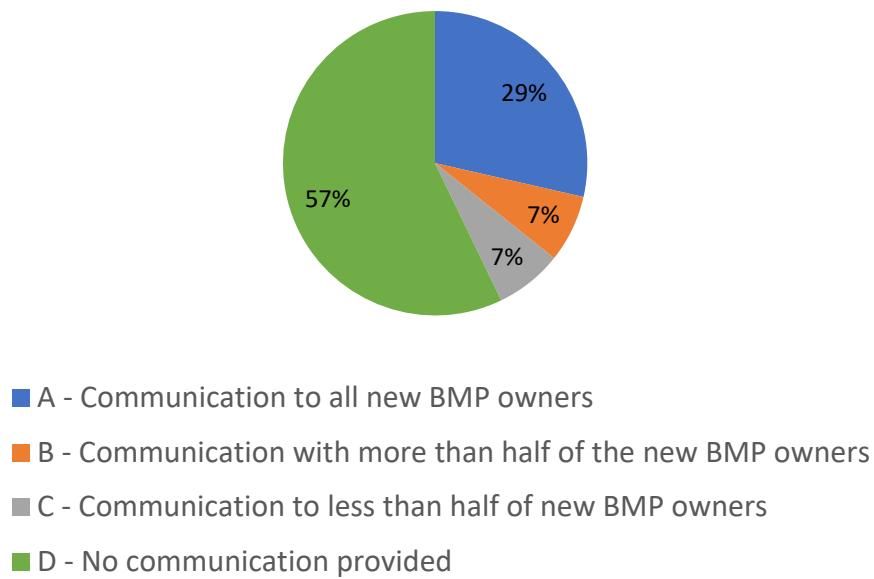
18. Does the jurisdiction provide BMP owners with O&M protocol written with terminology that can be easily understood by the general public and/or does the jurisdiction have a program to educate BMP owners about their O&M responsibilities?



19. Is O&M protocol provided in languages other than English?

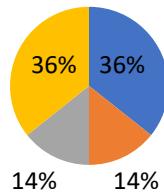


20. When ownership changes, does your jurisdiction have a process for communicating O&M responsibilities to the new BMP owner?



21. Does your jurisdiction have the appropriate equipment available to conduct maintenance of BMPs on private property?

D - No appropriate equipment , 0%

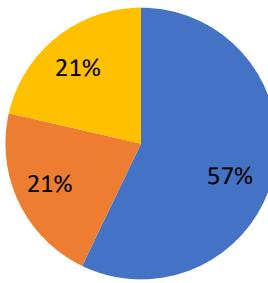


- A - Appropriate equipment for all
- B - Appropriate equipment for more than half
- C - Appropriate equipment for less than half
- D - No appropriate equipment
- E - N/A

22. Does your jurisdiction have the appropriate equipment available to conduct an inspection of BMPs on private property?

