White Paper

ASSESSING THE IMPACTS OF WATERSHED-SCALE DECISION-MAKING

The Santa Ana River Sustainability Assessment Pilot

Prepared for
California Department of Water Resources
and Santa Ana Watershed Project
Authority

February 2019

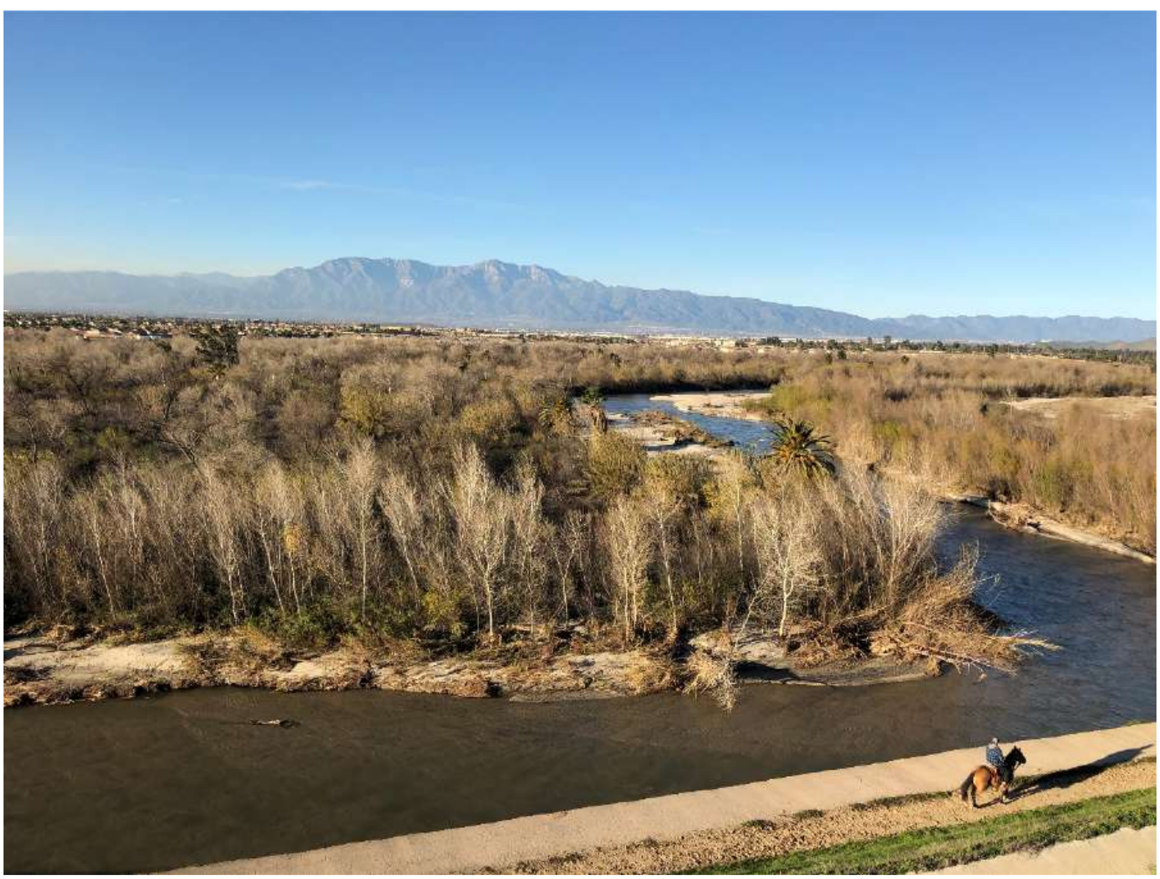

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TABLE OF CONTENTS

Assessing the Impacts of Watershed-Scale Decision Making

Appendices

List of Tables

CHAPTER 1
Introduction

The concept of assessing the sustainability of the Santa Ana River watershed has been pursued since the completion of the original One Water, One Watershed (OWOW) Plan in 2010. This White Paper was designed to support the Santa Ana River Project Authority (SAWPA) in undertaking the OWOW Plan Update 2018 with respect to sustainability assessment.

Background

SAWPA developed the first OWOW Plan as the Integrated Regional Water Management Plan (IRWMP) for the Santa Ana River watershed in 2010 with the subtitle "Moving Toward Sustainability." In 2014, when completing the first update of the OWOW Plan (OWOW 2.0 Plan), an assessment, supported by DWR, was conducted to evaluate progress towards meeting the OWOW Plan goals over the intervening years. During a similar timeframe, the California Department of Water Resources (DWR) had been investing in the development of assessment tools to better understand how to manage water resources for sustainability. In the process of developing the California Water Plan Update 2013, DWR recognized that to sustainably manage water resources, the work must be evaluated through a local lens, and that the indicators used to measure sustainability in one part of the state may be inappropriate for use in another. The California Water Plan Update 2018 is exploring how regionally-specific sustainability assessments will provide an understanding of how to manage water resources for sustainability at the appropriate scale. To that end, DWR has collaborated with SAWPA and sponsored the development of a SAWPA-directed Santa Ana River watershed sustainability assessment, of which this White Paper is a product.

Purpose and Content

This White Paper has been developed to present a method to assess management of water resources for sustainability for the Santa Ana River watershed and to demonstrate its application.[1] It provides historical context for an assessment approach, explores the potential utility of the watershed assessment for the California Water Plan and, similarly, the potential utility of the California Water Plan to support such an assessment. The White Paper presents the development of an assessment framework, drawing on prior assessment initiatives, including OWOW 2.0 Plan, the recent California Water Plans, and the Water Foundation's Sustainable Water Management (SWM) Profile. A proposed suite of indicators, relating to both stressor conditions and

[1] The application to be conducted to the extent reasonably practical within the available timeframe for completion of the OWOW Plan Update 2018.

management responses to those stressors, is presented, together with a rationale for their selection. The White Paper then summarizes feedback received from SAWPA stakeholders on the proposed indicators, and presents a final adopted suite of indicators, together with recommendations on which indicators are most appropriate for SAWPA to implement at this time. Finally, the results of the initial assessment are presented, together with documentation of the development process and lessons learned in its implementation.

CHAPTER 2
Assessment History

Introduction

Over the past two decades, multiple statewide and regional efforts have emerged in California to develop and apply indicator-based assessment frameworks and tools to help manage water resources for sustainability. Evaluation of these prior initiatives is needed to appreciate the opportunities and challenges associated with their development and better recognize how the current effort can build on that prior work to benefit the Santa Ana River watershed. This chapter describes some of the most relevant of these initiatives and how they have influenced each other.

This chapter evaluates the sustainability frameworks and visions presented in the California Water Plan (CWP) updates from 2005 through 2018, along with their potential for application to the One Watershed One Water (OWOW) Program. Additionally the Sustainable Water Management (SWM) Profile, an assessment tool prepared for the Water Foundation, is similarly evaluated.[2] Prior to the evaluations, the historical context and foundation for those indicator-based frameworks is provided.

Historical Context

During the last decade of the 20th century and the beginning of the 21st century, the continued deterioration of water-dependent ecosystems and water supply reliability, combined with new regulatory requirements and changing hydroclimates, stimulated collaborative planning approaches and greater investments in regional and watershed-based water resources and ecosystem management in California. The CALFED Bay-Delta program, integrated resource plans (e.g., Metropolitan Water District [MWD] Integrated Water Resources Plan[3]), and regional watershed plans (such as the San Francisco Bay Comprehensive Conservation and Management Plan[4]) emerged in the 1990s. In 2002, the Regional Water Management Planning Act (SB 1672) was passed, launching the development of Integrated Regional Water Management (IRWM) plans, designed to collaboratively identify and implement water management solutions on a regional scale to manage water to concurrently achieve social, environmental, and economic

2 More detailed evaluation of the CWP and OWOW updates as well as the SWM tool can be found in the January 30, 2018 "Findings Technical Memorandum for the Santa Ana River Pilot Phase 1." Information for the CWP Update 2018 is based upon draft documents released in December 2017 and January 2018, well before the release of Public Review Draft on December 20, 2018.

3 Metropolitan Water District of Southern California, *Integrated Water Resources Plan*, 1996.

4 San Francisco Estuary Project, *San Francisco Bay Comprehensive Conservation and Management Plan*, 1993.

objectives. Increasing public interest and awareness about ecosystem and watershed health simultaneously emerged at this time. As a result, in the late 1990s and early 2000s, non-governmental organizations (NGOs), in partnership with government agencies, developed watershed assessment frameworks and suites of ecological indicators.[5] NGOs and watershed partnerships furthered development of ecological indicators and management performance measures throughout the 2000s by applying them to watersheds or coastal areas and communicating the results in easy-to-understand report cards or scorecards.[6] Most NGOs and watershed partnerships received some financial support either from federal or state agencies, including DWR, to assess ecological indicators and management performance measures.[7]

These watershed efforts applied ecological, social, economic, and management indicators and performance measures to:

- assess watershed health and progress on watershed plans;
- provide decision support tools to guide actions and inform investments to improve watershed health; and
- assist in the development more effective monitoring and data management systems.

Management of water resources for sustainability was either an implicit or explicit goal in these efforts. Previous watershed assessment frameworks and suites of ecological indicators thus provide a foundation for the sustainability frameworks developed by CWP and the OWOW Program, both as "test beds" for indicator-based frameworks as well as the experience it provided for key contributors to the Sustainability Indicators Framework in CWP Update 2013, the OWOW 2.0 Plan, and the SWM Profile efforts.

Emergence of a Sustainability Vision: CWP 2005 and 2009

Until the CWP Update 2005, previous CWPs did not explicitly acknowledge the need to manage for sustainability other than to acknowledge that groundwater overdraft is not a sustainable solution to water supply needs (see, for example, CWP Update 1998). In the CWP Updates 2005 and 2009, the State focused attention on the sustainability of California's water management

5 Examples include Environmental Defense Fund and The Bay Institute, *Restoration of the San Francisco Bay-Delta-River System: Choosing Indicators of Ecological Integrity*, June 1996; U.S. Environmental Protection Agency, *A Framework for Assessing and Reporting on Ecological Condition: An SAB Report*, EPA-SAB-EPEC-02-009, June 2002.

6 Examples include The Bay Institute, *Ecological Scorecard, San Francisco Bay Index*, 2003; The Bay Institute, *Ecological Scorecard, San Francisco Bay Index*, 2005; San Francisco Estuary Partnership, *State of the Estuary Report 2004: Changes and Challenges;* Sacramento River Watershed Program, *Sacramento River Basin Report Card and Technical Report Feather River Watershed*, April 2010; Shilling, F., F, Knapczyk, B. Zlomke, C. Cornwall, D. DiPietro, J. Sharp, and R. Adams, *Technical and Final Report: Application and Findings of the North Bay-Delta Transect Watershed Assessment Framework*, May 24, 2010; Ridolfi, K., P. Vorster, and L. Micheli, *Indicators and Performance Measures for North Bay Watersheds*, prepared for the North Bay Watershed Association, January 11, 2010; Los Angeles and San Gabriel Rivers Watershed Council, *Assessing Ecosystem Values of Watersheds in Southern California*, February 2011.

7 See also the discussion of the Watershed Assessment Framework (WAF) in the CWP Update 2013.

systems and ecosystems given existing stresses and expected future hydrologic changes due to climate change. CWP Update 2005 was also the first CWP to emphasize integrated regional water management as a key component of managing for sustainability.

CWP Update 2005 established a *vision for sustainability* and a "Framework for Action" for *sustainable water use*, as well as foreshadowing the need for assessment tools. The CWP Update 2005 describes its vision, relating water management to broader sustainability goals[8], as follows:

> California's water resource management preserves and enhances public health and the standard of living for Californians; strengthens economic growth, business vitality, and the agricultural industry; and restores and protects California's unique environmental diversity.

The CWP Update 2005 vision for sustainable water use draws from the vision articulated in the 1987 Brundtland Commission Report[9] on sustainable development. The CWP Update 2005 states:

> Sustainable water use ensures that we develop and manage our water and related resources in a way that meets present needs while protecting and enhancing our watersheds and the environment and assures our ability to meet the needs of the future.

It goes on to speak about sustainable water use in this way:

> California can secure its water resources for the future by making the right choices and the necessary investments. To ensure that water use is sustainable, California must base groundwater and surface water management on three foundational actions: use water efficiently and protect water quality to get maximum utility from existing supplies; and manage water in ways that protect and restore the environment.
>
> In future Water Plan updates, we will refine our ability to measure water use and project the effects of our management strategies.

The CWP Update 2009 similarly envisioned:

> California has healthy watersheds and integrated, reliable, and secure water resources and management systems that
>
> - Enhance public health, safety, and quality of life in all its communities;
> - Sustain economic growth, business vitality, and agricultural productivity; and
> - Protect and restore California's unique biological diversity, ecological values, and cultural heritage.

8 Note that these goals were not referred to as "sustainability goals," but they are goals consistent with typical statements about sustainability.

9 World Commission on Environment and Development (1987). Our Common Future. Oxford: Oxford University Press.

The sustainability vision in Draft CWP Update 2018 remains consistent with these vision statements.

CWP Update 2009 used the same "Framework for Action" as CWP Update 2005 but explicitly added "managing for sustainability" by incorporating resource sustainability into planning for the future. CWP Update 2009 also recognized the value of sustainability indicators as a crucial tool ("Determine values for economic, environmental, and social benefits, costs, and tradeoffs to base investment decisions on sustainability indicators") and cited the work of the Sustainable Water Resources Roundtable (SWRR),[10] noting that "Indicators represent a way to measure progress. They can provide a metric for understanding the extent to which water resources are managed to meet the long-term needs of our social, economic, and environmental systems." However, incorporating sustainability indicators into CWP Update 2009 did not occur; it was observed that "the concept of resource sustainability into water planning is an ongoing process or approach that will continue to be developed in future water plan updates." A description of those efforts in the CWP Update 2013 is presented below.

Developing and Applying the Sustainability Indicators Framework: CWP Update 2013 and OWOW 2.0 Plan

The CWP Update 2013 incorporated sustainability indicators in response to recommendations from the CWP Update 2009 advisory process.[11] Development of a Sustainability Indicators Framework (SIF) began in 2007 with the DWR-supported process of developing and applying the Watershed Assessment Framework (WAF), an indicators-based framework combining the landscape indicators developed by the U.S. Environmental Protection Agency Science Advisory Board, with social and economic condition indicators.[12] The WAF was applied in multiple watersheds in California, including the Feather River, Napa River, and Arroyo Seco in Southern California.[13, 14] The WAF evolved into the SIF during 2010-2013, when the analytical framework and approach for developing and evaluating indicators was developed as the SIF. The SIF was then published as a Technical Appendix to CWP Update 2013. The SIF includes 120 proposed indicators organized under 7 goals and the Technical Appendix describes the process for selecting, evaluating, and reporting on the indicators. The SIF was designed to integrate sustainability indicators and performance measures into a single Water Plan reporting system, and

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10 Since 2002, the Sustainable Water Resources Roundtable has brought together federal, state, corporate, non-profit and academic sectors to advance our understanding of the nation's water resources and to develop tools for their sustainable management. The roundtable mission is to promote sustainability of our nation's water resources through the evaluation of information, development and use of indicators, targeting of research, and the engagement of people and partners to improve the management, conservation, and use of water and related resources.

11 Shilling, F., A. Khan, R. Juricich, V. Fong, D. Hodge, S. Cardenas, I, Larcher, H. Le Maitre, D. Waetjen, and C. Cornwall, *The California Water Sustainability Indicators Framework*, Final, June 2014.

12 Schilling, F., California Whole System Report Card (presentation), 2010.

13 Shilling, F., F, Knapczyk, B. Zlomke, C. Cornwall, D. DiPietro, J. Sharp, and R. Adams, *Technical and Final Report: Application and Findings of the North Bay-Delta Transect Watershed Assessment Framework*, May 24, 2010.

