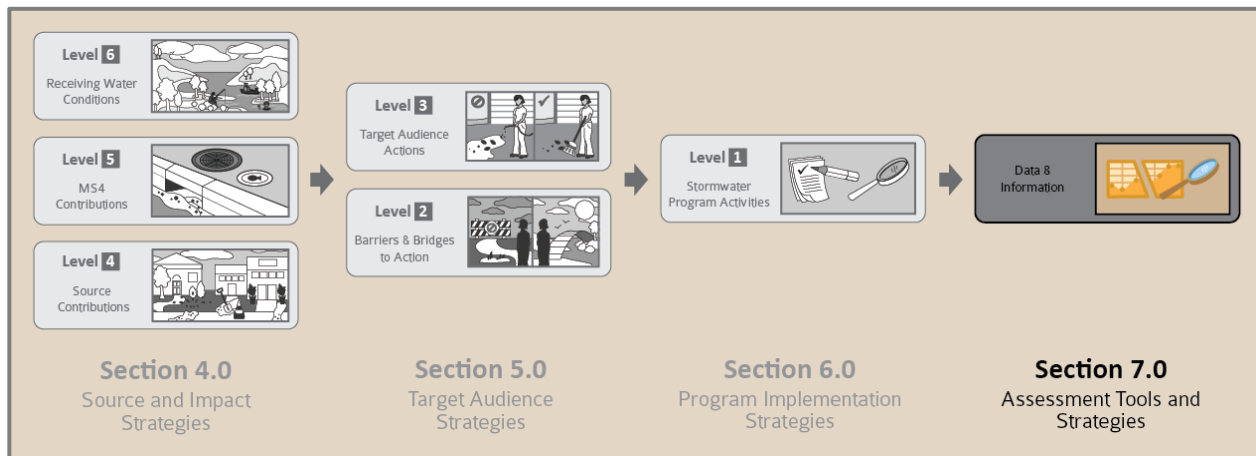


## Section 7.0 Assessment Tools and Strategies



### 7.1 Background

This section describes the development of **Assessment Tools and Strategies**, the last of four strategic planning components initially introduced in **Section 3.0**. Up to this point, managers will have focused on a planning process aimed at identifying a variety of specific measurable outcomes to:

- Define success;
- Guide the implementation and evaluation of programs; and
- Provide the structure and measurability needed to support adaptive management.

This section provides guidance to assist in developing appropriate metrics and assessment tools to measure progress toward meeting previously defined targets.

**Assessment Strategy:** The methods and approaches used to collect and analyze data to assess progress in meeting targets. Assessment strategies help identify linkages between outcome levels and data gaps. They are also part of an adaptive management approach that provides ongoing feedback to improve program effectiveness.

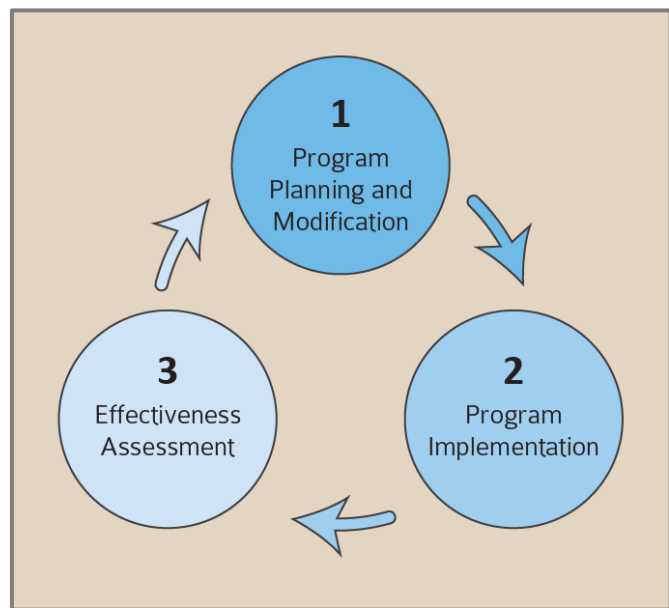
The starting point for assessment is the completion of the strategic planning process described in Sections 3.0 through 6.0 of this document. Building on the analytical objectives established in that process, this section provides additional guidance for defining the metrics, monitoring methods, and analytical approaches needed to inform decision-making for each outcome level. As programs are implemented and data obtained, managers may reevaluate how best to measure program progress as they compare new data against established targets.