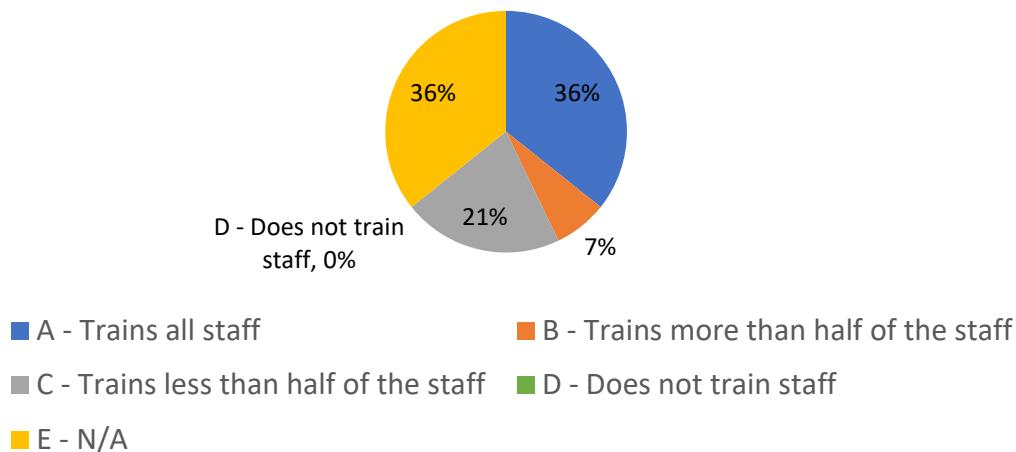
D - No appropriate equipment , 0%

C - Appropriate equipment for less than half, 0%

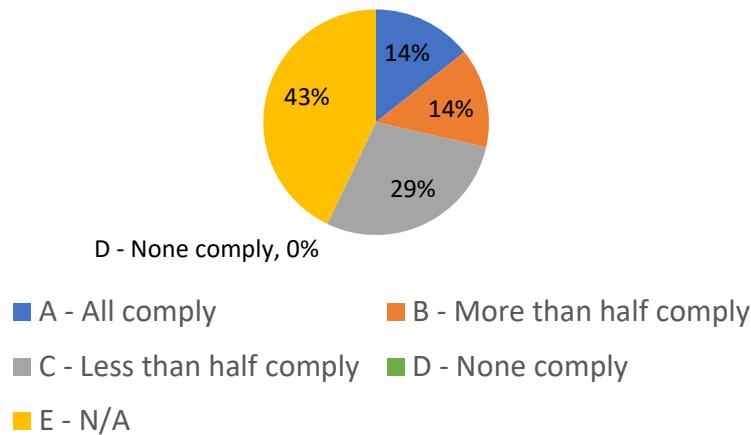


- A - Appropriate equipment for all
- B - Appropriate equipment for more than half
- C - Appropriate equipment for less than half
- D - No appropriate equipment
- E - N/A

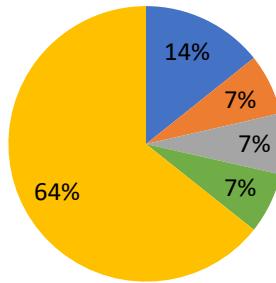
23. Does your jurisdiction train staff to conduct inspection and maintenance of BMPs on private property?



24. How often do BMP owners in your jurisdiction comply with paying for required maintenance?

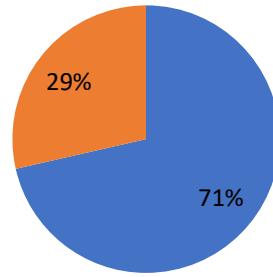


25. How often do BMP owners in your jurisdiction comply with paying for required inspection?



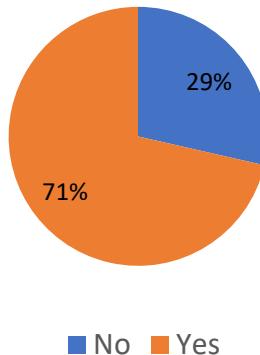
- A - All comply
- B - More than half comply
- C - Less than half comply
- D - None comply
- E - N/A

29. Does your jurisdiction offer incentives to private property owners to inspect or maintain structural BMPs on their property?