14 Los Angeles and San Gabriel Rivers Watershed Council, *Assessing Ecosystem Values of Watersheds in Southern California*, February 2011.

is to be used in conjunction with other aspects of the Water Plan, such as Progress Reports, Regional Reports, Resource Management Strategies, Scenario Planning, and other components.[15]

In addition to pilot testing at the state scale, the SIF was also applied at the regional scale. The assessment tool developed for the OWOW 2.0 Plan was expanded to test the application of the SIF in the Santa Ana River Watershed. The OWOW Plan, developed as a stakeholder-driven plan facilitated by the Santa Ana Watershed Project Authority (SAWPA), was in its second iteration in 2013 (the OWOW 2.0 Plan). Application of the SIF was envisioned as a way to understand the performance of integrated water management in the watershed. It was a collaborative process among SAWPA, the Pillars (the technical stakeholders of the OWOW plan), the Council for Watershed Health, and the University of California, Davis. The results were published in Appendix A of the OWOW 2.0 Plan as an "Assessment of the Health of Santa Ana River Watershed."

The following key attributes of the SIF implemented as part of the OWOW 2.0 Plan are useful to consider in the development of the OWOW Plan Update 2018 indicator-based assessment:

1. Application of the SIF used existing watershed management goals and objectives in the assessment. The watershed management goals helped drive selection of indicators and metrics.
2. The SIF encouraged stakeholder engagement in the creation of assessments. In the OWOW 2.0 Plan, efforts were made to engage SAWPA's stakeholders, with moderate success among the water management sector, and less success within the environmental and community advocacy groups. As a result, the Assessment tool was weighted towards water supply and water quality indicators. There were fewer indicators selected that reflected social well-being and economy.
3. Application of the SIF used "distance to target" as the basis for describing the condition or state of each indicator. The process identified a range from best case ("wanted" condition) to worst case ("unwanted" condition) for the indicators, which were then described as existing somewhere in that range. Comparing indicator condition against reference values, or targets, is a critical requirement to score condition assessments in the SIF.
4. Indicators that respond relatively quickly to management intervention and can effectively be used to measure change over time are preferable to those that require data over long periods of time to observe changes due to management actions.
5. The intensity of the data collection effort required and lack of available data precluded many SIF indicators from application. Data availability deficiencies prevented calculation of a numeric evaluation for seven out of the 18 indicators included in the OWOW 2.0 Plan.

[15] Shilling, F., *The California Water Sustainability Indicators Framework: Draft Final Report,* 2013.

Articulating a Sustainability Outlook for the State: CWP Update 2018

The CWP Update 2018, for the first time, identifies specific outcomes and indicators to track progress towards water management for sustainability in its Sustainability Outlook.[16] The Draft Assumptions and Estimates for California Water Plan Update 2018[17] presents the Water Plan's vision of sustainability:

> Sustainability is not defined as an end point, but as an ongoing, resilient, and dynamic balance among four societal values:
>
> - Public Health and Safety
> - Thriving Economy
> - Ecosystem Vitality
> - Enriching Experiences

The Societal Values indicate what society expects and values from water management in California. The Societal Values are based on the proposition that an outcome-driven approach is needed to improve the effectiveness of water management—an approach that balances societal goals across river basins, tracks results toward these outcomes over the years, and adapts over time to meet the changing needs of California.

Sustainability as an organizing principle led to the development of the Sustainability Outlook, which is described in the December 2018 Draft CWP Update 2018 supporting documents *The Sustainability Outlook: A Summary* and *Sustainability Outlook Indicator Descriptions and Methodology*.[18, 19] As noted in the *Sustainability Outlook Indicator Descriptions and Methodology*,

> The long-term goal of the Sustainability Outlook is to establish a single comprehensive and practical method for tracking and reporting progress toward and effectiveness of implementing water management actions and policies that provide shared agreement and consistency across State government and local governments across California's diverse regions.

The Sustainability Outlook uses data (indicators) to help assess progress in achieving desired results (intended outcomes) aligned with the four societal values. Multiple indicators previously developed for the SIF are included in the Draft CWP Update 2018's Sustainability Outlook, particularly basic ecosystem and water quality indicators. Development of Sustainability Outlook indicators involved: 1) establishing definitions for sustainability in the context of the four societal values, 2) creating a tool for linking these values with the wanted outcomes and those outcomes

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[16] See *The Sustainability Outlook: A Summary*, Draft, December 2018.

[17] *Assumptions and Estimates for California Water Plan Update 2018*, Draft, April 2017.

[18] California Department of Water Resources, *The Sustainability Outlook: A Summary*, Draft, December 2018.

[19] California Department of Water Resources, *Sustainability Outlook Indicator Descriptions and Methodology*, Draft, December 2018.

with the indicators, and 3) developing a compilation of indicators and metrics to assess progress towards achieving those outcomes. The supporting draft document describing the Sustainability Outlook includes 38 basic and watershed indicators, seven advanced or future indicators, and 40 archived[20] indicators.

The Sustainability Outlook screening criteria for indicator selection include "Supportive of Decision-making," noting that the indicators need to be "simple to understand and easy to communicate" to stakeholders and decision makers. Indicators should also have "relatively quick response to management intervention" and data that "spans many years to allow for reporting on trends over time." These latter criteria were also essential in the selection of indicators and metrics for the OWOW Plan Update 2018. The following concepts from the Sustainability Outlook were useful in developing the OWOW Plan Update 2018 assessment, as well as in aligning and integrating the OWOW Program and CWP.

1. Linking societal values to outcomes, and outcomes to indicators, provides a clear pathway from indicators to societal values.
2. Providing guidance on trend analysis to determine if progress is occurring with regard to a desired societal outcome in an understandable manner for decision makers is useful for establishing valuation when benchmarks or reference conditions are lacking.
3. Providing guidance on establishing reference conditions or benchmarks for desirable and undesirable conditions may be useful.
4. Recommended Action 6.3 (Improve Performance Tracking) of the Draft CWP Update 2018 envisions that "DWR will consider assessing State progress toward Update 2018's goals by using the Sustainability Outlook, a method to uniformly track outcomes and value of water system investments… DWR will also consider assisting regional and local water agencies with implementing the Sustainability Outlook to help measure local progress and inform future decision-making."

Advancing Sustainability Assessment Frameworks: The SWM Profile

In parallel with the CWP process, other efforts to assess water management for sustainability were also proceeding. One parallel effort was the Sustainable Water Management (SWM) Profile. In 2012, the Water Foundation (formerly the California Water Foundation) initiated the development of the SWM Profile as a tool to evaluate conditions that stress water supply management as well as progress towards sustainable water management at a water supply agency and regional scale. The SWM Profile is a two-step assessment framework that first uses simple metrics to assesses pre-determined stressors or vulnerabilities to sustainable water supply management, such as Supply Reliability, Demand, Watershed Health. It then evaluates management responses to the stressors by the water agency and the broader region by assessing the level and quality of management actions taken to address each stressor. Utilizing a points-based system, the SWM Profile rates where an agency and its larger region currently stand on the

[20] Archived most commonly due to lack of access to viable data, overlap with other indicators, or a determination that the indicator was not representative of the intended outcome.

path to sustainability. The SWM Profile was initially pilot-tested with the Sonoma County Water Agency in 2014, refined based upon extensive feedback, and pilot-tested again in 2016 with the Inland Empire Utilities Agency (located in the Santa Ana River watershed).[21]

Some of the lessons learned in developing and testing the SWM Profile that are useful for CWP Update 2018 and OWOW Plan Update 2018 include:

1. Simple categories (e.g., High, Moderate, Low) for the indicator or metric status are readily-understood and better allow for qualitative assessment where necessary. .
2. Metric thresholds could incorporate targets established by agency and watershed plans for the stressor metrics.
3. The SWM Profile's management response continuum can potentially be translated into indicators of management response as defined by watershed stakeholders.
4. Separating the indicators of stress from the indicators of management response allows decision-makers to act in response to the assessment. It overcomes a challenge often felt in assessment tools whereby those being assessed feel they are being held accountable to things outside their control. Here, high stress may be a reality an agency faces, and it is their effort to overcome the stress that is evaluated.

Summary Findings and Recommendations

Based upon the relevant findings from the analysis of the sustainability assessment frameworks developed since 2010 (such as SIF and SWM) and the other frameworks applied at the watershed scale over the last 20 years in California, the following are overall findings and recommendations for the development of an assessment framework with metrics and indicators for the OWOW Plan Update 2018:

1. Assessment frameworks are on an evolutionary path from an initial focus on watershed health and stewardship to sustainability indicators, and are currently evolving to encompass institutional, social, and economic indicators of sustainability, including management practices, governance and environmental justice.
2. The OWOW Plan Update 2018 assessment should review the Sustainability Outlook indicators to determine which would be potentially useful indicators and metrics of stressors facing the Santa Ana River watershed. That said, the OWOW Plan Update 2018 assessment should focus on the effective implementation of the OWOW Plan goals and objectives and therefore the management responses of the region, rather than mirroring the Sustainability Outlook focus on promoting sustainability outside of that framework.[22]
3. The indicators and metrics should attempt to build upon the OWOW 2.0 Plan assessment using a combination of the condition indicators and performance measures already developed. However, the primary focus for the OWOW Plan Update 2018 indicators and

[21] More detail on the characteristics of the SWM Profile are provided in the January 30, 2018 "Findings Technical Memorandum for the Santa Ana River Pilot Phase 1," included as **Appendix A** and at the following Water Foundation website: http://waterfdn.org/resources/swmprofile/.

[22] This recommendation was implemented as part of the Assessment, as discussed in Chapter 4.

metrics should be their effectiveness in assessing progress towards the updated goals and objectives in a simple and comprehensible manner, as well as the ability to meaningfully detect change over time.[23]

4. At some point in the future, if useful and desired, the assessment could accommodate a scoring system that would include reference and/or baseline conditions and/or thresholds for the wanted and unwanted conditions. Input from watershed decision makers, stakeholders and others should be solicited to determine the criteria and/or thresholds for scoring the indicators.

[23] This recommendation was implemented as part of the Assessment, as discussed in Chapter 4.

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CHAPTER 3
Benefits of a Watershed Sustainability Assessment

The watershed sustainability assessment directly benefits the Santa Ana watershed and its stakeholders by promoting watershed sustainability goals and providing indicators of where action is needed to achieve them. Statewide efforts to focus water management activities toward sustainability also benefit from implementation of a watershed (or regional)[24] sustainability assessment. This section discusses benefits from both perspectives and identifies ways the State can support the implementation of such sustainability assessments.

Benefits to the Watershed of Conducting a Watershed Sustainability Assessment

Supports Decision Making to Favor Sustainability

Human decisions at multiple scales affect water management throughout California. Water management for sustainability is the cumulative product of many factors, including a broad array of interdependent decisions and their associated outcomes: from the scale of state and regional policy, planning, and engineering activities, to the management decisions made by water agencies, to the actions of individuals in their homes or businesses. In the Santa Ana River watershed, the watershed sustainability assessment supports the One Water One Watershed Plan Update 2018 (OWOW Plan). The OWOW Plan is built and updated by stakeholders to be compliant with the California Integrated Regional Water Management Program while also describing the goals, objectives and recommended strategies for achieving a more sustainable watershed by 2040. The assessment supports decision making at multiple scales within the watershed, as well as supporting the flow of information for decision-making from the watershed to larger regions, such as the state, as will be discussed in the next section.

Watershed-Scale Decisions

At the watershed scale, the watershed sustainability assessment supports decisions about the choice of planning targets, as well as project design and selection. This is achieved by collaboratively identifying key indicators which when evaluated can reveal the impact of watershed-wide efforts to achieve high-priority goals and objectives. The watershed sustainability

[24] This document will refer to such assessments as being undertaken within either "watersheds" or "regions" somewhat interchangeably, as the assessments may be carried out within either a watershed or another regional management boundary.

assessment supports decisions by demonstrating whether existing efforts are producing progress and effecting desired change. The sustainability assessment can also be useful to the OWOW Plan itself by providing feedback between iterations. If the sustainability assessment finds the effects of implementing the OWOW Plan are successful, but fail to address key aspects of water resources sustainability challenging the watershed, modification of the OWOW Plan's goals and objectives may be appropriate.

Individual-Scale Decisions

At the individual scale, the watershed sustainability assessment summarizes current progress on efforts relevant to sustainability, which can foster adoption of a watershed ethic by providing individuals with sufficient information to align their actions with sustainability efforts. By supporting understanding of progress toward the shared goals expressed in the OWOW Plan, the watershed sustainability assessment also builds a sense of common purpose among watershed stakeholders. This amplifies the collective effect of their individual decisions.

The watershed sustainability assessment provides a succinct visual and conceptual "status update" of the watershed that can be used to support stakeholder engagement by generating an expectation for feedback on OWOW Plan effectiveness and management of water resources for sustainability. It can also be used as a basic educational tool for identifying key factors that represent water resources sustainability and highlighting status, efficiencies, progress, and the need for governance and investment.

Improves Water Resources Sustainability and Quality of Life

By supporting decisions that align management of water resources for sustainability with the OWOW Plan and by helping to educate and motivate stakeholders, a watershed sustainability assessment promotes and improves management of water resources for sustainability within the watershed. It both supports and reflects a watershed awareness or ethic. When the intrinsic value of the watershed—and the thoughtful management of the systems within it—becomes part of the fabric of the culture, challenges in the watershed associated with water management and sustainable use will recede.

The selection of indicators that reflect water resources management for sustainability shifts the management focus to actions that will, in part, affect these indicators and yield progress towards the goals.[25] This shift yields long-term return on capital investments and a resulting improvement in the quality of life for people within the watershed.

[25] Excessive attention to selecting management actions solely to shift metric results may be a concern. Yet by making the metric selection and implementation adaptable over time, excessive management action focus on moving individual metric values would be discouraged.

Benefits to the State of Regional Completion of Sustainability Assessments

Two general categories of benefits to the State emerge when watershed or regional sustainability assessments are conducted. First, completion of regional sustainability assessments aligns with and informs statewide planning efforts generally. Second, regional assessments help the State evaluate progress towards management of water resources for sustainability in a way that honors regional variability and local contexts.

Supports Statewide Sustainability Efforts

The State is developing outcomes and associated indicators and metrics as part of the Draft CWP Update 2018 Sustainability Outlook. Lessons learned from watershed-scale sustainability assessments provide feedback regarding which indicators and metrics are more useful (such as specific regional context, or whether data was easily available to provide a means for evaluation). Further, they inform the State's selection of example indicators. Additionally, watershed sustainability assessments provide the State with examples of how local planning goals can align with the four societal values identified by the State within the Sustainability Outlook and elsewhere.

Completed watershed or regional sustainability assessments will also help the State by providing examples that other regions can follow. Lessons learned will help other regions in the state consider and pursue adoption of some form of regional sustainability assessment more broadly.

Helps the State Address Variability Between Local Contexts

The watershed sustainability assessment provides an example of a regionally-specific framework for assessing progress towards sustainability that may be used to support an understanding of sustainability at a statewide scale. Additionally, it will serve as part of the California Water Plan, to educate the public about regional differences in managing water resources for sustainability.

The sustainability assessment being conducted for the OWOW Plan Update 2018 represents a particular *strategic* approach to crafting a watershed or regional assessment that could be applied anywhere and may be useful to other regions within the state.

Opportunities for the State to Support Watershed Sustainability Assessment

There are multiple opportunities for the State to support the watershed sustainability assessment. These opportunities primarily fall into three categories, related to providing training, funding, or data-related support.