**Section 7.0** builds on the targeted outcomes identified in Sections 4.0 through 6.0 to provide information on the following:

- **Iterative and Adaptive Management:** This section identifies how effectiveness assessment informs the adaptive management process.
- **Assessment Objectives:** This section addresses three assessment objectives that assist managers in determining whether their programs are properly directed and achieving the desired benefits, as well as in identifying what other knowledge and data are needed in order to adaptively manage the program.
- **Data Collection:** This section provides a summary of data resources as well as approaches and methods that can be used to obtain the data that are needed for program assessment.
- **Data Analysis:** This section provides an overview of the approaches that may be used by managers to analyze the assessment data at each outcome level.

## 7.2 Iterative and Adaptive Management

Effectiveness assessment is the mechanism by which feedback is evaluated to enable ongoing adaptive management. First introduced in **Section 3.0**, the iterative program management cycle (**Figure 7.1**) consists of program planning and modification, program implementation, and effectiveness assessment. Over time, the repeated application of this process – each phase continuously informing the next – should result in the improvement of stormwater programs and the achievement of the desired results.



**Figure 7.1: The Iterative Program Management Cycle**

An iterative and adaptive management process uses the results of the effectiveness assessments to modify and improve management measures to more effectively meet the interim and end-state targets. This may include addressing data gaps to reassess

assumptions that were used in developing the priorities, targets, and management measures. Adaptive management may also include the application of “lessons learned” to steer the program in new directions.

As program implementation proceeds, data gathered from the various activities should be assessed to evaluate and refine the critical assumptions as well as the approach and /or schedule for subsequent implementation measures.

Because adaptive management is critical to ensuring that stormwater programs are effective in achieving long-term goals, a manager should ensure that permit requirements provide the flexibility to adaptively manage the program. A recent trend in MS4 permit reissuance is to incorporate specific adaptive management measures to support the improvement of the programs. On a practical level, it is important to ensure that the permit provisions provide the flexibility to adaptively manage the program. This is something that might be considered during the development of the Report of Waste Discharge and during permit renewal.

### **7.3 Assessment Objectives**

This section describes the following program assessment objectives:

- Program Planning Evaluation and Refinement,
- Evaluation of Success, and
- Evaluation and Resolution of Knowledge and Data Gaps.

This section also presents assessment approaches for different outcome levels (e.g., MS4 discharge quality, source contributions to pollutant loading, and behavior changes) and provides examples.

#### **7.3.1 Program Planning Evaluation and Refinement**

Managers must assess whether a program is being effectively implemented and progressing toward the attainment of the goals. In other words, it is critical to understand if the program is effectively addressing the issues that it is intending to address.

As a first step, targeted outcomes should be established as described in Sections 3.0 through 6.0. It is preferable if managers have a specific idea as to what they want to achieve, as well as the data that are necessary to evaluate each outcome. However, managers should also be mindful of the challenges associated with the establishment and interpretation of these targeted outcomes.

In cases where a clear understanding of what can or should be achieved does not exist, it may be necessary to track results over time to determine feasible, appropriate, and worthwhile outcomes. Moreover, targeted outcomes must often be considered to be provisional, intended to illuminate a *direction* rather than to define an *endpoint*. As such, they are best understood as interim measures designed to support the iterative program management process, rather than as absolute representations of success.

Management questions form the basis for the types of data that must be gathered and evaluated. The types of questions that may be formulated include evaluating relationships of data between outcome levels and/or in relation to geospatial area, land use, targeted audience, or time interval. For example, defining or verifying the relationship between the volume of trash measured at targeted MS4 outfalls adjacent to an area subject to a targeted trash reduction outreach program may serve as a measure of program effectiveness.

Deciding where to set the targeted outcomes is often one of the most challenging aspects of stormwater management. The level of effort, performance, or change that constitutes a positive result is rarely obvious. Moreover, it can be difficult to relate individual assessment measures to each other or to longer-term goals for improving receiving water quality. When defining a targeted outcome, several elements should be considered (**Table 7.1**).