- No
- Yes

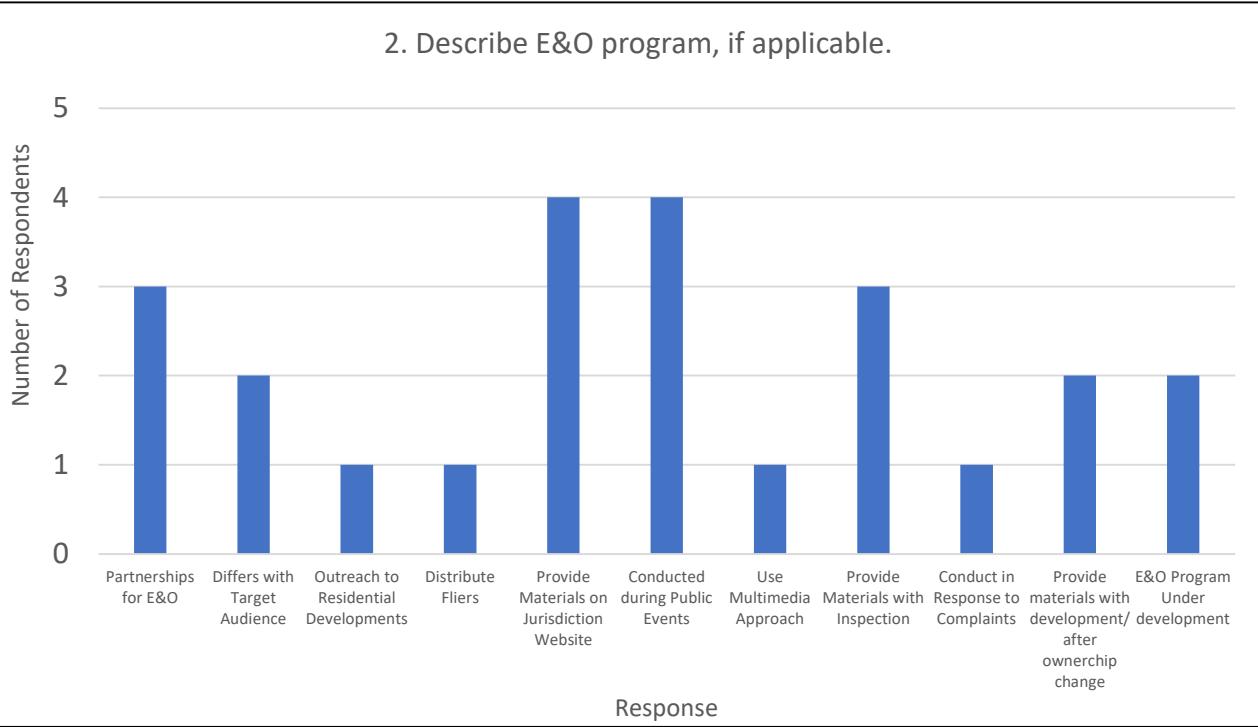
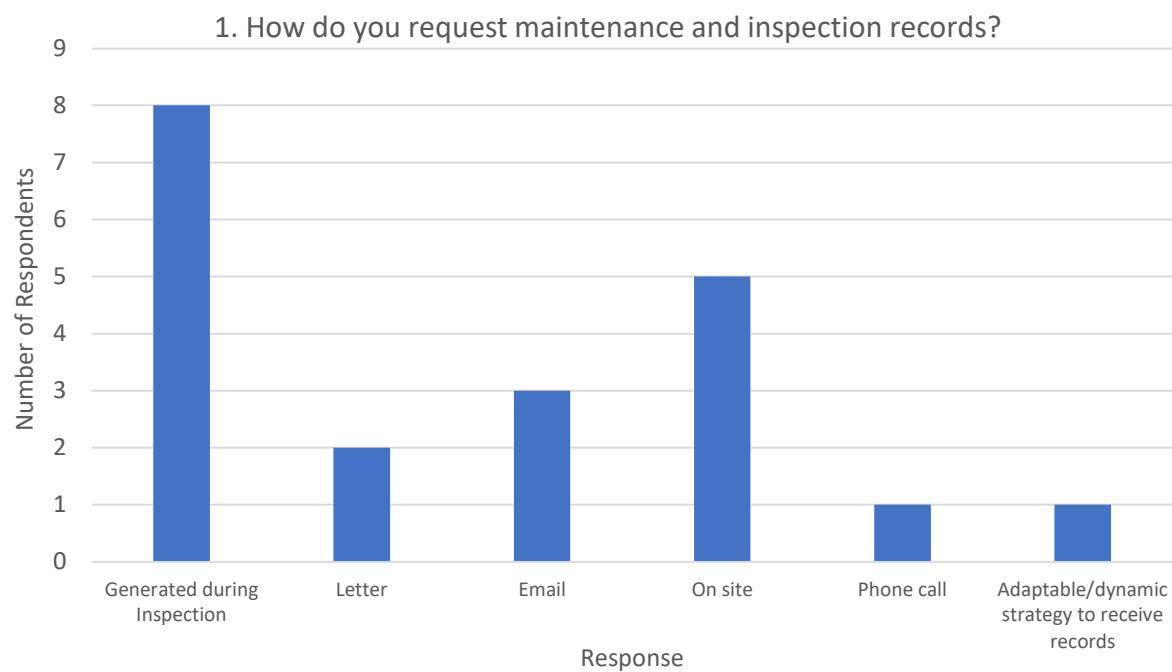
30. Does your jurisdiction have a way to penalize or fine a BMP owner for not demonstrating they are compliant with the requirements?