Training

The learning gained from regional sustainability assessments conducted to date could be disseminated through State-sponsored exchanges or workshops. Funding for coaches to work with regions may provide guidance or assistance to those undertaking a sustainability assessment for the first time. At a more significant level of funding, the State could support experienced personnel to work directly with a region to develop and implement a sustainability assessment, as was done for the OWOW Plan Update 2018 under the current effort.

Funding

The State can support watershed or regional sustainability assessment by funding such efforts. The State could also incentivize such assessment by prioritizing funding targeted to support project implementation in those regions.[26] To benefit effective and efficient sustainability assessment at a regional scale, the State could also sponsor active information sharing between the regions.

Data

The State can provide data support for sustainability assessment (or the stressors to sustainability) through data aggregation, data provision, establishment of common data formats, catalogs of independent data sources, and/or through data synthesis or analysis to produce information useful to sustainability assessment.

Data aggregation. The State could provide a repository for data useful to sustainability assessment. The submittal of data could be either voluntary or mandatory. Some data already being submitted to the State may fall into this category. The State could make data that is particularly useful to sustainability assessment (e.g., data for the evaluation of the State's Sustainability Outlook indicators) more easily available for regional-scale assessment or contextual understanding to inform planning. For example, the State could develop or fund a robust database of sources of water supply by wholesale and retail agency, or geography.

Data provision. In some cases, the State is actually developing data that is useful to sustainability assessment. As in the Data Aggregator role, the State could make data that is particularly useful to sustainability assessment more easily available for regional-scale assessment or contextual understanding to inform planning. Regular collection of relevant data by the State would reduce the burden on regions associated with regular tracking of stressors affecting water management for sustainability (e.g., data for the evaluation of the State's Sustainability Outlook indicators). By tracking the stressors faced by water managers both from within their service area and from areas beyond, DWR would enable regions to focus their own tracking efforts on management response to the stressors. Information literacy training sessions that explain how to access and use the data could also be provided by the State.

26 Equity of resource distribution should be a consideration if this approach is pursued.

Data analysis/synthesis. Turning data into useful information is often a significant undertaking. With guidance by the regions to identify pertinent data related to stressors to sustainable management at a regional scale, the State could process available data to generate statewide or regional information that is highly relevant to sustainability. This information might be compiled by the State and presented on a regional basis, and made available to the regions for their own use in assessing sustainability. The State might also develop open-source web-based reporting code for sustainability indicators that regions could customize and use.

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CHAPTER 4
Assessment Development

Strategic Approach

As described in Chapter 2, statewide and regional efforts to develop sustainability assessment tools have been ongoing for more than a decade. Assessment development for the OWOW Plan Update 2018 intentionally utilized concepts and indicators identified by these previous and concurrent efforts as a potential source for indicators and metrics aligned with the OWOW Plan's goals and objectives, which were developed through local collaborative watershed planning efforts. The intent of this strategic approach was to develop an assessment that reflected the best thinking related to managing water for sustainability while ensuring that the assessment results would be supportive of the OWOW Plan, locally meaningful, and time- and cost-effective to repeat on a regular basis.

Sustainability Goals and Objectives

The assessment was developed based on the OWOW Plan Update 2018 (OWOW Plan) goals and objectives. The OWOW Plan describes how collaborative watershed planning, water and land management, and project implementation supports improved sustainability, resilience, and quality of life throughout the Santa Ana River watershed through 2040. **Table 1** identifies the six goals and associated objectives of the OWOW Plan.

As a stakeholder-driven process, the OWOW Plan is literally written by the stakeholders, gathered together in workgroups called Pillars. The program is administered by the OWOW Steering Committee at the behest of the SAWPA Commission.

Because the OWOW Plan describes the high priority goals, objectives, and strategies for **ACHIEVING** a more sustainable Santa Ana River watershed, the assessment was developed to evaluate progress towards achieving the goals of the Plan. In this way, the assessment provides information to support collaborative governance, planning, and implementation efforts to manage water resources for sustainability. Indicators based on these goals and objectives reflect a shared vision for the watershed and are tuned to assess the effectiveness of actions targeting OWOW goals and objectives. The assessment focuses on the effective implementation of the Plan through management actions, rather than the effectiveness of the Plan in promoting sustainability. If made sufficiently easy to carry out, the assessment can be conducted often, perhaps even annually, to 1) help refine implementation of the Plan on a time scale that will be regularly meaningful to decision-makers, 2) build momentum through demonstrating progress towards the goals, and 3) serve to reinforce the value of the Plan and its implementation to the stakeholders in the watershed.

TABLE 1
OWOW PLAN UPDATE 2018 GOALS AND OBJECTIVES

Achieve resilient water resources through innovation and optimization. *Objectives*: • Increase the reuse of water • Innovate to increase water-use efficiency, conservation and interregional transfers • Manage precipitation as a valuable watershed resource • Reduce carbon emissions from water resources management • Safely strengthen links between flood protection, storm water management and water conservation • Sustainably manage groundwater basins • Plan for OWOW implementation beyond state grants	**Ensure high quality water for all people and the environment.** *Objectives:* • Achieve and maintain salt balance in the watershed • Ensure every human being in the watershed has safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes • Protect and improve source water quality • Protect beneficial uses and attain water quality standards in freshwater and marine environments • Reduce water systems vulnerability to climate impacts • Support alignment of regulatory action with watershed goals
Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function. *Objectives:* • Conduct regional effort to remove and manage invasive species • Preserve and restore beneficial hydrologic function of streams, arroyos, water bodies, and the coastal zone • Protect and restore wildlife corridors and habitat connectivity • Protect endangered and threatened species, and species of special concern • Support healthy watershed policies with local land use authority	**Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed.** *Objectives:* • Adopt best-practices for environmental justice action throughout water management • Analyze and confront unequal community vulnerabilities to climate impacts • Ensure community voices help identify strengths and needs • Strive to include community cultural values in watershed management decision-making • Support broad-based collaboratives alleviating homelessness and its impact on the watershed.
Improve data integration, tracking and reporting to strengthen decision-making. *Objectives:* • Apply new technologies to maintain and enhance transparency and efficiency • Collaborate to produce regular publicly-accessible watershed health reports • Develop standard data formats and data fields for comparative analyses • Increase appropriate access to data for decision-makers, managers, and the public • Reduce redundancy in data collection in overlapping programs • Streamline regulatory reporting requirements	**Educate and build trust between people and organizations.** *Objectives:* • Adopt policies strengthening transparency in water management decision-making • Collaborate with educators to broaden youth knowledge about water • Develop strong ongoing consultation and partnership with Native American tribes • Ensure conservation is a way of life in the Santa Ana River Watershed • Innovate communication strategies for diverse communities • Maintain and grow watershed and sub-watershed collaborative water management efforts

As a feedback mechanism for OWOW stakeholders and decision-makers, the assessment is specifically crafted for ease of understanding by the non-technical public. This assessment approach also benefits from the momentum gained through the stakeholder-driven OWOW planning process.

Assessment Framework

Components of the assessment framework include indicators and metrics, valuation or scoring, and presentation of results. Indicators are statements of what is being assessed. To perform the assessment, a metric—some measurable proxy for the indicator—must be selected and evaluated. Valuation or scoring are terms used to indicate methods of communicating the value of an assessment finding at the indicator and overall assessment scale. For example, a metric may have a numeric value which is then translated into a letter grade or "positive," "negative," or "neutral" finding or score for an indicator. A collection of indicator findings may be rolled up into an overall finding for the purposes of the assessment. Significant variability in how results are presented is possible and will depend on the purpose of the assessment, its intended audience, and the medium used. For example, a simple report card format can summarize results without presenting findings at the metric level. At the other extreme, summarization of results can be backed up by detailed discussion of each indicator and metric; the basis for its selection; presentation of the detailed methodology, data sources, and analysis conducted to produce the quantitative result and its valuation; and placement of that result in a broader context, often time-based and/or geographic.

The development of the Assessment Framework for OWOW Plan Update 2018 is presented below.

Approach to Selecting Indicators and Metrics

Potential indicators and their associated metrics were initially identified by considering indicators previously generated for other projects (and regions) and screening them to reflect our knowledge of the Santa Ana River watershed and metric criteria related to ease of implementation.

In particular, indicators and metrics developed for the following previous or ongoing efforts were reviewed:

- **OWOW 2.0 Plan.** The OWOW 2.0 Plan (2014) included an assessment to report on the status and trends of the economic, ecologic, and social systems that make up the Santa Ana River watershed. Using a facilitated, stakeholder process, SAWPA analyzed the goals and objectives in the original OWOW plan and compared them to the OWOW 2.0 Plan Framework to identify and fill gaps. The performance targets highlighted in OWOW were the starting point to develop a suite of indicators and metrics for the Santa Ana River watershed that addressed the needs of the community, the environmental context, and the IRWM planning requirements. Between three and five indicators were evaluated for each of the five OWOW 2.0 Plan goals. OWOW 2.0 Plan included 20 indicators, though 40 percent of them could not be implemented due to data deficiencies. The OWOW 2.0 Plan indicators are included in Table 1 of **Appendix B**.

- **Sustainable Water Management (SWM) Profile.** As discussed in Chapter 2, the SWM Profile was developed to assess the sustainability of water supply management in a region through the lens of a key regional water management agency. The primary objective of the SWM Profile was to increase water supply sustainability by highlighting a water agency's successes and vulnerabilities, and encouraging sound investments, policies, and regional coordination. The SWM Profile provided standards for assessing water supply vulnerability to key stressors (risks or threats), and for evaluating management responses to those stressors. The SWM Profile gave ratings based on points earned for the Management Response level for each stressor, weighted by stress level and additional criteria. Ten stressors were assigned a stress level based on one to four metrics each, and then management responses to each of the stressors were classified into one of eight tiers of accomplishment. The SWM Profile stress level metrics are included in Table 2 of Appendix B.

- **California Water Plan Update 2018 - Sustainability Outlook.** The Sustainability Outlook is a suite of indicators identified by the Department of Water Resources, with stakeholder input, to evaluate the status and trends of water resource conditions in terms of the four societal values: public health and safety, healthy economy, ecosystem vitality, and enriching experiences. At the time of assessment development, the draft Sustainability Outlook included a list of 44 potential basic indicators for assessing water resources management for sustainability, included in Table 3 of Appendix B. The assessment team evaluated each indicator for relevance to stressors in the Santa Ana River watershed, the OWOW goals and objectives, and data availability.

Review and Selection Process

Selection of the assessment indicators involved multiple iterations of thoughtful review. The indicator review process included consideration of indicators from the previous efforts to identify indicators that were potentially relevant in the SAWPA region and that were anticipated to be reasonably easy to implement. Then each of the OWOW Plan Update 2018 goals were reviewed to identify the most critical factor or factors associated with achieving each goal, and potentially relevant existing indicators were identified. Potential indicators and associated metrics were then assessed with regard to relevance to critical factors and in accordance with selection criteria described below. In some cases, new indicators were identified that did a better job of addressing critical factors than the available existing indicators. These were also evaluated in accordance to the selection criteria described below.

OWOW stakeholder feedback was sought at multiple stages during the assessment development process. Sets of potential indicators were shared during local stakeholder meetings to solicit feedback and share progress. For OWOW Plan Update 2018 goals with a broader array of potential interpretations, priorities were identified by surveying the relevant Pillar (subgroup of OWOW Plan stakeholders). Table 4 in Appendix B summarizes the indicators considered for this assessment, and the rationale for their inclusion or exclusion.

Selection Criteria

Selected indicators and metrics were those determined to be the most significant for the goals based on our knowledge of the watershed. The array of potential indicators was narrowed to a select group for further consideration based on the following four main criteria:

- **Easy to understand.** Is the indicator simple and clear?
- **Responsive to actions.** Would the indicator shift within a timeframe meaningful to planning schedules?
- **Easy to implement.** Is sufficient data regularly collected and readily available to meaningfully assess the indicator with a modest time investment?
- **Meaningful to stakeholders.** Will the value of this indicator and its relationship to OWOW Plan goals be evident or easy to communicate to stakeholders?

The indicator selection criteria were developed by the assessment team, including SAWPA staff, primarily based on the intent to make the assessment time- and cost-efficient to implement and to provide results that would reflect on the success of plan implementation. While not requisite for selection, potential indicators based on annually-updated data were considered desirable. **Table 2** identifies the selected indicators and metrics and summarizes the rationale for their selection.

Approach to Valuation

Determining how to value, or score, the identified metrics is a major decision influencing the look, feel, and utility of any assessment. The various decisions made by the assessment team with respect to valuation are presented and discussed below.

Reporting of Trends

The assessment team chose to report on trends (that is, to score or value a metric relative to past conditions) instead of scoring each indicator with either an absolute value or based on its relationship to a target condition (i.e., wanted or unwanted conditions), the approach taken in OWOW 2.0 Plan (2014). The team also elected to use only a three-bin set of results: a positive, negative, or neutral rating. There are several reasons for this approach:

1. **It is easy to understand.** Indicator results are either better or worse than they were before. And with only positive, negative, and neutral results, no reader will become lost in nuance (e.g., the difference between doing very, very well and doing very well).
2. **It limits the number of thresholds to be assigned.** With only three possible results, only two thresholds need be identified: how positive a result is required to consider the trend to be positive, and how negative a result is required to consider the trend to be negative. While sometimes science or policy can be relied on to identify broadly-accepted thresholds, where such sources do not exist, thresholds are arbitrary and subject to debate. As a result, minimizing the number of thresholds makes it more likely that broad acceptance of the thresholds can be achieved.
3. **It is adequate to indicate movement toward Plan goals**. This is the primary purpose of the assessment: a tool to indicate whether the Plan implementation is effective in progressing the region towards its goals.

TABLE 2
SELECTED INDICATORS FOR OWOW PLAN UPDATE 2018 GOALS

Goal	Indicators	Metric	Rationale
Achieve resilient water resources through innovation and optimization	Maximization of locally-managed supplies	Percent of total annual supply sourced or managed locally	Water that is sourced locally or imported and stored locally is more reliable than water that is imported and must be immediately used. Optimizing supplies and storage in the region will make us more resilient and effective managers of an increasingly variable water supply.
	Efficiency of outdoor water use	Percent of watershed population in agencies using parcel-level data to assess outdoor water use	Implementing innovative technology and data management can increase irrigation efficiency and help make landscapes less irrigation dependent. Landscape irrigation is the single largest use of water in the watershed and improving its efficiency will significantly increase watershed resilience.
Ensure high quality water for all people and the environment.	Maintenance of groundwater salinity at or below target levels	Non-exceedance of groundwater salinity standards	Management of water quality in the groundwater basins of the watershed is essential to preserving their utility. Groundwater basins are the watershed's most important local water storage tool, and salinity levels are a primary consideration for maintaining a high-quality, reliable water supply.
	Safety of water for contact recreation	Percentage of monitored sites where recreational use is likely and identified as high risk due to bacterial contamination	Bathers in our streams, lakes, and coastal waters must be protected from undue health hazards from water quality impairment.
Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	Abundance of vegetated riparian corridor	Area of vegetated riparian corridor	Active engagement in conserving and restoring riparian vegetation is necessary to retaining and enhancing the values supported by this resource. Vegetation within the riparian corridors of the watershed provides valuable habitat for a large number of species, including those with special status. It also provides beauty and shade for people recreating alongside streams and lakes.
	Abundance of conserved open space	Area of conserved open space	Deliberate management and protection is necessary to maintain the recreational and ecosystem values of open space.
Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	Equitable access to clean drinking water	Relative value of the drinking water contaminant index from CalEnviroScreen in less resourced parts of the community and more resourced parts of the community [a]	Ensuring that all people in the watershed have clean drinking water is essential to human health and prosperity within the watershed.
	Proportionate implementation of climate change adaptation strategies	Relative value of tree and shrub density in less resourced parts of the community and more resourced parts of the community [a]	Targeted implementation of climate change adaptation strategies that address the potential for increased dangerous heat, a climate change impact predicted in the watershed, will reduce the extent to which vulnerable people are inequitably impacted.
Educate and build trust between people and organizations.	Collaboration for more effective outcomes	Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation	Collaborative action with shared outcomes must be prioritized by water managers because many of the complex challenges facing the watershed cannot be overcome by a single organization.
	Adoption of a watershed ethic	Total gallons of potable water used per capita per day watershed-wide	Helping conservation become a way of life in California involves education and civic action. As more people learn the true importance of a reliable and resilient water supply for the watershed, many of the challenges will be more easily overcome.