**Table 7.1: General Elements to Consider in Establishing Targeted Outcomes**

Element	Example(s)
<ul style="list-style-type: none"> <li>The <b>direction</b> of the change</li> </ul>	<ul style="list-style-type: none"> <li>Increase or decrease</li> </ul>
<ul style="list-style-type: none"> <li>The <b>nature</b> of the outcome</li> </ul>	<ul style="list-style-type: none"> <li>Hotline calls received, chemical concentration</li> </ul>
<ul style="list-style-type: none"> <li>The <b>metric</b> (magnitude + unit) of the change</li> </ul>	<ul style="list-style-type: none"> <li>20 people, 50%, 3.0 mg/L, 30 lbs.</li> </ul>
<ul style="list-style-type: none"> <li>The <b>reference point</b> from which change is measured</li> </ul>	<ul style="list-style-type: none"> <li>Existing or baseline levels, previous results, results at another location</li> </ul>
<ul style="list-style-type: none"> <li>The <b>timeframe</b> for achieving the change. This can include time elapsed or a <b>period of time</b>.</li> </ul>	<ul style="list-style-type: none"> <li>Hours, days, months, years, reporting period, permit cycle.</li> </ul>

When crafting a targeted outcome statement, it is suggested that managers begin with a general outcome statement, and then add specificity and units of measurement, as follows:

***[DIRECTION] [NATURE] by [METRIC] over [REFERENCE POINT] by [TIMEFRAME]***

Two examples of targeted outcome statements are provided below. These examples are for illustration only. There is no single template for targeting outcomes that applies in all instances.

#### Example 1

**General Outcome Statement:**

*Decrease copper levels in the San Diego River*

**Add Specificity and Units of Measurement:**

[DIRECTION **Decrease**] [NATURE **receiving water concentrations of copper**] by [MAGNITUDE / UNIT OF MEASUREMENT **3.0 mg/L**] from [REFERENCE POINT **June 2011 levels**] by [TIMEFRAME **March 2025**]

**Result:**

*Decrease receiving water concentrations of copper by 3.0 mg/L from June 2011 levels by March 2025.*

#### Example 2

**General Outcome Statement:**

*Increase awareness of the residential sector*

**Add Specificity and Units of Measurement:**

[DIRECTION **Increase**] [NATURE **hotline calls, website reports, referrals**] by [MAGNITUDE / UNIT OF MEASUREMENT **number or %**] over [REFERENCE POINT **baseline, existing levels**] by [TIMEFRAME **reporting period**]

**Result:**

*Increase the number or % of hotline calls, website reports, and referrals over baseline, existing levels by the end of the reporting period.*

### 7.3.2 Evaluation of Success

For programs to succeed, managers must have the tools to determine if the targeted outcomes set for the program are being achieved. In addition, managers need to know how efficient the program was in meeting those goals.

This step focuses on evaluation of *assessment results* using the targeted outcomes and associated metrics established during the planning process. Metrics need to be developed to assure that an assessment can be made in order to track progress in meeting the target. For example, a metric to measure progress toward a target of a 50% reduction in a pollutant load needs to include the

measurement of flows and concentrations over a representative time period, which can then be compared to a baseline load in order to establish a percent reduction in load.

The use of targeted outcomes in interpreting results of assessment data and measuring success can be represented as follows:

$$\left( \frac{\text{Actual Outcome}}{\text{Targeted Outcome}} \right) = \text{Assessment Result}$$

Where:

- The Actual Outcome is a measured condition or implementation result;
- The Targeted Outcome is a value established during planning to define adequacy or success (interim or final); and
- The Assessment Result describes the relationship of the Actual and Targeted Outcomes and in doing so ties the planning and assessment processes together.

#### Example

During planning, a goal of inspecting all of the 125 facilities in an industrial facility inventory is set. At the end of the year, 100 initial inspections have actually been conducted, representing an 80% success rate.

$$\left( \frac{100 \text{ inspections conducted}}{125 \text{ inspections targeted}} \right) = 80\% \text{ success}$$

Considered in this way, targeted outcomes are requisite for the planning of an assessment approach and the interpretation of results. Without them, outcomes do not have a context and can only be reported or described. In practice, the analysis of outcomes involves a variety of approaches, all of which build on this fundamental relationship of actual and targeted values.