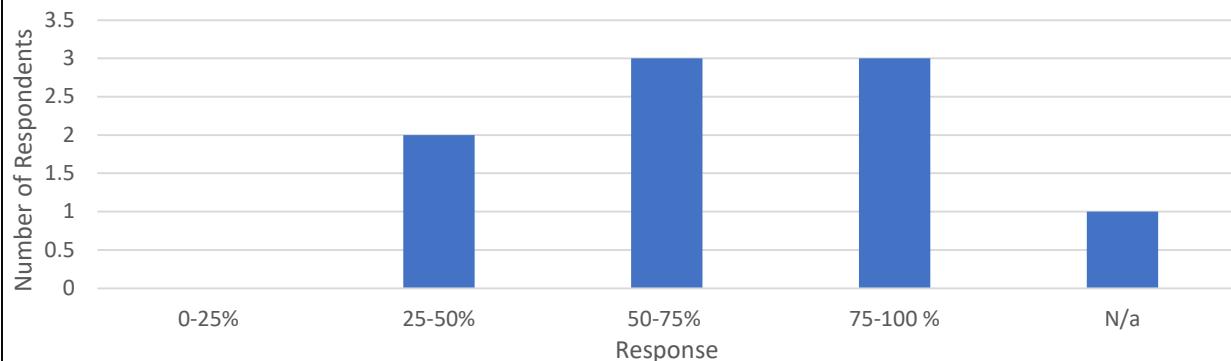
Appendix C. Interview Data Summary

General Interview Questions

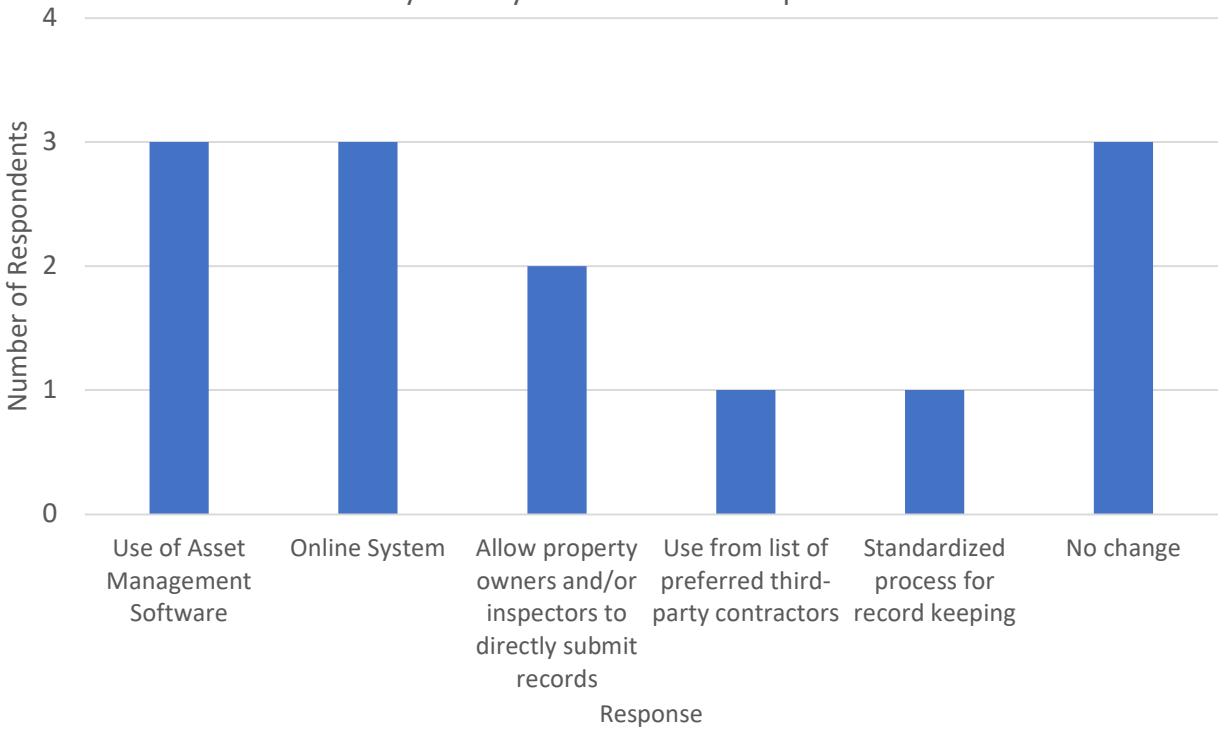
1. How do you request maintenance and inspection records?
2. Describe your E&O program, if applicable.
3. What percent compliant are property owners in your jurisdiction?
4. What would you like your documentation process to look like?
5. What would you like your E&O program to look like?
6. How often is enforcement used to assist compliance?
7. How often is E&O used to assist compliance?
8. How often are incentives used to assist compliance?
9. Do you pair any of these strategies (enforcement, E&O, or incentives)?