TABLE 2 (CONTINUED)
SELECTED INDICATORS FOR OWOW UPDATE GOALS

Goal	Indicators	Metric	Rationale
Improve data integration, tracking and reporting to strengthen decision-making	Broaden access to data for decision-making	Percent of watershed population in agencies whose residential customers receive relative performance information about their water use.	Everyone who uses water is a decision-maker. Informing people how they are using water relative to past and/or budgeted use will improve decisions, increase efficiency, and make us more resilient.
	Participation in an open data process	Percent of watershed population in agencies participating in establishment of a regional data sharing system	Our ability to create data is outstripping our ability to make effective use of it. Ensuring that data produced is meaningful, is applied to decision-making, and is shared freely without jeopardy is a critical next step for the management of the watershed's supply and demand.

NOTES:

[a] California Water Code Section 79505.5(a) defines a "disadvantaged community" as a community with annual median household income that is less than 80 percent of the statewide annual median household income. The Department of Water Resources (DWR) uses data from the U.S. Census Bureau American Community Survey to characterize areas (census tracts) throughout California where people would be considered as members of "disadvantaged communities" in accordance with the Water Code definition. Areas where people who would be considered members of disadvantaged communities as identified in the DWR data were considered less-resourced parts of the watershed community for purposes of this analysis. All other census tracts within the watershed were considered more-resourced parts of the community.

While it would be desirable to assess the indicators relative to defined conditions (i.e., numeric target or desired conditions), these have not been defined by the OWOW stakeholders. As cited above, the strategic approach taken for the OWOW Plan Update 2018 is for the indicators (through their associated quantitative metrics) to assess progress toward the stated goals of the OWOW Plan Update 2018. Quantitatively-defined target conditions must be developed through a collaborative process by the stakeholders. The OWOW stakeholders have intentionally not identified target conditions associated with OWOW goals and objectives, because the concept of sustainability is not well-suited to targets; instead, sustainability will be achieved through effective ongoing processes. While at this time the indicators are not evaluated relative to target conditions, the assessment indicators could be evaluated relative to target conditions in the future, if conditions are identified. Comparison of indicator values with target conditions is a feature that could be added to future OWOW assessments.

Approach to Evaluating Indicators/Metrics with Multiple Values

Some metrics rely on results at multiple locations and some indicators rely on multiple metrics. Both of these circumstances raise specific valuation questions.

In the instance of multiple locations, results could be assessed as a trend for each site, or results could be assessed as a trend for the collection of the locations as a whole (e.g., the trend in the average or median value). The assessment team decided to adopt a strategy of evaluating each location independently, and then combining the collection of individual location trends into a reported overall trend.

As an additional option for multiple locations, there is an opportunity to apply weighting, or modifying a result to better reflect its importance to the region. The assessment team elected to use weighting sparingly, as it was seen as a step that could obscure the self-explanatory nature of metric results.

Additionally, one indicator (surface water quality for contact recreation) relied on two metrics, one for coastal and one for inland water quality. In this case, it was necessary to combine the results of the two different analyses to address this indicator. This could have been done by weighting them differently, or not, or the assessment team could have simply shown the worst of the two scores. The assessment team chose to weight them the same and show a result that relied on both scores.

Use of Multi-Year Average Values for Trend Assessment

For some metrics, particularly those affected by hydrologic or other weather-related variability, it makes sense to assess trends on a longer-term basis than just one year to the next. For example, a trend might be measured between the value of a metric for the last five years relative to the value of the metric for the preceding ten years, or the value for the last year relative to the value of the metric for the preceding ten years. In most cases, such a long-term look at trends will not be possible in the current assessment, though it will likely become possible over time as the metric is assessed in subsequent years and data quality is improved. If not currently possible, the need for such a longer-term perspective should be acknowledged in reporting on the results of the assessment and putting those results in context.

Evolution of Trend Thresholds

Additionally, the trends thresholds (e.g., the values that demarcate the divide between a neutral and a positive trend) chosen for the purposes of the current assessment also likely need to evolve over time. Year-to-year variability that is not addressed by use of a multi-year average as described in the preceding paragraph may inform the selection of appropriate thresholds for identifying how positive a trend should be to be considered "positive," and the reverse for a negative trend. These thresholds can evolve over time and prior assessments re-analyzed to reflect the updated threshold values.

Evolution of Metrics and Indicators

Over time, it may become desirable to revise the assessment metrics and even the indicators themselves. New availability of data, or new analysis by others, may make it feasible to adopt and evaluate better indicators and metrics. As the OWOW Plan is implemented and assessments are completed, it may also become apparent that there is limited utility in reporting on a selected indicator or metric. For example, the focal issue related to a given indicator or metric may warrant a lower priority, or removal from the implementation of the Plan due to limited utility. In that case, a new, more useful indicator or metric may be adopted.

Approach to Presentation of Results

Because the OWOW Plan Update 2018 Sustainability Assessment is geared to providing readily-digestible feedback to stakeholders and decision-makers, the assessment team determined that results should be presented in a readily-digestible, graphic form. A summary table would provide a roll-up view at a glance on a single page, while short, one-page graphically-oriented sheets for each indicator could provide a slightly higher level of detail. Additional background on methodology, data sources, challenges, and recommendations for future consideration would be provided for each metric in a succinct format.

Selected Indicators and Metrics

This section presents each goal of the OWOW Plan Update 2018 and the indicators and metrics selected for them.

Goal 1. Achieve resilient water resources through innovation and optimization

This goal highlights the importance of establishing a water supply that is minimally affected by disruption, whether the result of natural disaster or periodic climatic or human-induced stress. The goal also recognizes that geographically-coordinated supply systems provide opportunity to develop more resilient supply and demand programs.

Major Factors Considered in Indicator Selection

Resilient water resources are the result of two factors: supply and demand. For the sustainability assessment, the assessment team sought to identify an indicator to address each of these two factors. In the Santa Ana River watershed, water supply uncertainty is significantly affected by the uncertainty and vulnerability associated with imported supplies. Locally, groundwater basins are relied on as both a water source and a storage mechanism for locally-generated stormwater, imported water, and recycled water. Thus, these locally-managed supplies are the most significant determinant of water supplies that are less vulnerable to disruption.

With respect to demand, typical classes of water use include municipal, industrial, commercial, agricultural, and residential, and include both indoor and outdoor water use. The greatest opportunity to reduce overall urban water demand in California typically lies in outdoor landscaping, particularly in regions with newer and expanding housing stock and warmer climates.

Thus, our supply-related indicator focus was on locally-managed supplies, while our demand-related indicator focused on outdoor water use.

Potential Indicators Considered

Previous indicator development efforts provided a starting point for potential indicators supporting this goal. Potential supply indicators generally assessed the reliability of water supplies (based on source water quality or volume of water available) or assessed how much water was locally-controlled. Demand-related indicators considered, included per capita consumption.

More indirect or specific indicators were also considered. Other indicators considered were associated with groundwater banking, years of sustainable yield in groundwater storage, and loss of recharge areas. While these types of indicators would be responsive to actions, other factors affect groundwater levels, and focusing on groundwater limited the indicator to only one source of water supply. In addition, some of these potential indicators would only be meaningful or measurable if additional infrastructure or data collection activities came into being (such as a more widespread adoption of formal groundwater banking systems, or adequate mapping of high recharge areas). Changes in demand assumptions would also affect this indicator, without any physical changes "on the ground." Production of recycled water was also considered as a potential indicator, but similarly limited the indicator to only one source of supply. The Sustainability Outlook indicator "Percent of water supplies derived from 303(d) listed impaired water bodies" was also considered but was not carried forward due to the focus only on surface water and its anticipated low responsiveness to local actions.

Indicators related to supplies under local control were considered more responsive to actions, and variations of local supply indicators had been evaluated in the previous OWOW Plan. The team considered an indirect measure of local control (local supply development and use compared to import supply development and use) as well as a more direct measure (percent of annual use derived from locally-managed supplies). The more direct measure was selected as one of the two indicators for this goal.

The second indicator selected for this goal was "Efficiency of outdoor water use." The team also considered a broader measure of outdoor water use generally; however, availability of a consistent and complete dataset was uncertain for this potential indicator. DWR is reportedly in the process of establishing a standard method for collecting outdoor water use data, but the method and data were not available at the time of indicator selection. The emerging availability of more accurate parcel-level landscaped area holds promise for developing targeted programs for outdoor water use management.

Selected Indicators and Metrics

As noted in Table 2, the following indicators and metrics were selected for this goal.

- ***Indicator*: **Maximization of locally-managed supplies
  - *Metric:* Percent of total annual supply sourced or managed locally
  - *Rationale:* Water that is stored or sourced locally is more reliable than water that must be imported and immediately used. Increasing supplies and storage in the region will make the region more resilient. Data collected by DWR is available to assess this metric, the data is responsive to local action, and the metric is not limited to one type of water supply.
- ***Indicator*: **Efficiency of outdoor water use
  - *Metric:* Percent of watershed population in agencies using parcel-level data to assess outdoor water use
  - *Rationale:* Implementing innovative technology and data management can increase irrigation efficiency and help make landscapes less irrigation dependent. Landscape irrigation is the single largest use of water in the watershed and improving its efficiency will significantly increase watershed resilience. Outdoor water use has historically been difficult to measure and therefore difficult to manage for efficiency

Goal 2. Ensure high quality water for all people and the environment

The quality of water is key to its usefulness to both people and the ecosystems that rely on it.

Major Factors Considered in Indicator Selection

Potential indicators of both groundwater quality and surface water quality were considered for this goal. For the sustainability assessment, the assessment team sought to identify an indicator to address each of these two aspects of water quality. In the Santa Ana River watershed, groundwater quality is particularly important to water supply for human use, as groundwater basins are a major source of storage and supply. Surface water quality, on the other hand, is relevant to water supply for groundwater recharge, the ability to support ecosystem uses, and safety for contact recreation.

Potential Indicators Considered

The potential major concerns with respect to groundwater quality for human use in the Santa Ana River watershed are salinity and nitrates. While the presence of nitrate in groundwater poses a greater hazard to public health, agricultural land uses contributing to nitrate loading have declined over the past decades as urban areas have expanded, and so salinity is the relatively more prominent groundwater concern at present and will remain so into the future. Thus, salinity was identified as the groundwater constituent of greatest concern. Groundwater salinity objectives are a major feature of water quality management within the Basin Plan developed and administered by the Santa Ana Regional Water Quality Control Board. An indicator based on the Basin Plan's water quality objective for groundwater salinity was determined to be appropriate. A potential indicator from assessment systems reviewed, the "presence of assimilative capacity," or the ability of the groundwater basin to accept more salt (e.g., from recycled water infiltrated into storage) without compromising the beneficial use of groundwater in storage, was selected as the groundwater quality indicator. If a groundwater basin is at or below the salinity water quality standard, it is assumed to be operating for maximum benefit with regard to salinity. An increase or decrease in salinity is not considered problematic unless it exceeds the groundwater salinity standard.

The potential indicators of surface water quality were more varied. The ideal indicator would assess whether a decline in water quality (increased salts and/or other constituents) from the Santa Ana River headwaters to the mouth is present; this, however, proved difficult to define without additional data collection and extensive analysis to select appropriate measurement locations. The incoming raw water salinity at water treatment plants was also considered as an indicator but was not ultimately selected because water treatment plants in the area treat groundwater in addition to surface water. Another potential indicator, from other indicator efforts, measured surface water quality based on the number of contact exposure warnings issued for harmful algae and bacteria (rivers, lakes, and coastal). None of these indicators were a good fit given the criteria calling for ease of implementation.

Given that it made sense to focus the groundwater quality indicator on water supply for human use, especially direct consumption, the assessment team chose to focus the surface water quality indicator on something other than human consumption.

The selected indicator for surface water quality was based on the availability of ongoing water quality monitoring data on suitability for contact recreation, which indirectly addresses its health for ecosystem uses as well. Both a routinely analyzed extensive coastal water quality suitability for contact recreation dataset was available, as well as a less extensive but targeted inland dataset that focused on locations with the highest potential for human contact recreation, also routinely analyzed.

Selected Indicators and Rationale

As noted in Table 2, the following indicators and metrics were selected for this goal.

- ***Indicator*:** Maintenance of groundwater salinity at or below target levels
  - *Metric:* Non-exceedance of groundwater salinity standards
  - *Rationale:* Groundwater basins are the watershed's most important local water storage tool, and salinity levels are a primary consideration for maintaining a high-quality water supply and getting the greatest benefit from the aquifer storage capacity.

- ***Indicator*:** Safety of water for contact recreation
  - *Metric:* Percentage of monitored sites where recreational use is likely identified as high risk due to bacterial contamination
  - *Rationale:* Bathers in our streams, lakes, and coastal waters must not be exposed to undue health hazards from water quality impairment caused by bacterial contamination.

Goal 3. Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function

Major Factors Considered in Indicator Selection

For this goal, the assessment team felt that one of the two indicators should be focused on lands that were explicitly protected for recreation, open space, or habitat, most of which will also help to preserve natural hydrologic function. The other indicator could then broadly evaluate the quantity of some portion of these land use types that are not necessarily specifically protected for such uses, or a measure of natural hydrologic function.

Potential Indicators Considered

The potential indicators of change in the quantity of qualifying protected lands included “change in acreage of protected natural lands,” “change in acreage of certain land cover types in the National Land Cover Database,” and “the number of projects implemented or being implemented” from a local land use plan, the Santa Ana River Parkway and Open Space Plan. What separated these potential indicators from the selected indicator was mainly data availability. Identifying which lands are “protected” natural lands, or which lands are “natural” instead of agricultural, based on satellite or other land use data sources (such as local zoning, Williamson Act information, or the National Land Cover Database) was not a straightforward task and would require additional data collection and processing to be sufficiently meaningful. Regarding the Santa Ana River Parkway and Open Space Plan projects, this potential indicator may initially increase but then ultimately decline over time as projects are completed; in addition, it was not clear whether focusing on the geography of the Parkway Plan alone would be sufficient to assess progress in the watershed as a whole. Thus, the assessment team elected to rely on an existing database of protected lands, which is updated every 1-3 years by a non-governmental organization.

The assessment team reviewed the relevant indicators developed by others that might be suitable for measuring either qualifying land use types that were not necessarily protected or the degree of natural hydrologic function. Other indicator efforts had focused on degree of aquatic fragmentation to measure the hydrologic function of a stream; this potential indicator was not carried forward because it would require significant effort to implement and was not as holistic as other potential indicators. Change in impervious cover was also considered for this goal but was not ultimately selected because the availability of effective imperviousness (that is, after accounting for low impact development measures) data was uncertain. In addition, given the widespread adoption of low impact development requirements or incentives into local ordinances, the problem posed by the lack of effective imperviousness data would likely be significant, making a measure of imperviousness likely not a very responsive indicator for this goal. The level of investment allocated to, or acreage of, aquatic habitats restored or conserved was a third potential indicator considered; this too was ultimately not carried forward, given that the level of investment might increase initially but then decrease over time as the most readily-implemented restoration projects are completed.

Selected Indicators and Rationale

As noted in Table 2, the following indicators and metrics were selected for this goal.