Examples of outcome types, interim targets, metrics, and assessment results are provided in **Tables 7.2** through **7.6**. *These examples are provided as guidance and do not represent program requirements. Each program will have its specific requirements depending on factors such as regulatory requirements, program priorities, and available resources.*



**Table 7.2: Outcome Level 6: Receiving Water Conditions – Example Outcome Types, Targets, and Metrics and Assessment Results**

Example Outcome Types	Example Targets	Example Metrics	Assessment Result = Actual vs. Target
<b>Chemical – Water Quality Priority Problems</b>			
<b>Receiving Water Quality -</b> Average constituent concentrations Constituent concentrations during wet weather	Reduce constituent concentration to WQ benchmark	Water Quality Benchmark concentration in µg/L	Measured constituent concentration as percentage of benchmark or reference system condition
	Reduce average daily constituent concentration to a specified percentage above WQ Benchmarks.	% change in loading or concentration compared to previous year’s results	Estimated % pollutant loading change
<b>Physical Priority Problems</b>			
<b>Hydromodification</b> Peak flow measurements compared to reference site condition	Reduce peak flow volumes by X% in impacted stream segments.	Flow Volume and Peak Flow - change in trend toward reduced peak flows for specific storm events	Measured % reduction in peak and total flow
		Flow Volume and Peak Flow - % reductions in peak flow toward end-state target based on allowable velocities and peak flows for impacted stream	Measured condition versus pre-conditions or interim target
<b>Biological Priority Problems</b>			
<b>Beneficial Use Protection –</b> Bio-indicators (benthic impairment in creek)	Achieve a specific bioassessment rating or a value comparable to reference site conditions	Measured IBI ratings	IBI rating for reporting period compared to target or applicable reference site conditions



**Table 7.3: Outcome Level 5: MS4 Contributions - Example Outcome Types, Targets, and Metrics and Assessment Results**

Example Outcome Types	Example Targets	Example Metrics	Assessment Result = Actual vs. Target
<b>Chemical – Water Quality Priority Problems</b>			
<b>Urban Runoff Quality:</b> Constituent concentration during wet weather in MS4 Outfalls	Reduce constituent concentration to certain % below Action Level in Targeted MS4 Outfalls.  Reduce annual loading by specified percentage compared to previous reporting period.	Constituent concentration in µg/L  Specified % change in estimated annual loading	Measured constituent concentration compared to Action Level  % reduction compared to % reduction targeted or Action Level
<b>Physical Priority Problems</b>			
<b>Urban Runoff Hydrology:</b> Peak flow and flow volumes at MS4 Outfalls	Reduce peak flow volumes by X% in targeted MS4 outfalls.	Flow volume and peak flow in CFS  % reductions in peak flow toward end-state target based on allowable velocities and peak flows for impacted stream	% reduction in peak and total flow toward pre-conditions compared to % reductions of Interim Target  % of MS4 outfalls that meet target compared to % of Interim Target





**Table 7.4: Outcome Level 4: Source Contributions - Example Outcome Types, Targets, and Metrics and Assessment Results**

Example Outcome Types	Example Targets	Example Metrics	Assessment Results = Actual vs. Target
<b>Example: Construction Sites</b>			
<p><b>Source Pollutant Loads:</b> Inspection and enforcement data indicates sites that are sources of sediment</p>	<p>Reduce loads from construction site sources of sediment by certain % in one year.</p> <p>Achieve specified % of construction sites that have properly implemented erosion control BMPs (indirect measure of loading).</p>	<p>Quantity of sediment that diverted from MS4</p> <p>Number of Construction sites properly implementing BMPs</p>	<p>Estimated reduction in sediment released into MS4</p> <p>% of construction sites that have properly implemented erosion control BMPs compared to established interim or end-state target</p>
<b>Example: Over-Irrigation (Residential and Commercial Properties)</b>			
<p><b>Site Source Hydrology and Source Pollutant Loads:</b> Over-irrigation in residential land uses and commercial properties that are landscaped results in dry weather flows to MS4</p>	<p>Reduce dry weather runoff observed at MS4 outfalls by specified % in one reporting period.</p>	<p>Average 24 Hour Flow volume (cubic feet) at MS4 Outfalls during dry weather months</p> <p>Estimated volume of irrigation runoff based on observation during inspections of targeted residential areas and commercial properties</p>	<p>% reduction in volume of flow from over-irrigation from residences and commercial properties compared to interim target within targeted drainage areas</p>