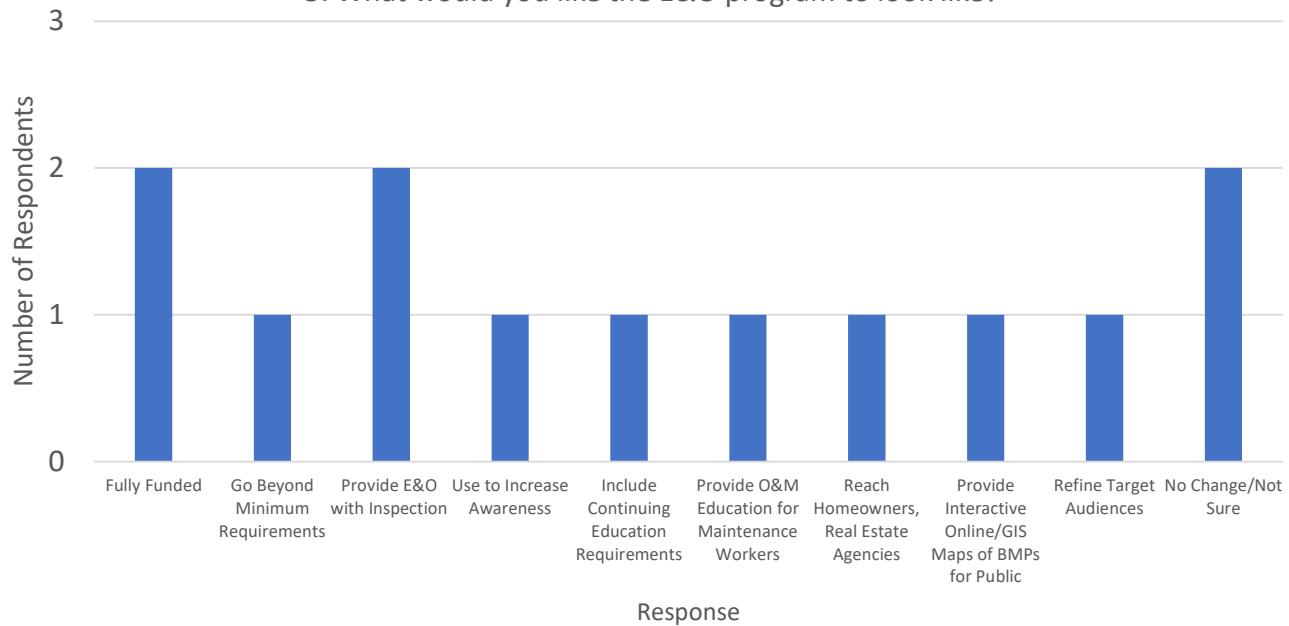
3. What percent compliant are property owners in your jurisdiction?



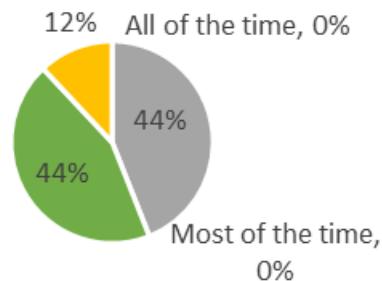
4. What would you like your documentation process to look like?



5. What would you like the E&O program to look like?

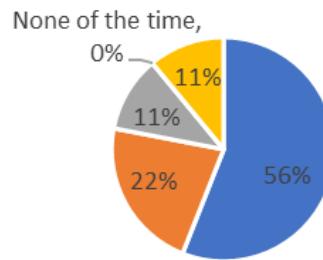


6. How often is enforcement used to assist compliance?



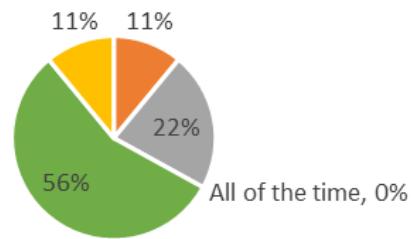
■ All of the time ■ Most of the time ■ Some of the time ■ None of the time ■ N/A

7. How often is E&O used to assist compliance?



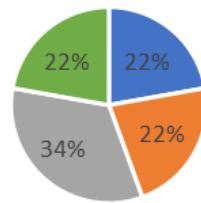
■ All of the time ■ Most of the time ■ Some of the time ■ None of the time ■ N/A

8. How often are incentives used to assist compliance?



■ All of the time ■ Most of the time ■ Some of the time ■ None of the time ■ N/A

9. Do you pair any of these elements?



■ Paired all strategies ■ Paired education and enforcement ■ Did not pair strategies ■ N/A