- ***Indicator*****:** Abundance of vegetated riparian corridor
  - *Metric:* Area of vegetated riparian corridor
  - *Rationale:* Healthy and abundant vegetation within the riparian corridors of the watershed provides valuable habitat for a large number of species, including those with special status. It also provides beauty and shade for people recreating alongside streams and lakes. Recent development by the U.S. Forest Service of a tool using the annually-developed dataset relied on for the National Land Cover Database, surface topography, and stream gage data to calculate riparian vegetation made the assessment of this metric reasonably feasible.
- ***Indicator*****:** Abundance of conserved open space
  - *Metric:* Area of conserved open space
  - *Rationale:* Maintaining the values of recreational, habitat, and open space lands requires explicit management and deliberate protection. While the change in open space conservation data indicated by the database may be due partially to the additional input of existing protected lands data (reflecting the database "catching up" to on-the-ground conservation), this feature of the existing database is something that keepers of the database expect to address with the addition of a "date added" field. Additionally, stakeholders in the Santa Ana River watershed can work to improve the accuracy of the database over time. For the current assessment, the temporal disconnect was considered to be a non-fatal flaw.

Goal 4. Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed

This goal highlights the importance of reducing environmental injustices in the course of improving conditions throughout the Santa Ana River watershed as envisioned in the OWOW Plan.

Major Factors Considered in Indicator Selection

The first step in developing indicators for this goal was to consider potential environmental injustices in the watershed that had a nexus with watershed management. The OWOW Pillar on Environmental Justice issues had identified environmental injustices in a draft chapter of the OWOW Plan Update 2018 plan; this draft chapter, along with knowledge of environmental injustices in other areas of the state, informed the development of a short survey that was shared with OWOW Pillar stakeholders. The survey asked the stakeholders to rank the top four environmental injustices in the watershed, from a list of nine options. Based on survey results, the team focused on indicators related to access to clean water for human consumption and vulnerability to climate change.

Potential Indicators Considered

While homelessness in the watershed is an ongoing concern in the OWOW planning effort, it is an attribute of only a small portion of the population within the Santa Ana River watershed. Therefore, the assessment team decided not to focus either indicator being sought on the homeless.

For both indicators, in order to incorporate the environmental justice concept of "disproportionate effects," the team elected to assess the indicator/metric for census tracts identified as disadvantaged communities by the State and compare the value to the indicator/metric calculated for all other census tracts in the watershed.

The team considered the concept of "access to clean water" from multiple angles to explore the metrics that might be used to evaluate it and how it might influence the specific wording selected to represent the indicator. Access can be affected by the cost of water, so an indicator of water affordability was contemplated. The distribution of benefits from infrastructure investment was also considered as a potential indicator of access to clean water. Adequate existing datasets were not available for these two potential indicators, and defining the key terms (what qualifies as affordable, and what qualifies as an investment) proved challenging. Access could also conceivably be assessed by approximating the percent of the population served by sewer systems, or the change in the number of people who do not have access to clean water and sanitation. These two potential indicators were not carried forward because the outcomes for the Santa Ana River watershed would not likely change much year to year (the number of people who do not have access to clean water and sanitation, or access to sewer systems, is already very low). Another potential indicator considered was the CalEnviroScreen drinking water contaminants indicator. CalEnviroScreen is a tool developed by the California Office of Environmental Health and Hazard Assessment that uses a science-based method for evaluating multiple pollution sources in a community while accounting for a community's vulnerability to pollution's adverse effects. The drinking water contaminants indicator combines information about 13 contaminants and 2 types of water quality violations, generating an index value based on the average concentrations of the contaminants as well as the present of the water quality violations. An index value had been calculated for each census tract in California, and the technical approach had already undergone development. Further, the index is anticipated to continue to be updated every one to two years, and is more likely to be evaluated if it is being used, as in the OWOW assessment. On the basis of the availability of the CalEnviroScreen drinking water contaminants analysis for use as a metric, the broadly worded "access to clean water in disadvantaged communities" was selected as one indicator for this goal.

Multiple metrics were also considered with respect to the indicator that might generally represent "vulnerability to climate change," including: percent of the population residing within floodplains with equal to or greater than a one percent annual change of flooding; percent of public transportation infrastructure within floodplains with equal to or greater than a one percent annual change of flooding; and estimate of the heat island effect approximated by impervious area. While floodplain data was available, the two potential indicators that included floodplains were considered only moderately responsive to local actions, given that much of the region has already developed flood management interventions and flood risk is relatively modest. Heat island effect based on impervious area did not meet the selection criteria as well as another potential indicator also related to heat: change in tree and shrub density. SAWPA has developed a tree and shrub dataset for use in development of parcel-level water budgeting. To the extent that residential parcels in less-resourced parts of the community have lower tree and shrub density, this indicator can measure the equitable implementation of vegetation planting as a climate change adaptation strategy. Because tree and shrub density is broadly representative of vulnerability to climate change stresses, and this dataset has a high likelihood of being routinely updated by SAWPA in the future to serve multiple purposes, the second selected indicator was "proportionate implementation of climate change adaptation strategies."

Selected Indicators and Metrics

As noted in Table 2, the following indicators and metrics were selected for this goal.

- ***Indicator*:** Equitable access to clean drinking water
  - *Metric:* Relative value of the drinking water contaminant index from CalEnviroScreen in less resourced parts of the community and more resourced parts of the community
  - *Rationale:* Ensuring that all people in the watershed have clean drinking water is essential to human health and prosperity within the watershed. The drinking water contaminant index is evaluated at a meaningful level of detail for purposes of evaluating disproportionate effects, and data is anticipated to be updated regularly in the future. Water quality improvement efforts in the watershed are ongoing; this metric can help track progress on those effects as well.
- ***Indicator*:** Proportionate implementation of climate change adaptation strategies
  - *Metric:* Relative value of tree and shrub density in less resourced parts of the community and more resourced parts of the community
  - *Rationale:* Increased dangerous heat is predicted as a climate change impact in the watershed, and vulnerable people will be inequitably impacted. Tree and shrub density provides protective shade and does not absorb and reemit heat, reducing human exposure to heat. SAWPA already collects tree and shrub density data for populated areas in the watershed, and anticipates ongoing data collection. To the extent that residential parcels in less-resourced parts of the community have lower tree and shrub density, this indicator can measure the equitable implementation of vegetation planting as a climate change adaptation strategy.

Goal 5. Educate and build trust between people and organizations

The OWOW Plan can only be successful if it broadly engages stakeholders and organizations in the Santa Ana River watershed to act collaboratively in support of the Plan and its goals.

Major Factors Considered in Indicator Selection

Indicators of success in educating and building trust between people and organizations can focus on either process (e.g., educational actions taken, or engagement of numbers of people in certain activities) or on outcomes (e.g., what degree of understanding about watershed issues is evident among stakeholders). The assessment team determined that outcome-type indicators would be preferable, as they are more directly tied to the impactfulness of actions. For this goal, the assessment team decided to seek outcome-type indicators, one education-based and one trust-based.

Potential Indicators Considered

The team decided that outcome-based indicators would be more indicative of progress than process-based indicators, which focus more on what actions were taken, without regard for their effectiveness. For example, watershed stewardship indicators related to educational programs or outreach, and attendance at such programs, were considered for this goal. However, these potential indicators demonstrated the magnitude of management actions rather than their effectiveness. Identifying the number of educational programs quantifies the extent of educational opportunities provided but does not measure whether those programs are effective. Similarly, quantifying the number of attendees at such programs does not measure whether those attendees implement what they've learned. Thus, while both types of indicators were considered, a preference emerged for outcome-based indicators.

Generating an indicator of trust proved challenging. The team contemplated identifying the number of lawsuits or length of project delays due to public protest or controversy as indicators of trust within the watershed, though assembling such datasets appeared daunting and the fact that these metrics were already relatively low would make them unresponsive to actions. Also considered were indicators of collaboration such as the number of OWOW Plan projects being conducted with two or more participating entities, the number of SAWPA member agencies that regularly participate in collaboration meetings, and the percent of water quality compliance actions carried out in partnership in the watershed. Data availability limited the applicability of many of these potential indicators. Documentation of financial or in-kind contributions to water quality improvement projects (required by the RWQCB pursuant to Total Maximum Daily Load [TMDL] orders) was available, however, and while implementation is legally required, the fact that entities in the watershed are generally participating and have been doing so for multiple years is an outcome of collaboration, albeit under pressure.

For the education-based indicator, the assessment team considered what might be used to indicate educational success. An indicator of the extent to which a watershed ethic exists in the watershed—that is, to assess the extent to which water users in the watershed understand both the limitations and value of water—was considered. Accurately measuring knowledge (much less trust) is inherently difficult, even if a context for standard measurement (such as surveys or tests) is in place. However, the team concluded that water use itself demonstrates this understanding. Measuring water use in gallons per capita per day for residential water use and comparing to statewide or local water use targets was considered, but not carried forward due to the decision to assess trends instead of measuring against a target value (see Chapter 5). Given the data available, <u>total</u> water use for the entire Santa Ana River watershed in gallons per capita per day (as opposed to something more specific, like indoor residential water use) was selected for this indicator.

Selected Indicators and Rationale

As noted in Table 2, the following indicators and metrics were selected for this goal.

- ***Indicator*:** Collaboration for more effective outcomes
  - *Metric:* Percent of entities identified in Total Maximum Daily Load (TMDL) orders that are contributing financially or in-kind to implementation projects associated with the TMDL
  - *Rationale:* Many of the complex challenges facing the watershed cannot be overcome by a single organization, so collaborative action with shared outcomes must be prioritized. Contributions are a simple measure of the extent of participation in collaborative efforts to improve water quality in the watershed. Regular ongoing contributions to TMDL implementation activities reflect the presence of collaboration within the watershed.
- ***Indicator*:** Adoption of a watershed ethic
  - *Metric:* Total gallons of water used per capita per day watershed-wide
  - *Rationale:* Making conservation a way of life in California involves education and civic action. As more people learn the true importance of a reliable and resilient water supply for the watershed, many of the challenges will be more easily overcome. Total GPCD was also selected for this indicator because the data is available and the outcome is moderately responsive to actions.

Goal 6. Improve data integration, tracking and reporting to strengthen decision-making

This goal requires both the generation of data and its availability as well as its suitability to support decision-making.

Major Factors Considered in Indicator Selection

This goal clearly states that actions related to data management should support decision-making. With that in mind, the assessment team considered the scales of decision-making as well as the factors related to data sharing when developing these indicators.

Potential Indicators Considered

Indicators of support of decision-making at the water supplier, elected official, water manager, and customer levels were considered. Of these potential indicators, it was determined that decision-making data was most straightforward to assess at the customer level. The team considered tracking customer water usage decision-making as well as water loss, but ultimately focused on customer usage because this information is more readily available. The selected indicator focused on the provision of water use performance data to the customer . Broader versions of the selected indicator were also considered (such as including other customer classes instead of focusing on residential customers), but ultimately not chosen due to the desire to be inclusive of all possible versions of providing water use performance data in this first assessment.

Participation in data sharing through data repositories or clearinghouses was the other theme of potential indicators for this goal. Previous efforts to establish data sharing within the watershed proved problematic, as multiple entities felt their data was ultimately misinterpreted. For this reason, potential indicators related to local development or maintenance of a data repository were considered unlikely to change in the foreseeable future. However, with the California legislature's passage of the Open and Transparent Water Data Act (AB 1755), it was understood that a framework for such data sharing would be developed by the State. An indicator of participation in a data sharing system or open data process was therefore developed and adopted. The metric for this indicator is a two-step process. The first step assesses progress on establishment of a framework designed to build trust between agencies as well as trust in the functionality of data management systems. The second-step is assessing participation in the establishment of a regional data sharing system.

Selected Indicators

The following indicators and associated metrics were selected for this goal:

- ***Indicator*:** Broaden access to data for decision-making
  - *Metric:* Percent of watershed population in agencies whose residential customers receive relative performance information about their water use.
  - *Rationale:* Everyone who uses water is a decision-maker. Informing people how they are using water relative to past and/or budgeted use, will improve decisions, increase efficiency, and make us more resilient.
- ***Indicator*:** Participation in an open data process
  - *Metric:* Percent of watershed population in agencies participating in establishment of a regional data sharing system
  - *Rationale:* Our ability to create data is outstripping our ability to make effective use of it. Ensuring that data produced is meaningful, is applied to decision-making, and is shared freely without jeopardy is a critical next step for the management of the watershed's supply and demand.

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CHAPTER 5
Assessment Implementation

Once indicators and metrics were selected, the assessment was implemented for the OWOW Plan Update 2018. Implementation occurred in parallel with the development of the OWOW Plan with the goal of release of assessment results as part of the public draft of the OWOW Plan Update 2018 itself.

For each indicator and metric, the following general implementation steps were completed:

- **Data collection.** Data relevant to each indicator's metric were collected or collection of the data was attempted.
- **Data review**. Data available was reviewed for completeness and adequacy.
- **Data analysis and results.** Data for the most current conditions available and recent historic conditions, if available, were analyzed using the implementation steps described for each indicator in **Appendix C**
- **Scoring analysis and rating.** The rating was based on a trend analysis, comparing current conditions to recent historic conditions to determine if the metric is improving, worsening, or about the same. A scoring analysis was carried out using recent historic data, if available, or professional judgement if relevant historic data was not available (described herein as a "qualitative" analysis). The output was a score for the metric or metrics, which then yielded a rating (happy face for positive results, neutral face for neutral results, and sad face for negative results) to standardize the assessment output for ease of comparison among indicators. In some cases, data or information was not even sufficient to yield a qualitative positive, neutral, or negative rating. For the purpose of giving every indicator a rating of some sort, these "unrated" indicators were given a qualitative neutral rating.

Detailed implementation steps for each indicator's metric are included in Appendix C.

Analysis, scoring, and rating-related challenges were addressed during the assessment implementation. The approach to scoring and rating each metric was deferred to the implementation stage to allow that process to be informed by review of available data, findings, and consideration of the overall look and feel of the assessment products. This was a significant aspect of the assessment process and warrants further review by experts and stakeholders in the SAWPA region. Many metrics also included the need to determine the subset of available data that would be evaluated, and how. Most metrics involved decisions regarding the selection of the appropriate period to use for "recent historic conditions," which were compared to "current conditions" for the scoring analysis. Appendix C provides a detailed description of the implementation approach, which describes analysis, scoring, and rating decisions made for each metric.

Most metrics also had issues related to data availability and/or quality. Appendix C identifies specific data-related implementation challenges for each metric.

The following sections discuss some of the issues encountered in the process of conducting analyses, scoring, and rating a metric generally, as well as describing typical data challenges. This chapter also summarizes recommendations, which are based on lessons learned during implementation.

Analysis, Scoring, and Rating Challenges

Multiple decisions were required in order to complete the scoring analysis and rating steps of assessment implementation. These include selection of data; developing methods to combine data or combine metrics; and identifying approaches, thresholds, and baseline used to develop scores and ratings for each metric.

Data Selection

Often it was necessary to identify the specific data for analysis out of a larger dataset for the SAWPA region. For example, the environmental justice metric required selection of a method for separation of more- and less-resourced portions of the watershed. As another example, the decision was made to use only dry weather surface water quality data for the contact recreation metric, as that was the period in which the greatest amount of recreation was anticipated to occur, and it also provided a longer historic dataset.

Scoring Missing Data

In some cases, data was generally available to assess the metric, with a small subset of missing values. To avoid falsely inflating results, and to reinforce the message that missing data is not desirable, missing values in datasets were considered poor results. If enough data were missing such that a quantitative assessment would be misrepresentative, a qualitative assessment to generate the rating was performed instead. For example, when assessing the abundance of conserved open space, missing Williamson Act data for one county under current conditions was counted as a zero contribution to the total area. Similarly, when evaluating the coastal water quality indicator with respect to contact recreation, monitoring sites that lacked a grade were considered to have an “F,” or the worst possible score.