**Table 7.5: Outcome Level 3: Target Audience Actions - Example Targets and Metrics and Assessment Results**

Example Targets	Example Metrics	Assessment Results = Actual vs. Target
<b>Informational Requests</b>		
Increase number or % of construction companies who have correct information on construction requirements	No. of hotline calls from construction companies requesting information on construction requirements in 1 year	Number of calls received compared to number or % of Interim Target
<b>Pollution Reporting</b>		
Increase no. of callers reporting construction site violations	No. of reported construction site violations Number of confirmed violations based on hotline calls	% of all calls received that are related to a confirmed violation compared to Interim Target
<b>Public Participation/Involvement</b>		
Increase number or % of contractors who are knowledgeable regarding SWPPP preparation and implementation	No. or % of contractors participating in SWPPP training in one year	% of contractors participating in SWPPP training compared to Interim Target
<b>Administrative and Procedural Behaviors</b>		
Increase number or % of sites with approved SWPPPs	No. of sites with approved SWPPPs or other required documentation based on site inspections	No. of sites with approved SWPPPs or other required documentation compared to interim target
<b>Illicit Discharge Control</b>		
Decrease number or % of sites with illicit discharges	No. of sites without observed discharge violations based on site inspections	No. of sites with fewer observed discharge violations compared to previous inspection
Reduce frequency of over-irrigation from residences	No. of landscape conversions and installations of smart irrigation systems in one dry weather season	% increase in the number of turf conversions by and installation of smart irrigation compared to previous year and Interim Target
<b>BMP Implementation</b>		
Achieve properly implementation of BMPs to reduce runoff	Number of sites where BMPs implemented in accordance with approved SWPPP based on site inspections	Increase in number of sites where BMPs are implemented in accordance with approved SWPPP compared to initial inspection results



**Table 7.6: Outcome Level 2: Barriers and Bridges to Action - Example Outcome Types, Targets, and Metrics and Assessment Results (Personal Factors only)**

Example Outcome Types	Example Targets	Example Metrics	Assessment Results = Actual vs. Target
<b>PROGRAM COMPONENT / ELEMENT: <u>Construction [Private]</u></b>			
<b>TARGET AUDIENCE: <u>Construction Projects / Proponents</u></b>			
1. <b>AWARENESS OF PROGRAM RESOURCES</b>	Increase number or % of current target audience know how to report illicit discharges.	Number of calls to storm water hotline to report violations or illicit discharges	Number of calls to storm water hotline to report violations compared to total number of calls Increase in calls reporting violation compared to previous year
2. <b>KNOWLEDGE OF GENERAL OR SPECIFIC CONCEPTS</b>	Increase number or % of target audience aware of the difference between the storm drain and sanitary sewer.	% of survey respondents responding correctly to questions regarding difference between the storm drain and sanitary sewer	% of correct responses compared to target
	Increase number or % of construction staff that know about impacts of construction on waterways.	Number of construction staff that have attended training and ranked it effective	Actual % of construction staff that have ranked it effective compared to interim target
3. <b>ATTITUDES</b>	Increase number or % of construction staff that believe implementation of BMPs helps the environment.	Number of construction staff responding to a post-training survey that implementation of BMPs will prevent pollutants from reaching waterways	% of construction staff responses from post-training survey compared to pre-training survey

### 7.3.3 Evaluation and Resolution of Knowledge and Data Gaps

At this step in the process, it may be evident that a program does not have all of the information it needs in order to conduct the assessment. Determining which of these data or information gaps are the most important will help to guide the future assessments.

Identification of knowledge and data gaps should be ongoing throughout the planning process at each Outcome Level. At its conclusion, managers should have developed a list of gaps that can be incorporated into the overall assessment strategy. As discussed in previous sections, clearly defining the problem and establishing a targeted outcome will often result in identifying aspects of the problem where more information is needed. This could include better quantification of sources, characterization of the target audience, or determination of local restrictions that need to be addressed before putting a new program in place.

Addressing data gaps found during the planning process by finding new data sources, alternate solutions, or ways to address the gaps will help to improve a program's ability to meet the targeted outcomes. As data gaps are addressed, the original basis used to set these metrics, targets, and control measures may change; therefore, corresponding modifications may need to be made to these components, as well as to the program itself.