Appendix D. Data Quality

Appendix D.1 Assessment of MPCs and DQIs

MPC	DQI Addressed	Result of Data Quality Assessment
During the pilot test of survey, the group pilot testing mutually agrees on interpretation of survey and interview questions.	Validity, Reliability	During pilot testing, the survey questions were revised as needed until the group pilot testing the survey mutually agreed upon interpretation of survey questions. Interview questions were developed as a group and based upon survey questions to streamline the process.
During the audit, it is verified that data is being collected in accordance with SOPs.	Reliability, Objectivity, Integrity	Data was collected in accordance with the SOPs and any deviations from the SOPs were documented. Results of the audit are documented in Appendix C.2. A summary of deviations is included in Appendix C.3.
All those involved in data collection were trained on the SOPs prior to data collection.	Integrity	Those involved in data collection were trained on the SOPs prior to data collection.
Responses from the survey and interview are consistent.	Reliability, Credibility, Integrity	Responses from the survey and interview were consistent.
Respondent confirms that they or another staff member are knowledgeable regarding their jurisdiction's practices and has provided responses representative of the jurisdiction's practices.	Reliability, Transferability	A question was included in the survey which asked the respondent to confirm whether they are knowledgeable regarding their jurisdiction's practices, and that they would involve other staff if needed to respond to questions. No respondents indicated they were not knowledgeable regarding their jurisdiction's practices.
A list of information needed to respond to interview questions is provided to participants prior to interview and participants indicate they are certain about their responses.	Reliability	A list of the interview questions specific to each participant (interview questions included questions to clarify survey responses) was provided in advance of the interviews. No uncertainty about responses was indicated during the interviews by participants.
During peer debriefing process, the group will mutually agree on interpretation of coding of open-answer survey responses and interview responses.	Objectivity	During the peer debriefing process, the group reviewing the coding revised the codings as needed until all of the codings for open-answer survey and interview responses were agreed upon.
Procedures for handling missing data and coding are followed.	Completeness	Missing data for the survey was identified with "DNF" (did not finish), because most missing responses were due to incomplete surveys. Missing responses were recovered for those respondents who were willing to complete the survey; all other responses were noted with a "DNF". Responses from incomplete surveys were kept and used to supplement data on the most commonly used strategies as well as effective and non-effective elements of those strategies.
The sample size identified for the study is consistent with the number who participated in the study.	Completeness	<p>The sample size identified for the study consisted of 30 survey respondents and 10-15 interview respondents. Twenty-six participants responded to the survey while nine participated in the interview.</p> <p>The goal for the survey was to obtain at least 30 survey responses per the study QAPP, as 30 is considered a large sample size in qualitative research (Statistics Solutions, n.d.). However, no rule was observed in the literature requiring a minimum of 30 responses. Additional effort was undertaken to obtain the 26 responses, and the responses represent a variety of jurisdictions in Washington and the Columbia Basin. For that reason, the 26 responses were deemed acceptable for the study.</p> <p>Attempts to achieve higher interview participation were halted as it appeared "saturation" of responses (i.e. no additional themes are emerging and no new insight is being gained) had been reached at 9 responses. This is consistent with findings from Guest, Bunce, and Johnson (2006), who found that fewer than 10 responses could be necessary to reach saturation. Galvin (2015) found that for 54 separate investigations in prominent building and energy journals that 6 to 15 interviews were typically used to make conclusions about the population. For these reasons, the 9 interviews were deemed acceptable for the study.</p>
Participants have similar O&M Requirements for BMPs on private property.	Transferability	Each participant in the study is subject to a permit which requires permittees to employ a strategy or program to inspect, maintain, and enforce maintenance at BMPs on private property (See Table A-2, Appendix A).
The identity of all respondents are replaced with an identification code.	Integrity	The identity of all respondents to the survey and interview was replaced with an identification code, and any identifying information was stripped out.

Note: This table summarizes the DQIs and MPCs for the study. See the study QAPP for detailed list of MPCs for each DQI.

Appendix D.2 Results of Audit

Yakima County Effectiveness Study Audit

Name of Auditor: *Raul Sanchez*

Date Performed: *6/24/2021*

Interview Administration		Notes Overall for SOP:	
Step #	Standard Operating Procedures (SOP)	Yes/No/Modified	If No or Modified, explain:
1	Select 10-15 respondents who provided a variety of responses for similar strategies. <i>11 - 12 Respondents</i>	<i>yes.</i>	
2	Contact selected participants for interviews. Provide reasons for why interviews are being conducted, expected duration, number of questions, information needed to answer questions, time at the end of the interview.	<i>yes.</i>	
3	Develop list of questions and follow procedures in Section 8.3 of QAPP for validating questions. Provide this list to interviewee.	<i>yes.</i>	
4	Contact participants to conduct interview. Provide quick description of study, reasons for why interviews are being conducted, expected duration, number of questions, information needed to answer questions, time at the end of the interview for questions, and that responses will remain confidential.	<i>yes.</i>	
5	Interviewer will read list of prepared questions and take detailed notes to capture the responses. No additional prompts will be given to assist answers.	<i>yes.</i>	
6	Ask participant if they would like to clarify any statements at end of interview or if they have questions about the future of the study or how data will be reported.	<i>yes.</i>	
7	Answers will be recorded according to Section 10.0 of the QAPP, where it states that interview questions and answers will be transcribed into excel.	<i>yes.</i>	
8	Data will be recorded in excel with the associated identification code and as described in section 10.2 of the QAPP. This includes indication of what municipal permit the participant is subject to, the area in which the permittee functions, and a three digit number unique to the participants.	<i>yes.</i>	