Scoring Analysis – Good/Bad Approach

Many of the metrics could be scored as having either an improving or worsening trend simply based on the values of the metric for current and recent historic conditions. But for some metrics, it is desirable for the scoring system to reflect the maintenance of “good” conditions as a positive trend (as opposed to continued improvement being considered the only positive trend). This approach was desirable for metrics that had an objectively “good” and “bad” condition (e.g., meeting a water quality objective) or could not reasonably be expected to continue to “improve” over time (e.g., if all permittees are already collaborating on implementing a TMDL, that number will not increase).

For metrics using this approach, ratings were established using a decision tree approach to evaluate the various combinations of recent historic and current conditions (such as a transition from "good to good," "good to bad," "bad to bad," as well as intermediate combinations such as "bad to appreciably less bad"). This approach is a special type of trend analysis, referred to in this assessment as the "good/bad approach" and shown in **Table 3**.

TABLE 3
EXAMPLE OF GOOD-BAD ASSESSMENT SYSTEM

Prior Conditions	Recent Conditions	Result
GOOD	GOOD	Positive
BAD	GOOD	Positive
BAD	BAD	Neutral (if appreciably better)
GOOD	BAD	Negative
BAD	BAD	Negative (if similar or worse)

Combining Multiple Metrics or Metrics for Multiple Sites

Metrics that relied on data from multiple sites and indicators relying on multiple metrics required combining results for the scoring and/or rating.

In several instances, data was available for specific locations (e.g., groundwater management zones or water quality monitoring sites). A decision was made to evaluate at the site scale and then combine the results to score the metric and produce a rating. For example, results from multiple groundwater management zones had to be combined to produce one score for groundwater quality in the region. Because groundwater quality data was available for both recent historic and current conditions, a scoring analysis was completed for each groundwater management zone. A method to combine the individual scores, each weighted based on estimated groundwater in storage in each zone, was then developed, and an overall rating identified.

In another instances, multiple datasets were analyzed as separate metrics and combined at the scoring analysis step to fully characterize one indicator. The Recreational Water Quality metric used two datasets in order to capture data from both coastal and inland areas. A method to combine the results of the two datasets into one meaningful rating was required. To generate a single score for the region, separate scores were produced for inland and coastal water quality. Separate ratings were established, and then combined using a decision tree, using equal weighting for both inland and coastal waters. In another example, a metrics analysis of data related to equitable access to drinking water was completed separately for the less-resourced parts of the community and more-resourced parts of the community.[27] The results of these analyses were then combined in order to assign a rating for the drinking water quality metric for the watershed as a

[27] Existing "disadvantaged community" data generated by DWR was used to define less-resourced parts of the community; for purposes of comparing all other parts of the community that were considered more-resourced.

whole. A decision tree approach was used to combine the two results and produce a rating for each of these metrics (discussed in greater detail in Attachment A of Appendix C).

Selecting Thresholds for Use in Scoring Analysis

Thresholds for what qualifies as a positive or negative change in a given metric had to be established individually for each metric. In some cases, the thresholds selected were absolute values (for example, a reduction in conserved open space of 1,000 acres was considered a negative change); in other cases, they were based on a percentage change (for example, if the metric value increased by greater than 5%, the change was considered to indicate a positive trend). Thresholds were selected based on expert judgment or known or apparent variability in the data but were inherently a subjective choice.

Selecting a Recent Historic Baseline

Like the selection of thresholds, the selection of recent historic conditions are meant to serve as a baseline for comparison varied by metric. The recent historic baseline was used in a trend (or good/bad scoring) analysis to compare the current with recent historic conditions.

To score the metrics based on a trend (instead of scoring in comparison to target conditions, as discussed in Chapter 4), a value for the metric under recent historic conditions was required. Historic data was available for some metrics, allowing a quantitative assessment. In some cases, the baseline, or recent historic, conditions were identified using the prior year's data. For metrics that varied significantly over time due to hydrologic variability, or changes in measurement methods, or other types of variability, an average over multiple years was selected as the baseline for comparison. The length of the period used for multi-year averaging was often limited by data availability.

Use of Qualitative Assessment

A qualitative assessment was used to generate a rating for an indicator where quantitative assessment was not possible. This largely occurred when some current data, but no recent historic data, was available to establish a recent historic baseline. Expert judgement based on available information was then used to give a rating. Based on best professional judgement, a qualitative neutral rating was given to multiple indicators due to incomplete current data or lack of baseline data and information.

Data Challenges

Three types of data challenges were encountered during assessment implementation. Data availability and data quality required the assessment team to decide whether the metric could be fully scored during this implementation. In addition, some data were available and of sufficient quality, but collected less often than annually—for example, once every three years instead of each year—which limited the ability to assess both current conditions and annual trends. Each of these challenges are further discussed below.

Data Availability

Data access or availability limited the ability to assess the metrics in some cases. Some of the data sought were known to be obtainable but were not obtainable for the current assessment due to time constraints or because they are not regularly compiled in the region. In response, either proxy data was collected or surveys were undertaken to compile the data.[28]

In multiple cases, recent historic data did not exist. In these cases, a quantitative trend could not be assessed. As discussed above, a qualitative evaluation of the trend was completed instead for these metrics. In other cases, the compilation of the desired data would be too time-consuming within the implementation timeframe of this assessment due to the need to collect data from specific individuals at water supplier or regulatory entities; for these metrics, a simplified version of the data was collected.

In one case (participation in an open data process), no data exists because an open data process has not yet been established in the region. The metric was nonetheless maintained in the assessment because it is closely tied to the OWOW Plan Update 2018 goals and because an open data process is expected to exist in the future.

Data Quality

In other cases, data was available, but assessment implementation was hindered by inconsistent data quality or incomplete datasets, as described below.

Inconsistent Data

In some cases, the Public Water System Statistics (PWSS) and State Water Resources Control Board (SWRCB) Drinking Water Program data used to assess multiple metrics was not internally consistent, was clearly inaccurate, or was reported in units that differed from the expected units (for example, the sum of reported monthly totals did not equal the reported annual total). In addition, the SWRCB data collection system does not provide enough guidance for the retailers to report their supply sources in a consistent manner, resulting in accounting of supply that differs from what is reported in the Urban Water Management Plans. Another example occurred in the effort to assess data for gallons of water used per capita per day (GPCD) for the watershed. Approximately 10 percent of the records used to calculate the GPCD had a quality control issue requiring adjustment. In some cases, monthly data was unavailable for select retailers. Reported monthly totals and annual totals did not align. Some data values were clear outliers, potentially indicating inaccurate data entry. Units were also sometimes mismatched (for example, gallons entered into a column which should have been reported in acre-feet).

An additional factor associated with generation of inconsistent data from one period to another also exists. From time to time, changes in methodology for any given metric may trigger changes

[28] For example, instead of surveying retailers and the wholesalers in the watershed to assess whether they were using or had used any kind of parcel-level data to quantify landscape water use and measures to improve its efficiency, the number of retailers and wholesalers who had procured parcel-level vegetation data from SAWPA was compiled to assess this metric.

in results from one year to the next that are not driven by changes in conditions. For example, the satellite imagery characteristics or interpretive methodology used to generate the land cover dataset used to assess vegetated riparian areas may change from time to time, creating results that may not be directly comparable to a historical baseline. This was the case for the data used to evaluate the land cover metric in the current dataset but did not appear to be so significant as to make quantitative data analysis meaningful. Instead, a multi-year average was used as a historical baseline, which addressed the effects of both interannual variability due to hydroclimate factors as well as minor changes in satellite imagery sources from year to year.

Incomplete Datasets

1. Some datasets were generally complete but were missing a subset of data entries. For example, in the groundwater quality datasets collected, some water quality estimates were missing. As discussed in greater detail in Appendix C, because the basins that lacked sufficient data were assumed to be less important sources of water supply, The metric-by-metric implementation details. These provide an overview of the assessment approach, any scoring and rating approach details, identification of data sources, detailed implementation steps, and a record of data-related implementation challenges.

Digital files used to produce assessment findings will be provided to SAWPA for their files and future use in repeating the assessment.

Assessment Findings Overview

As shown in Appendix C, the assessment was carried out for 12 different indicator/metric pairs, two for each of the six OWOW Plan Update 2018 goals. Six of the metrics (associated with three of the goals) were given qualitative ratings. Two of these had only one data point, but trends were assessed qualitatively to produce ratings. Four had inadequate data overall; the rating was simply shown as a qualitative neutral result. The remaining six metrics were evaluated quantitatively; all six were rated as showing a positive condition.

Because the ratings shown are entirely driven by the ratings criteria developed for each metric, further consideration and discussion of the ratings criteria by the SAWPA stakeholders is appropriate. Ultimately, the purpose of the assessment is to provide appropriate feedback to the stakeholders of the SAWPA region on their success in making progress towards OWOW Plan goals. It may be desirable to have more conservative ratings criteria for some or all the goals to better reflect the sense of the stakeholders as to what constitutes an acceptable level of progress (i.e., a positive rating) towards achieving them.

Recommendations for Future Assessments

The following recommendations are made based on lessons learned during implementation.

Data Collection Recommendations

Cooperative efforts between the watershed's water supply and management agencies, in concert with State and local agencies to whom data is reported, would improve data availability for future assessments, for example in producing improved-quality data about local supplies. The region could also look for opportunities to help stimulate the establishment of a trust framework and a federated data sharing system for the watershed by encouraging the watershed's water supply retailers to engage with DWR's PWSS survey and the SWRCB's Large Water System Drinking Water Program Electronic Annual Report (SWRCB EAR) about the water supply and demand data those reports require, to ensure that it is more usable for both State and regional planning efforts. Another opportunity may be developing a constituency for an AB 1755 use case in the watershed. DWR may also want to participate in further development of the USFS tool used to identify riparian corridors, for example.

Other recommendations regarding data collection could be implemented locally. In some cases, SAWPA may want to conduct surveys of entities within the watershed, as the compilation of these data by other agencies does not appear to be forthcoming or is not required for regulatory compliance. A more complete assessment of the watershed's use of parcel-level data, by surveying retailers and wholesalers in the watershed, is recommended. Surveying TMDL permittees about projects implemented in partnership annually is another example of data that currently is not compiled by a single entity in the watershed. The next assessment of retailers about the relative water use information provided to customers should be conducted as a survey.

A few arenas may warrant other types of action besides surveys to improve the data available in the future for the metrics used in the current assessment. Conserved open space data relied on voluntary additions to a database, which were known to be incomplete. Addition of relevant easement and open space lands data within the SAWPA region, including the dates of implementation, would significantly improve the quality of those datasets for analysis development purposes. Collaboration among regional stakeholders may be necessary to accomplish such an enhancement. With regard to groundwater quality data, it may be possible for SAWPA or another stakeholder to obtain information prior to the publication of the supporting analysis for the triennial review sufficient to perform analysis of this metric more often than once every three years—provided it is determined prudent to perform an assessment based on pre-publication data.

Data Review and Analysis Recommendations

Implementation of the current assessment identified data verification steps that could improve data quality in future implementations. For example, a validation step not taken with this implementation of GPCD, but potentially valuable in future implementations, would be to compare the values from the PWSS or SWRCB EAR data to the values reported in the Urban Water Management Plans of relevant agencies.

In some cases, analysis approaches were guided by hypotheses or assumptions were made based on expert judgment informed by review of available data (for example, the hypothesis that inland dry season water quality is not significantly affected by hydrologic variability). Evaluation based on the availability of additional data or insight from additional expert review in the future could confirm or disprove these working assumptions or hypotheses.

Assessment Structure Recommendations

Additionally, future assessments are anticipated to evolve over time and this consideration should be built into each subsequent assessment undertaken. The scrutiny applied with each successive iteration of the assessment process will help to continue to tune the OWOW Plan Assessment. Future assessments could consider alternative approaches to scoring analysis of the metric results, including both methodologies and thresholds. Additionally, it is entirely likely that, in the future, an indicator or metric that is part of the assessment currently will be replaced as better metrics or indicators become available. Reasons for such a replacement include the following: a decrease in its perceived importance; recognition that an alternative metric or analysis approach, including scoring, would be more appropriate or provide greater value for a given indicator; a change in the selection of its associated indicator, possibly due to evolving OWOW Plan goals or conditions; or a change in dataset availability or other changes in conditions.

CHAPTER 6
A View Toward the Future

The OWOW Plan Update 2018's Sustainability Assessment, conducted as a pilot project for the California Water Plan Update 2018's Sustainability Outlook, was driven by the goals identified in the OWOW Plan Update 2018. This focus on regional shared goals was selected to support decision-making in the Santa Ana River watershed. In specifically focusing on indicators that are responsive to management actions within shorter time frames, the Sustainability Assessment is dominated by metrics that are a degree removed from underlying watershed conditions. As such, the Sustainability Assessment is similar to, but different than, the Sustainability Outlook described in the California Water Plan Update 2018, which represents a broad survey of conditions that serve as indicators of the outlook for sustainability. This difference provides a real opportunity to leverage the value of each of these tools. The concept described below was a part of how the Sustainability Assessment was envisioned by SAWPA and the OWOW stakeholders.

SAWPA encouraged an approach that focused on understanding the challenges faced in the management of water for sustainability *and* understanding the effectiveness of the decisions made to overcome those challenges. The OWOW Sustainability Assessment serves the latter role, by focusing on management responses to regional conditions, thereby supporting regional decision-making. SAWPA believes the Sustainability Outlook can serve the former role, by describing the broad challenges, or stresses, faced by regions. Regions can select from that common set of indicators those most relevant to their particular context to help inform their planning.

The California Water Plan Update 2018's Sustainability Outlook was envisioned during Plan development as a tool for the regions to implement to support integrated regional planning, using a subset of the proposed indicators as appropriate to their region. Many of the Outlook's indicators are based on data that is being collected by State agencies. For those indicators, the State is well-positioned to both (a) refine data collection approaches so as to yield quality data to serve the purposes of the Sustainability Outlook, and (b) evaluate a subset of sustainability indicators that have common utility in many parts of the state. The regions could review the evaluations and assign meaning to the results based on their regional perspectives.

Coupling State and regional efforts for sustainability assessment is worth consideration. If the State were to invest in conducting the evaluation of some or all of the Sustainability Outlook indicators statewide, using established protocols, the evaluation of those indicators would be implemented consistently and more efficiently than if their evaluation were conducted independently by each watershed or region. Watershed-scale input to identify the key regional drivers could also help the State interpret the Sustainability Outlook results at that watershed or regional scale. And regions, using the Sustainability Outlook results as a partial or complete assessment of watershed conditions relevant to sustainability, can develop plans informed by that data. Regions can supplement State-evaluated indicators as appropriate with regionally-developed indicators, both for assessing the outlook for sustainability and to evaluate the effectiveness of their management responses.

This dual-scale approach would align responsibilities with interests, support efficient sustainability assessment at both the regional and statewide scales, and support the overall goals of the State in promoting actions to achieve water management for sustainability.

CHAPTER 7
Report Preparers

This white paper was a collaborative effort, prepared by individuals from multiple organizations and advised by California Department of Water Resources staff. The individuals who performed the assessment, advised in the development of the white paper, and/or helped prepare this white paper are listed below, along with each individual's affiliation.