## 7.4 Data Collection

Depending on the implementation activity, program and/or goals, a variety of data collection approaches and methods may be appropriate. It is recommended that managers consider a broad spectrum of targeted outcomes, programmatic outcomes, and/or data gap resolution goals when selecting appropriate data collection methods.















**Table 7.7** provides examples of data collection approaches and methods that can be used as a basis for identifying and developing the data collection activities for your program.

**Table 7.8** presents the general applicability of these data collection method approaches to the different outcome levels. In addition, several examples of data and information resources are listed in **Table 7.9**. More information on data and information resources is provided in Section 4.0 through 6.0.

**Table 7.7: General Approaches to Data Collection**

Approach	Description
 <p>Internal Tracking by Stormwater Program</p>	<p>Internal tracking and evaluation of data is the primary means by which Level 1 activities can be assessed. Internal program data; inspection data, outreach conducted, etc.</p>
 <p>Reporting to Stormwater Program</p>	<p>Various types of program data or information may be reported to the stormwater program either by regulated parties or other municipal staff that are not part of the stormwater program. In some instances regulated parties must periodically certify compliance with specific requirements (e.g., maintenance of structural treatment controls). Third parties; BMP maintenance certifications, industrial facility monitoring data, correction of violations, etc.</p>
 <p>Site Investigations</p>	<p>Site inspections and audits are among of the most common tools used to verify compliance or gather additional data. Inspections typically consist of observations, record reviews, and sampling as needed. For example, does the target audience, in this case a facility operator understand what is required to comply with the storm water program, does the understanding lead the effective implementation of BMPs that will lead to reductions in pollutant loading. Complaint investigations are similar to site inspections except that they are in response to reports of potential violations (e.g., through or complaints or staff referrals) but can provide insight into public awareness and reach of program messaging.</p>
 <p>Interviews</p>	<p>Interviews may be completed by municipal staff, facility staff or third party contractor. Interviews can be structured with specific questions or in response to inspection results, and are an essential piece of site audits as well as complaint responses. They are a useful tool for gauging awareness and BMP compliance understanding.</p>
 <p>Surveying and Testing</p>	<p>Surveys, tests, and quizzes are generally focused on entire populations (e.g., all residents) or sub-populations (e.g., used oil recyclers), and tests and quizzes administered to individuals (e.g., municipal staff or schoolchildren). They are fundamentally different in that surveys generally focus on understanding the prevalence or distribution of attitudes, knowledge, or behaviors within a population, whereas tests and quizzes focus on “correct knowledge”, i.e., respondents’ understanding of specific facts.</p>
 <p>Monitoring and Sampling</p>	<p>Monitoring or sampling of runoff and receiving water quality may occur as part of routine programs or in response to audits or complaints. Sampling may be focused on MS4 discharges, receiving waters, or the sources discharging to them.</p>
 <p>Review of External Data Sources</p>	<p>Data may also be obtained from outside sources that can be used for assessment purposes. When using third party and outside data, data quality should be considered. Data of similar or higher quality should be used in making quantitative assessments.</p>
 <p>Special Investigations</p>	<p>Special Studies may be part of a requirement in a MS4 permit or Investigation Order by the Regional Board to address specific data requirements for a TMDL or in response to historical receiving water and/or MS4 outfall data. Special studies may also include source identification studies in cooperation with other stakeholder for priority constituents or potential sources. Special Investigations can encompass any of the categories above, but generally tend to be a more intensive question- or project-driven focus.</p>

**Table 7.8: Potential Applicability of General Data Collection Approaches**

		Internal Tracking	External Reporting	Site Investigations	Interviews	Surveying & Testing	Monitoring & sampling	Special investigations	External reporting
Level	Program Element								
 <p>1 Stormwater Program Activities</p>	Administrative activities	○							○
	Facilitation activities	○							○
	Data collection activities	○							○
 <p>2 Barriers and Bridges to Action</p>	Awareness, knowledge, & attitudes				○	○		○	
 <p>3 Target Audience Actions</p>	Information seeking	○						○	○
	Pollution reporting	○						○	○
	Participation and involvement	○	○		○	○		○	○
	Administrative and procedural behaviors	○	○	○		○		○	○
	Implementation of control measures	○	○	○		○	○	○	○
	Regulatory compliance		○	○		○	○	○	○
 <p>4 Source Contributions</p>	Source pollutant loads			○		○	○	○	○
	Site / source hydrology			○		○	○	○	○
 <p>5 MS4 Contributions</p>	Urban runoff quality			○			○	○	○
	Urban runoff hydrology			○			○	○	○
 <p>6 Receiving Water Conditions</p>	Receiving water quality			○			○	○	○
	Hydromodification impacts			○			○	○	
	Beneficial use protection			○			○	○	