Yakima County Effectiveness Study Audit

Name of Auditor: *Raul Sanchez*

Date Performed: *6/24/2021*

Survey Distribution and Follow-Up		Notes Overall for SOP:	
Step #	Standard Operating Procedures (SOP)	Yes/No/Modified	If No or Modified, explain:
1	Stormwater managers identified as participants for the study will be assigned identification codes.	<i>yes.</i>	
2	Emails will be sent to participants and will include a due date, explanation and confirmation of confidentiality, and to email reminders or deadline extensions.	<i>yes.</i>	
3	Data will be recorded in excel with the associated identification code and as described in section 10.2 of the QAPP. This includes indication of what municipal permit the participant is subject to, the area in which the permittee functions, and a three digit number unique to the participants.	<i>yes.</i>	
4	Participants will be given 3 weeks to respond, given reminders two weeks after the link to the survey has been sent out, and contacted by via phone to provide a final reminder or address questions.	<i>yes.</i>	
5	Responses will recorded in excel and number of participants and number of those who did not respond will be recorded.	<i>yes.</i>	
6	Missing data on the data collection forms is noted as a M (for Missing). A reason for why the data is missing will be provided if known. Missing data will be reported in the Technical report as well as a description of how the data set was analyzed without the missing data.	<i>yes. / modified</i>	<i>Instead of using DNF, some participants did not finish survey.</i>
7	The specific permit requirements for each respondent related to O&M of privately owned BMPs will be compared to verify they have similar permit requirements.	<i>NO</i>	<i>To be completed. compile all data.</i>

Yakima County Effectiveness Study Audit

Name of Auditor: *Raul Sanchez*

Date Performed: *6/24/2021*

Data Management		Notes Overall for Plan:	
Step #	Data Management Plan Procedures	Yes/No/Modified	If No or Modified, explain:
1	Each participant is assigned an identification code, using the format (Phase of Permit) (Area/State) (three-digit number), for example P2EW003. The spreadsheet associating the participant information and identification code is stored in a spreadsheet separate from the other data collected during the study.	<i>modified.</i>	<i>Used a random # instead of a code to permit.</i>
2	Data compiled in Excel will include: -Participant Identification Number -List of jurisdictions in study area -List of participants who have agreed to participate in the study area -Survey questions, responses, and respondent ID -List of respondents to interview -Interview responses and ID code -Summary of requirements related to O&M on private properties	<i>No.</i>	<i>To be completed.</i>
3	Any missing data is noted in Excel using the code "M". A note will also be added to the spreadsheet explaining why the data is missing (if known).	<i>modified.</i>	<i>DNF for coding.</i>

Appendix D.3 SOP Deviations Documentation

Revision #	Section and Page	Original Instructions	Suggested Revision	Reason for Change
1	Section 8.2.2	The same list of questions must be provided to each interviewee.	General questions/questions not specific to the interviewee must be the same for each interview. Additional questions to clarify survey responses may differ between interviewees.	Interviews were used to clarify the survey responses in addition to develop a deeper understanding of strategies used and the effectiveness of those strategies. Questions specific to survey responses were different for each interviewee because their survey responses were different.
2	Section 10.1 Data Identification; Page 39	The identification code will consistently incorporate: an indication of which Phase municipal permit the participant is subject to; area in which the permittee is subject to the municipal permit; a three digit number which is unique to the participant	Identification code consists of a randomly assigned number between 1-100.	There was concern that participants could still be identified through their Phase of permit, area, and responses. While individual responses aren't being reported, the code was changed to limit concerns.
3	Section 10.3 Procedures for Missing Data; Page 40	Any data missing on the data collection forms will be documented in the Excel spreadsheet by coding the data as M (for missing). In addition, a note will be added to the spreadsheet explaining the reasons why the data is missing (if known).	Missing data for the survey will be noted with a "DNF" for "did not finish".	The only missing data during the study was due to a few surveys which were started but not completed before the end of the survey response collection period. "DNF" was used as a code because it captured the reason why the data was missing and noted that the data was missing.