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- James Songco, Environmental Science Associates
- Peter Vorster, The Bay Institute
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Appendix A

Findings Technical Memorandum for Santa Ana River Pilot Phase 1

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memorandum

date January 30, 2018

to Mike Antos, SAWPA

cc Lew Moeller, DWR; Tom Filler, DWR

from Peter Vorster, TBI; Betty Andrews, ESA

subject Findings Technical Memorandum for Santa Ana River Pilot Phase 1

This memo reviews previous indicator-based assessment frameworks to accomplish two goals. First, it seeks to support the Santa River Watershed Project Authority (SAWPA) efforts to develop a framework to assess status and progress towards goals (outcomes) that local stakeholders developed as part of the One Water One Watershed (OWOW) Update 2018 planning process "to support improved sustainability, resilience, and quality of life throughout the Santa Ana River Watershed through 2040." Secondly, the memo evaluates alignment of the OWOW Plan Update 2018 with the California Water Plan 2018 Sustainability Outlook.
The five indicator-based assessment framework efforts listed below are reviewed. Key findings relevant to the development of an assessment framework for OWOW Plan Update 2018 are summarized below this initial list of indicator-based assessment frameworks[1].

1. **California Water Sustainability Indicators Framework (SIF)** developed as part of the California Water Plan Update 2013 by UC Davis-led team. This framework will be referred to as the **CWP SIF**.

[1] The following indicator-based assessment frameworks were developed over the past 15 years for watersheds in California but are not reviewed in this memo. They are listed because they share some common characteristics with some of the reviewed frameworks and are relevant to the development of watershed-based frameworks. will be noted in the memo recommendations and conclusions. These include:
1. The Bay Institute: San Francisco Bay Index, Ecological Scorecards, 2003 and updated in 2005
2. North Bay Watershed Association (NBWA), Indicators and Performance Measures for North Bay Watersheds, 2010
3. Napa Watershed Assessment and Scorecard 2010
4. Sonoma Creek Watershed Health Scorecard 2010
5. San Francisco Estuary Partnership (SFEP), State of the Bay, 2011 and State of the Estuary, 2015

2. **Assessment of the Health of Santa Ana River Watershed** developed for the SAWPA OWOW Plan 2.0 and published as Appendix A in the Plan. This will be referred as the **OWOW 2.0 framework** and the findings will be combined with the CWP SIF review, as this framework relied heavily on the CWP SIF.
3. **California Water Plan Update 2018 Sustainability Outlook (Outlook 2018)** as described in the draft Chapter 2 and its appendix. The review is based upon December drafts of each document.
4. **Water Management Effectiveness Framework (WMEF)** contained in Chapter 3 of Appendix I of the DWR Outcome-Based Approach to Flood and Water Management, November 2016 (Preview Draft). For the purposes of this review, relevant findings for the Outlook 2018 and the WMEF will be combined, as this framework relied heavily on the Outlook 2018.
5. **The Sustainable Water Management (SWM) Profile (SWM Profile)** developed by the Water Foundation in the 2012-2017 period.

CWP SIF and OWOW 2.0

The CWP SIF was developed as part of the California Water Plan Update 2013 by a team led by Fraser Shilling of UC Davis; the SIF publications are in Volume 4 of the CWP 2013, available at: http://www.water.ca.gov/waterplan/cwpu2013/final/vol4/index.cfm and on the UC Davis website at https://indicators.ucdavis.edu/water/assessments.

This framework was pilot-tested at the scale of California and in the Santa Ana River Watershed to test its effectiveness. For the Santa Ana River Pilot, the goals, objectives (see Table 1, below), and indicators (see Table 2, below) were chosen and defined as part of the OWOW Plan 2.0 process in partnership with the Council for Watershed Health. The results are published in Appendix A of OWOW 2.0 as "Assessment of the Health of Santa Ana River Watershed."

Relevant Findings

Characteristics

1. It is centered on two principles:

    a. stakeholders can provide the policy and technical framing for sustainability vision, goals, and objectives necessary to choosing indicators, and

    b. indicators and reference points are the necessary tools for measuring progress toward sustainability.

2. A number of the indicators developed for this framework are used in the CWP 2018 Outlook, particularly basic ecosystem and water quality indicators.

Application

1. It was devised as a watershed health assessment for understanding the performance of integrated water management in the watershed.

2. It used existing watershed management goals in the assessment. The watershed management goals helped drive selection of indicators and metrics.

3. Most of the indicators selected for OWOW 2.0 were directly related to water supply and quality. There were fewer indicators selected that reflected social well-being and economy.

4. It used "distance to target" as the basis for describing the condition or state of each indicator. The process identified a range from best case ("wanted" condition) to worst case ("unwanted" condition) for the indicators, which are then described as existing somewhere in that range.

5. Data availability prevented calculation of a numeric evaluation for 7 out of the 18 indicators that could be assessed at the time. (There was an additional forward-looking indicator on sea-level rise and an indicator on cost-effectiveness of management that could not be developed

6. It actively encouraged stakeholders to participate in the creation of the assessment. However, despite a high level of engagement, a number of issues arose related to stakeholder inclusion, particularly disadvantaged communities, as well as in the selection and evaluation of indicators. As a result, the assessment did not engender much feedback from the stakeholders, and may indicate more buy-in is needed from the stakeholders on carrying out an indicator-based assessment.

Observations

1. Comparing indicator condition against reference values, or targets, is a critical requirement to inform condition assessments. These targets could be based on historical conditions, desired future conditions, legal thresholds, current or anticipated physical limits, or some other value. These targets provide the context for interpreting indicator results — a number against which current status and trends can be compared.

2. Indicators that respond relatively quickly to management intervention and can effectively be used to measure change over time may be preferable to those that require data over long periods of time to observe changes due to management actions. The ability to report on trends over time is a key function of an indicator.

3. Indicators can be organized by domains[2] and by goals and objectives for natural and human systems.

4. Consideration should be given to keep consistency in some of the indicators used so that trends over time can be meaningfully assessed.

The goals and objectives and the selected indicators for the OWOW Plan Update 2018 assessment are provided at the end of this memo.

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[2] *Water sustainability domains*, as used in the CWP SIF, refer to the components of the natural and artificial water system. Domains are also used to organize indicators so that the combined scores of indicators within a domain can be used to understand specific areas of concern (e.g., water quality).

Outlook 2018 and WMEF

The Outlook is described in the CWP Update 2018 Chapter 2 and its appendix, and the vision for its application at the watershed level is described in Chapter 3.

Relevant Findings

Characteristics

1. The process to develop the Outlook 2018 indicators involved establishing definitions for sustainability in the context of the four societal values, creating a framework for linking the values with the outcomes and those outcomes with the indicators, and developing a compilation of desired outcomes, indicators and metrics for those values using existing information.
2. The Outlook 2018 developed 44 basic and watershed indicators, seven advanced or future indicators, and archived 40 indicators (archived most commonly due to lack of access to viable data, overlap with other indicators, or a determination that the indicator was not representative of the intended outcome).
3. The screening criteria for indicator selection in the Chapter 2 appendix includes "Supportive of Decision-making," noting that the indicators need to be "simple to understand and easy to communicate" to stakeholders and decision-makers. The document also notes that indicators should be "applicable in a short-term and usable in a long-term time frame for the ability to report on changes due to management actions" and "have the ability to report on trends over time."
4. The Chapter 2 appendix defines targets for many, but not all, the 44 indicators. The desirable targets are mostly defined by aspirational, but generally unrealistic, goals of full legal compliance or complete elimination of stress (such as receiving full allocation of Federal and State water supply in every year). No guidance is provided on establishing reference conditions or benchmarks for undesirable conditions.
5. The Societal Values indicate what society expects and values from water management in California. They are derived from the DWR Outcome-Based Approach to Flood and Water Management, November 2016 (Preview Draft) and described in greater detail in Chapter 3.
6. The WMEF is based upon the proposition that an outcome-driven approach is needed to improve the effectiveness of water management—an approach that balances societal goals across river basins, tracks results toward these outcomes over the years, and adapts over time to meet the changing needs of California. The WMEF establishes four Levels of Outcomes: Level 4 - Sustainability; Level 3 - Resource and Societal Conditions; Level 2 - Physical Assets and Behaviors; Level 1 - Enabling Conditions[3].

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[3] **Sustainability (Level 4)** – Outcomes at this level are defined and tracked to assess whether societal goals are being fulfilled in a way that results in a politically acceptable, resilient, dynamic balance between the four societal goals that could reasonably be maintained over time. Sustainability (the dynamic balance between the four societal goals, also known as Level 4 outcomes) is the ultimate goal of implementing the Framework.

Resource and Societal Conditions (Level 3) – Outcomes at this level are tangible changes to the natural resource and societal conditions important for long-term sustainability. Level 3 outcomes include changes in observable conditions over time such as the following: fish or other species population, land subsidence rates, agricultural revenues, groundwater levels, water reliability, and flood damages. Many Level 1 and 2 outcomes affect these Level 3 outcomes.

Physical Assets and Behaviors (Level 2) Outcomes at this level include items such as physical water management assets, O&M of systems, water use, and performance tracking. Level 2 outcomes also include investment decisions (e.g.,

7. The 44 indicators in Outlook 2018 are geared to inform the Level 4 and Level 3 outcomes.

Application

Application of Outlook 2018 and WEMF has not yet been carried out.

Observations

1. Linking societal values to outcomes, and outcomes to indicators, provides a clear pathway from indicators to societal values.
2. Providing guidance on establishing reference conditions or benchmarks for undesirable conditions may be useful.
3. Providing guidance on trend analysis to determine if progress or reversion is occurring and to help evaluate current status in an understandable manner for decision-makers may be useful.
4. The WMEF found that "Outcomes at Level 1 provide the foundation for outcomes at the other levels. When intended outcomes at Level 1 are not achieved, or when unintended outcomes occur at Level 1, they can inhibit accomplishing higher level intended outcomes." Currently Outlook 2018 does not provide any indicators to inform enabling management and governance conditions or Level 1 outcomes, but these could be added.
5. Chapter 3 in Update 2018 envisions that "DWR will engage regional stakeholders in developing and maintaining Regional Sustainability Outlooks (Outlooks) to provide a regional-scale snapshot and evaluation of the metrics or indicators demonstrating movement toward sustainability." The Regional Outlooks could encompass Level 1 and Level 2 Outcomes, as the draft Update 2018 states that they should "include an assessment of the efficacy of governance, regulations, and funding of water resource management activities statewide and for individual regions."

Sustainable Water Management (SWM) Profile

In 2012, the Water Foundation initiated the development of tool in the form an assessment framework to evaluate both water stress conditions as well as progress towards sustainable water management. In July 2014 a pilot project was launched with Sonoma County Water Agency to develop and test the SWM Profile. After the pilot's conclusion in January 2015, the Water Foundation conducted an outreach effort to engage a wide variety of

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appropriation of funding to improve stormwater quality in a particular watershed), changes in the way natural resources are used (e.g., reduction in urban water use), changes in the way physical infrastructure and landscapes are maintained or modified (e.g., completion of improvements to levees that offer flood risk reduction), and changes to social structures or interactions (e.g., improved alignment between agencies).

Enabling Conditions (Level 1) Enabling conditions include items such as mutual agreement on clear goals and objectives, written agreements between public agencies, authorization for funding, clear decision-making processes, necessary policies in place, institutional capacity (skilled people, funding, and technical resources) within public agencies to do the work, and a robust program to monitor and report progress so that strategies can be adapted to continually improve system performance over time.

(Excerpted from Chapter 3 of the Preview Draft of the DWR Outcome-Based Approach to Flood and Water Management, November 2016.)

stakeholders, including representatives from water agencies, the business and financial sector, state and federal government, NGOs, and academia, to get feedback on the SWM Profile. After modifying the SWM Profile based on feedback from the pilot test and outreach effort, the Water Foundation implemented a pilot with Inland Empire Utilities Agency in Southern California in 2016

The SWM Profile assesses how a water supply agency is performing by examining the water supplies it directly or indirectly relies upon. Using simple metrics, the SWM Profile identifies the vulnerability of water systems to key stressors (also known as risks or threats). The SWM Profile evaluates management responses to these stressors by the water agency and the broader region. Utilizing a points-based system, the SWM Profile determines where an agency and its larger region currently stand on the path to sustainability.

Relevant Findings

Characteristics

1. The SWM Profile assesses pre-determined Stressors or vulnerabilities to sustainable water management, such as Supply Reliability, Demand, Watershed Health (similar to "domains" identified in CWP SIF), organized by four themes: Environment, Supply, Demand, and Finance. The Profile calculates a Stress Level for each Stressor, based on evaluating one or more metrics against scoring thresholds. Several of the metrics used are similar to Outlook 2018 and OWOW 2.0 indicators.
2. The metric evaluation categorizes the Stress Level as High, Moderate, or Low based upon numerical thresholds. The thresholds are largely based upon state, federal or local regulatory objectives and professional judgment.
3. SWM developed a management response continuum or "Maturity Model," describing a range of response levels from Initial Steps to Leading Practice for each stressor based upon pre-determined evaluation criteria.
4. SWM evaluated actions by the individual agency (the Profile Subject), and actions outside the agency but within the Region of Interest defined by SWM. The evaluation of actions outside of the physical watershed boundary or an agency's control that may directly affect sustainable watershed management (e.g., import supply reliability).

Application

1. A few metrics for which data was thought to be readily available could not be scored as originally conceived.

Potentially Useful Features

1. Metric thresholds could incorporate targets established by agency and watershed plans for the stressor metrics.
2. Use of simple categories (e.g., High, Moderate, Low) may provide decision-makers a more understandable evaluation of the indicator or metric status. Scoring categories like these could help focus management actions on indicators with high stress levels to supplement the numerical scores based upon the axiomatic normalization of distance from targets in the OWOW 2.0 framework.
3. The SWM Profile's management response continuum can potentially be translated into indicators for enabling conditions as defined by the WMEF, the 2018 CWP chapter 3 vision for the Outlook, or watershed stakeholders.

4. The SWM Profile's assessment of actions at different actor levels, as well as its disaggregation of geographies may be useful for communicating results.

Summary Findings and Recommendations

Based upon the relevant findings from the analysis of the assessment frameworks developed over the last 5 years and the other frameworks applied at the watershed scale over the last 15 years in California, the following are overall findings and recommendations for the development of a sustainability assessment framework for the OWOW Plan Update 2018:

1. The new framework should build upon the OWOW 2.0 assessment using a combination of the condition indicators (see Table 1 below) and performance measures already developed, along with new condition indicators, as appropriate, to encompass the updated goals and objectives. If not already completed, a side-by side comparison ("crosswalk") of the old and new goals and objectives should be completed (see Table 1 and Attachment, respectively).
2. The goals and objectives from OWOW Update 2018 (see Attachment) should be crosswalked to the Outlook 2018 goals and outcomes.
3. The indicator selection should include a review of the 44 Basic and Watershed Sustainability Outlook 2018 indicators to determine relevancy to the watershed, using the indicator selection criteria presented in Outlook 2018, with additional criteria such as:
    a. ability to meaningfully detect change over time
    b. ability to accommodate some type of scoring system that may include reference and/or baseline conditions and/or thresholds for the wanted and unwanted conditions.
4. Consideration of a scoring system that builds upon or supplements the "distance to target" system used in OWOW 2.0 should be made, including ones that go beyond simple numeric scores including value statements such as "poor, fair, good."
5. The framework should evaluate translating and incorporating WMEF enabling conditions or the SWM management responses into indicators. Input from watershed stakeholders and others should be solicited to determine the criteria and/or thresholds for scoring these indicators.