**Table 7.9: Potential Data and Information Resources<sup>1</sup>**

Outcome Level	Examples of Data and Information Resources
 <p><b>6</b> Receiving Water Conditions</p>	<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Receiving water and MS4 monitoring programs</li> <li><input checked="" type="checkbox"/> Regulatory agencies and research institutions (SCCWRP, WERF, etc.)</li> <li><input checked="" type="checkbox"/> Online repositories, directories, and databases (CERES, SWAMP, etc.)</li> <li><input checked="" type="checkbox"/> Published or unpublished research, literature, and technical reports</li> </ul>
 <p><b>5</b> MS4 Contributions</p>	<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Special investigations</li> <li><input checked="" type="checkbox"/> MS4 maintenance inspections</li> </ul>
 <p><b>4</b> Source Contributions</p>	<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Facility or site inspections, monitoring, development plans, etc.</li> <li><input checked="" type="checkbox"/> Published research, literature, and technical reports</li> <li><input checked="" type="checkbox"/> BMP performance studies</li> <li><input checked="" type="checkbox"/> Third party submission of monitoring data</li> <li><input checked="" type="checkbox"/> Special studies and investigations</li> <li><input checked="" type="checkbox"/> Published or unpublished research, literature, and technical reports</li> </ul>
 <p><b>3</b> Target Audience Actions</p>	<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Interviews, surveys, tests, and quizzes</li> <li><input checked="" type="checkbox"/> Facility or site inspections</li> <li><input checked="" type="checkbox"/> Third party submission of compliance data</li> <li><input checked="" type="checkbox"/> Special investigations</li> </ul>
 <p><b>2</b> Barriers and Bridges to Action</p>	<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Published or unpublished research, literature, and technical reports (community-based social marketing studies, etc.)</li> </ul>
 <p><b>1</b> Stormwater Program Activities</p>	<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Annual compliance reports, source inventories and databases, etc.</li> <li><input checked="" type="checkbox"/> Completed effectiveness assessments</li> </ul>

<sup>1</sup> This is a general summary for illustration only. See Sections 4.0 through 6.0 for more detailed listings of potential resources applicable to each outcome level.

## 7.5 Data Analysis

The last consideration for any targeted outcome is how the data that are collected will be evaluated. As noted above, specificity is critical. Managers may often have a better idea of how they will collect data than what they will do with it. Failing to identify specific analytical approaches up front is a common mistake that can severely limit the explanatory value of data. Moreover, the choice of analytical method can dictate what specific metrics should be used, how the data should be collected, and the quality of the result.

**Table 7.10** provides examples of Data Analysis Approaches and Methods that can be used as a basis for identifying and developing the data analysis activities for your program. The example data analysis approaches and methods presented in **Table 7.10** can then be applied to the various outcome level results.

## 7.6 Relationships between Outcomes



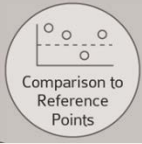


Although this document has focused on individual outcomes, a critical objective is to understand how outcomes are related. Strategic integration of individual outcomes focuses on understanding how the outcomes relate to or influence each other and can be used to address all six Outcome Levels. By evaluating program implementation, target audience, and source impact planning and assessment components, managers can improve the measurability and understanding of outcomes. For example, managers must first understand the relationship of program implementation to changes in awareness or behavior, or of individual behaviors to pollutant load reductions. These program-level results may be used to interpret broader concepts such as changes in runoff quality that result from individual changes in behavior or the cumulative impact of several individuals changing their behavior.

**Figure 7.2** presents three objectives that can be used to evaluate the relationships between outcomes.

Objective 1 focuses on how program implementation influences knowledge and awareness and the target audience's actions. The initial goal of any stormwater program is to provide information and to identify approaches to communicating it effectively. Knowledge and awareness regarding stormwater pollution is one bridge to the target audience eliminating PGAs and implementing BMPs. Other external factors will assist in building the bridge to action.