Appendix E. Summary of QAPP Revisions

Appendix F. Fact Sheet for Recommended Manual

Stormwater Guidance Manual - Fact Sheet

Strategies for Privately Owned BMPs

Project Purpose

The Stormwater Guidance Manual will provide Permittees with strategies to develop and/or improve their maintenance, inspection, and enforcement programs for structural BMPs that are privately owned. The Manual is intended for statewide use to support implementation of NPDES MS4 Permit, which requires Permittees to ensure maintenance is performed as required so that structural BMPs continue to operate as designed and provide the intended runoff treatment and flow control functions.

Stormwater Management Problem & Background Information

It is evident from discussions with Permittees and a review of literature that privately owned structural BMPs represent a unique problem. Specifically, ensuring long-term design-based performance due to challenges with identifying and correcting operational and maintenance (O&M) problems. While strategies for improving the problem were identified in the literature, none reported on the effectiveness. In response to this need, Yakima County conducted a study titled BMP Inspection and Maintenance Responsibilities for Privately Owned Facilities. The goal of the study was to identify and evaluate commonly used strategies for inspection, maintenance, and enforcement of privately owned stormwater BMPs. These strategies were evaluated based on survey and interview responses from Permittees in Washington, Oregon, Idaho, and Montana. Based on results from the study, several strategies were identified that can be used to develop successful programs and support permit compliance. Examples of some of the key attributes of these programs that were identified during the study are noted below.

Program Attributes	Strategies
Jurisdiction has access to BMPs to perform inspection and/or maintenance	Provide E&O materials and trainings targeted for specific groups (businesses, HOA's, developers, individuals, etc.)
Jurisdiction has sufficient funding, and all of their staff are trained	Maintain a consistent and easy to use record keeping process
BMP owners are provided incentives for compliance	Have mechanisms to enforce penalties for noncompliance
E&O/training materials are targeted to specific groups (e.g., HOA, business, etc.) and are available in multiple languages	Provide BMP O&M protocol and/or E&O materials to BMP owners

Scope of Work

The Manual content will be developed utilizing a combination of sources, including information collected during the Yakima County Effectiveness Study; from a literature search of journal articles and municipal documents; and through interviews with Permittees from Washington or states with similar permit requirements. A Technical Advisory Committee (TAC) will play an integral role in shaping the Manual vision to support the development of a useful resource for Permittees to identify solutions that support permit compliance and best align with their jurisdiction's goals. An online training program will be developed that provides an overview of the Manual content, guidance for how to use the Manual, and discussion/examples regarding the different ways jurisdictions are meeting NPDES MS4 permit requirements for structural BMPs that are privately owned.

Proposed Manual Outline

The proposed Manual content will identify effective strategies, describe how they can support the overall program success and permit compliance, and provide case studies of the different ways Permittees are implementing these strategies, as well as their lessons learned. The Appendix will include examples and templates that Permittees can use or modify to develop and/or improve their jurisdictions program.

Topics anticipated to be addressed in the Manual include:

- **Chapter 1 Introduction:** Intended manual use and audience, relevant permit requirements, why the manual was developed, manual organization.
- **Chapter 2 Inspection and Maintenance Strategies:** Overview of different inspection and maintenance strategies; challenges/benefits of each.
- **Chapter 3 Staffing and Funding Challenges/Solutions:** Options for funding and staffing, identifying and justifying funding/staffing needs, creative approaches: doing more with less.
- **Chapter 4 Required Documentation and Record Keeping:** Methods for Jurisdictions and BMP Owner, forms/schedules, streamlining options.
- **Chapter 5 Who Owns the BMP:** Different types of BMP owners, where responsibilities are documented, managing unclear/changing ownership.
- **Chapter 6 Ordinances & Covenants:** Types and examples of ordinances and covenants; how they support compliance.
- **Chapter 7 Incentives Mechanisms:** Description of incentive types, examples.
- **Chapter 8 Penalty Mechanisms:** Description of penalty types, examples.
- **Chapter 9 Training and E&O:** Target audiences, types of materials and methods for delivering materials, tailoring materials to audiences, examples.

Project Budget & Timeline

Task Name	Task Fees	Project Timeline
Task 1: Project Administration & Management	\$27,201	Jan-22 to Apr-23
Task 2: Project Coordination	\$39,713	Jan-22 to Apr-23
Task 3: Project Kick-off	\$35,602	Jan-22 to Mar-22
Task 4: Manual Development	\$126,337	Apr-22 to Jan-23
Task 5: Training	\$38,018	Dec-22 to Apr-23
Total Project Budget	\$266,871	

Project Team

Lead Entity: Yakima County

Partners: Osborn Consulting