**Table 7.10: General Approaches to Data Analysis**

 <p>Qualitative Assessment</p>	<p><b>Qualitative assessment</b></p>	<p><b>Confirmation</b> -- e.g., confirmation (Y/N) that a stormwater hotline was operated during the year, or that outreach materials were made available at a building counter.</p> <p><b>Completion</b> -- e.g., confirmation (Y/N) that a specific task was completed. For example, completion of a brochure or updating of a source inventory.</p> <p><b>Narrative assessment</b></p>
 <p>Descriptive Statistics</p>	<p><b>Descriptive statistics</b> (counts [incl. quantification and tabulation], averages, variance, etc.)</p>	<p><i>Descriptive statistics</i> are numbers that are used to summarize and describe data. The word "data" refers to the information that has been collected from an experiment, a survey, an historical record, etc. Any other number we choose to compute also counts as a descriptive statistic for the data from which the statistic is computed. Several descriptive statistics are often used at one time, to give a full picture of the data.</p>
 <p>Comparison to Reference Points</p>	<p><b>Comparison to established reference points</b></p>	<p>Comparisons to established reference points include established targets [targeted outcomes, discharge prohibitions, WQS, required activity levels, etc.], or other reference points ["state of the art," other programs, previous results, baseline values, etc.].</p>
 <p>Temporal Change</p>	<p><b>Temporal change</b> (Simple change [absolute or %] or statistical trends)</p>	<p>The most general goal of trend analysis is to look at data over time. For example, to discern whether a given indicator such as copper concentrations in a receiving water has increased or decreased over time, and if it has, how quickly or slowly the increase or decrease has occurred.</p>
 <p>Spatial Analysis</p>	<p><b>Spatial analysis</b> (spatial variability, comparisons between watersheds or other geographic areas, etc.)</p>	<p>Spatial analysis allows comparisons between watersheds or other geographic areas. Impacts of runoff and/or control measures can be evaluated based on characteristics of the geographic regions (differences in land use, geology and geomorphology, hydromorphology, etc.). The ability to conduct spatial analysis is generally only limited by the availability of appropriate data for spatial characteristics and project budget.</p>

For example, establishing recycling facilities or curbside pickup or recyclables provides the needed structure to enable the target audience to implement the BMP of properly disposing of reuseable materials. Neighborhood focused programs are also bridges or external factors that can encourage residents to reduce irrigation, use IPM or eliminate car washing in the streets.

Objective 2 looks at how source contributions are related to MS4 and receiving water conditions. As discussed in Section 4.0, the significance of source contributions will

depend on many factors including proximity to the MS4 or receiving water, seasonal differences in the probability of pollutants entering waterways, and the ability of the target audience to take actions that will effectively control the source. These are all factors to consider in evaluating the impact of a source on receiving waters and the ability to reduce the impact.

Finally, Objective 3 addresses the relationship between Program Implementation and Receiving Water Conditions. To evaluate such relationships, managers must inevitably consider each of the other specific outcomes established between Levels 1 and 6. Success can ultimately be determined only through a “weight of evidence” that considers all available results. Approaches that seek direct correlations between program implementation and water quality improvement are likely to yield simplistic and unsatisfying results.

Outcome Level 6	Outcome Level 5	Outcome Level 4	Outcome Level 3	Outcome Level 2	Outcome Level 1
Receiving Water Conditions	MS4 Contributions	Source Contributions	Target Audience Actions	Barriers & Bridges to Action	Stormwater Program Activities
Sources & Impacts			Target Audiences		Implementation
<b>Objective 1: Relating Program Implementation to Target Audiences and Sources</b>					
				How is Stormwater Program Implementation related to Barriers and Bridges?	
			How are Barriers and Bridges related to Target Audience Actions?		
		How are Target Audience Actions related to Source Contributions?			
<b>Objective 2: Relating Source Contributions to MS4 and Receiving Water Conditions</b>					
	How are Drainage Area and Source Contributions related to MS4 conditions?				
How are MS4 Contributions related to Receiving Water Conditions?					
<b>Objective 3: Relating Program Implementation to Receiving Water Conditions</b>					
How do all of the above elements combine to address the relationship of Stormwater Program Implementation to Receiving Water Conditions?					

**Figure 7.2: Questions Guiding the Evaluation of Relationships between Outcomes**

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