Table 1. List of water sustainability goals and objectives for the OWOW 2.0 plan

Goal 1: Maintain reliable and resilient water supplies and reduce dependency on imported water	Objectives: increase use of rainfall as a resource, increase use of recycled water, decrease water demand, increase water-use efficiency, sustainably develop local water resources, maintain sufficient storage to overcome multi-year (3 year) drought over a ten-year hydrologic cycle, reduce green-house-gas emissions and energy consumption from water resource management.
Goal 2: Manage at the watershed scale for preservation and enhancement of the natural hydrology to benefit human and natural communities	Objectives: Preserve and restore hydrologic function of land, preserve and restore hydrogeomorphic function of streams and water bodies, safely co-manage flood protection and water conservation, include ecosystem function in new development planning and construction.
Goal 3: Preserve and enhance the ecosystem services provided by open space and habitat within the watershed	Objectives: Increase the capacity of open space to provide recreational opportunities without degrading its quality or increasing its consumption of water & energy; protect existing and restore native habitats; manage aquatic and riparian invasive species; protect estuarine and marine near-shore habitats; reduce ornamental irrigated landscapes; improve management support for landscaping that utilizes native vegetation ; protect endangered and threatened species and species of special concern through improved habitat.
Goal 4: Protect beneficial uses to ensure high quality water for human and natural communities	Objectives: Attain water quality standards in fresh and marine environments to meet designated beneficial uses; protect and improve source water quality; achieve and maintain salt balance in the watershed.
Goal 5: Accomplish effective, equitable and collaborative integrated watershed management in a cost-effective manner	Objectives: Improve regional integration and coordination; ensure high quality water for all users; balance quality of life and social, environmental and economic impacts when implementing projects; maintain quality of life; provide economically effective solutions; engage with disadvantaged communities to leverage capacity to effectively respond to their needs; engage with Native American tribes to leverage capacity to effectively respond to their needs; reduce conflict between water resources and protection of endangered species.

Table 2. List of indicators for OWOW 2.0

	Indicator Name
1	Proportion of Water Use from Imported and Recycled Sources
2	Water Use (per capita)
3	Local Water Supply Reserves
4	Adoption of Sustainable Water Rates
5	Water Availability and Stress (WRI Aqueduct 2.0)
6	Annual Water Resource Energy Use Relative to Rolling Average
7	Stream Network with Natural Substrate Benthos
8	Impervious Surface: Water Quality Index and Geomorphic Condition
9	Coastal Impacts from Sea Level Rise
10	Aquatic Habitat Fragmentation
11	Open Space for Recreation
12	Invasive Species and Native Landscapes
13	Area with Restoration Projects and Conservation Agreements
14	Exceedance of Water Quality Objectives in Watershed
15	Exceedance of Groundwater Salinity Standards
16	Exceedance of Water Quality Objectives at Discharge
17	Exceedance of Water Quality Objectives at Recreation Sites
18	Biological Condition Index
19	OWOW (Stakeholder-Community) Participation

ATTACHMENT

The One Water One Watershed (OWOW) Plan Update 2018 describes how collaborative watershed planning, water and land management, and project implementation supports improved sustainability, resilience, and quality of life throughout the Santa Ana River Watershed through 2040.

The six goals of the OWOW Plan Update 2018 are to…

1. Achieve resilient water resources through innovation and optimization.

Objectives:

- Increase the reuse of water
- Innovate to increase water-use efficiency, conservation and interregional transfers
- Manage precipitation as a valuable watershed resource
- Reduce carbon emissions from water resources management
- Safely strengthen links between flood protection, storm water management and water conservation
- Sustainably manage groundwater basins
- Plan for OWOW implementation beyond state grants

2. Ensure high quality water for all people and the environment.

Objectives:

- Achieve and maintain salt balance in the watershed
- Ensure every human being in the watershed has safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes
- Protect and improve source water quality
- Protect beneficial uses and attain water quality standards in freshwater and marine environments
- Reduce water systems vulnerability to climate impacts
- Support alignment of regulatory action with watershed goals

3. Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function.

Objectives:

- Conduct regional effort to remove and manage invasive species
- Preserve and restore beneficial hydrologic function of streams, arroyos, water bodies, and the coastal zone
- Protect and restore wildlife corridors and habitat connectivity
- Protect endangered and threatened species, and species of special concern
- Support healthy watershed policies with local land use authority

4. Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed.

Objectives:

- Adopt best-practices for environmental justice action throughout water management
- Analyze and confront unequal community vulnerabilities to climate impacts
- Ensure community voices help identify strengths and needs
- Strive to include community cultural values in watershed management decision-making
- Support broad-based collaboratives alleviating homelessness and its impact on the watershed

5. Educate and build trust between people and organizations.

Objectives:

- Adopt policies strengthening transparency in water management decision-making
- Collaborate with educators to broaden youth knowledge about water
- Develop strong ongoing consultation and partnership with Native American tribes
- Ensure conservation is a way of life in the Santa Ana River Watershed
- Innovate communication strategies for diverse communities
- Maintain and grow watershed and sub-watershed collaborative water management efforts

6. Improve data integration, tracking and reporting to strengthen decision-making.

Objectives:

- Apply new technologies to maintain and enhance transparency and efficiency
- Collaborate to produce regular publicly-accessible watershed health reports
- Develop standard data formats and data fields for comparative analyses
- Increase appropriate access to data for decision-makers, managers, and the public
- Reduce redundancy in data collection in overlapping programs
- Streamline regulatory reporting requirements

Appendix B
Previous and Ongoing Indicator Efforts

TABLE 1
LIST OF INDICATORS FROM OWOW 2.0

	Indicator Name
1	Proportion of Water Use from Imported and Recycled Sources
2	Water Use (per capita)
3	Local Water Supply Reserves
4	Adoption of Sustainable Water Rates
5	Water Availability and Stress (WRI Aqueduct 2.0)
6	Annual Water Resource Energy Use Relative to Rolling Average
7	Stream Network with Natural Substrate Benthos
8	Impervious Surface: Water Quality Index and Geomorphic Condition
9	Coastal Impacts from Sea Level Rise
10	Aquatic Habitat Fragmentation
11	Open Space for Recreation
12	Invasive Species and Native Landscapes
13	Area with Restoration Projects and Conservation Agreements
14	Exceedance of Water Quality Objectives in Watershed
15	Exceedance of Groundwater Salinity Standards
16	Exceedance of Water Quality Objectives at Discharge
17	Exceedance of Water Quality Objectives at Recreation Sites
18	Biological Condition Index
19	OWOW (Stakeholder-Community) Participation

SOURCE: Santa Ana Watershed Project Authority, One Water One Watershed Moving Toward Sustainability: 2010 Integrated Regional Water Management Plan, adopted February 4, 2014.

TABLE 2
SWM PROFILE STRESS LEVEL METRICS

Theme	Stressor	Metric
Environment	Natural Hazards	Water Supply Exposure
	Climate Change	Climate Risks to Water Supply: Snowpack-dependence of Water Supply
		Climate Risks to Water Supply: Percent of Water Supply at Risk from Sea Level Rise
		Climate Impacts of Water Supply: Reliance on Non-Renewable Energy Sources
	Sensitive Species	Sensitive Species Constraints on Supply Operations
	Watershed Health	Freshwater Ecosystems: Native Fish and Frog Populations
		Stream Water Quality: Impaired Waterbodies
		Watershed Condition: Proportion of Land in a Pervious Condition
Supply	Supply Reliability	Portfolio Strength: Source Vulnerability
		Incidence of Unplanned Mandatory Delivery Cutbacks
		Future Need for Additional Supplies
	Groundwater Supply	Declining Water Levels
	Source Water Quality	Surface Water: Drinking Water Source Water Quality Impairment
		Groundwater: Groundwater Quality Impairment
Demand	Urban Demand	Residential Indoor Water Use
		Urban Outdoor Water Use
		Urban Water Demand: Future Use Trend
	Agricultural Demand	Acreage and Use Trends
Finance	Finance & Investment	Debt Coverage Ratio
		Days of Working Capital
		System Renewal/Replacement Rate

SOURCE: The Water Foundation, ESA, TBI, SEC, M.Cubed, and Mike Antos, Sustainable Water Management Profile: Inland Empire Utilities Agency and its Region of Interest, August 2017.

TABLE 3
DWR POTENTIAL "BASIC INDICATORS" FOR ASSESSING SUSTAINABLE WATER MANAGEMENT

Societal Value	Intended Outcome	Potential Sustainability Indicator/Metric	Notes / Description	Ref No.
Public Health and Safety	A reliable water supply for domestic needs, sanitation, and fire suppression	Population and percentage of population without reliable domestic water supplies	Basic Indiator: Would be developed using data from local/municipal agencies on supply reliability, weighted by population	1
		Population and percentage of population without access to reliable sanitation	Basic Indicator: Would be developed using data from local/municipal agencies on sanitation system coverage/service, weighted by population	2
		Water supply vulnerability to wildland fires (composite indicator of cumulative water defecit, fire regime inerval departure [FRID] and post-fire erosion potential)	Advanced (Future) Indicator: Would be developed using information colleced by CalFire for their FRAP assessment.	3
		% of urban fire water systems that pass 5-year mandated inspections	Advanced (Future) Indicator: Placeholder for future indicator that addresses urban fire protection, likely in coordination with State Fire Marshall (no centralized data available)	4
	Reduce number of people exposed to waterborne health threats such as contaminants or infectious agents	Number of public water systems (and population served) not in compliance with drinking water standards	Basic Indicator: Would use data from SWRCB, USEPA, and local water agencies.	5
		Number of Native American tribal communities without access to reliable, safe water supplies	Basic Indicator: Would use data from SWRCB, USEPA, Indian Health Services.	6
		Contact exposure warnings issued for harmful algae and bacteria (rivers, lakes, and coastal)	Basic Indicator: Would use composite data for contact exposure hazards in inland and coastal water bodies, such as algae and bacteria.	7
		Water supplies derived from 303(d) impaired water bodies	Basic Indicator: Would use data from SWRCB on impaired water bodies in combination with local water agency assets, with severity indicated by the number or type of TMDLs exceeded.	8
		Potential for consumption of contaminated fish (water bodies that exceed TMDL for mercury and other water-borne contaminants found in fish consumed by humans)	Basic Indicator: Would use data from SWRCB related to new mercury standards.	9
	Reduced loss of life, injuries and health risks caused from extreme hydrologic conditions, catastrophic events and/or system failures (including infrastructure)	Population not served by hazard mitigation plans, county emergency operations plans, emergency response plans, and/or evacuation plans.	Basic Indicator (Future): Placeholder for an indicator that would assess populations not covered by basic emergency planing.	10
		Number of communities without drought preparedness plans and (in the future) water shortage contingency plans	Basic Indicator: Would use information from DWR, SWRCB (DDW), OES, and local entities to assess coverage & extent of existing emergency preparedness planning.	11
		Urban population without state-mandated urban level of flood protection	Basic Indicator: Would use information from CVFPB, DWR, and cities/counties, with census data, to estaimte urban popultion wihout State-mandated 200-year level of flood protection.	12
		Population within floodplains with equal to or greater than a 1% chance of flooding in any given year (100-year floodplains)	Basic indicator: Would be developed using data from DWR, FEMA, others along with census data to indicate population at risk.	13
		Population within floodplains (2% chance event) with potential for >3' flooding	Basic indicator: Would be developed using data from DWR (CVFPP), FEMA, others along with census data to indicate population at risk.	14

SOURCE: California Department of Water Resources

TABLE 3 (CONTINUED)
DWR POTENTIAL "BASIC INDICATORS" FOR ASSESSING SUSTAINABLE WATER MANAGEMENT

Societal Value	Intended Outcome	Potential Sustainability Indicator/Metric	Notes / Description	Ref No.
Ecosystem Vitality	Maintained and increased ecosystem and native species distributions in California while sustaining and enhancing species abundance and richness	Native Fish Conservation and Status index	Basic Indicator: Index developed by UC Davis that assesses status of native fish by waterway.	15
		Non-native invasive species distribution and status	Basic Indicator: Would use data collected by CDFW, USFWS on non-native invasive species distribution throughout the state.	16
	Maintained and improved ecological functions and processes vital for sustaining ecosystems in California	Degree of aquatic fragmentation	Basic Indicator: Index developed by UC Davis that assesses aquatic health using information on hydrology, built infrastructure, and others.	17
		Deviation from unimpaired flows	Advanced (Future) Indicator: Future indicator that could be developed from comparing actual to unimpaired flows during periods important to ecosystem functions.	18
		California Stream Condition Index	Basic Indicator: Index used by various entities to assess natural functions critical to healthy aquatic ecosystems.	19
		California Integrated Assessment of Watershed Health	Advanced (Fugure) Indicator: Existin index developed by USEPA but that would require additional work/data collection to apply at a refined scale throuhout the State.	20
	Achieved designated beneficial uses for water bodies throughout the State	Number of impaired water bodies	Basic Indicator: Some overlap with other basic indicators that use SWRCB 303(d) impaired water bodies; same indiacator could be used for multiple otucomes.	21
		Number of fish consumption advisories	Basic Indicator: Some overlap with other basic indicators related to consumption of fish contaminated with mercury (see Public Health and Safety); same indicator could be used for multiple otucomes. Potelntial Source: OEHHA satewide fish advisories.	22
		Number of swim advisories	Basic Indicator: Some overlap with other basic indicators related to Public Health and Safety and Enriching Experiences; same indicator could be used for multiple otucomes. Potential Source: County health departments.	23
Healthy Economy	Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply	Delivery reliability for SWP, CVP, CO River Aqueduct	Basic Indicator (Statewide): Only covers a portion of the state's water supply systems, so appicable at statewide level but not necessarily relevant at watershed level.	24
		Real cost of water to end user	Advanced (Future) Indicator: Would be developed considering the total cost to secure, transport, treat, and deliver water supplies to end users. Reliable data or methodolgies do not yet exist, but examining trends could be useful in decisionmaking.	25
		Comparison of actual water use to proposed Statewide water use targets	Basic Indicator: Would assess progress in achieving proposed statewide water use targets by SWRCB.	26
		Watersehd drought response capacity index	Advanced (Future) Indicator: Would be a new index or composite indiator that asses the capacity for a watershed (or subshed) to respond to drought, considering local water supply portfolio diversity (surface and groundwater, regional and imported supplies); operational flexibility; carryover storage capacity, etc.	27

SOURCE: California Department of Water Resources

TABLE 3 (CONTINUED)
DWR POTENTIAL "BASIC INDICATORS" FOR ASSESSING SUSTAINABLE WATER MANAGEMENT

Societal Value	Intended Outcome	Potential Sustainability Indicator/Metric	Notes / Description	Ref No.
Healthy Economy (Continued)	Reliable water supplies of suitable quality for a variety of productive uses, and productive water uses are based on a reliable supply (continued)	Groundwater basins with stable or recovering groundwater levels	Basic Indicator: Would use data from DWR and SWRCB collected in assocation with SGMA to assess groundwater basin health and trends.	28
		Groundwater wells that do not meet drinking water quality standards	Basic Indicator: Would use information on domestic groundwater quality from SWRCB and local cities/counties.	29
		Change in groundwater storage	Basic Indicator: Would use data from DWR and SWRCB collected in assocaition with SGMA to assess groundwater basin health and trends.	30
		Local Groundwater Management Plans/Groundwater Sustainability Plans in and out of compliance with SGMA	Basic Indicator: Would use data from DWR and SWRCB collected in assocaition with SGMA to assess groundwater basin health and trends.	31
	Consideration of economic risks and rewards on floodplains, rivers, and coastal areas	Acreage of lands along river corridors, and in coastal areas at risk of sea level rise, that are (1) newly developed, (2) approved for development	Basic Indicator: Would use land use information from general plans in combination with sea level rise projections to assess threats to developed and developing areas.	32
		Areas vulnerable to sea level rise that are covered/not covered by a Sea Level Rise Preparedness Assessment (or equivalent)	Basic Indicator: Would use information on the completion of requried Sea Level Rise Preparedness Assessments (under AB691) or equivalent to assess planning and preparedness.	33
	More benefits from economics activities, including from reduced costs to provide a given level of service (including transaction and permitting costs)	Volume of water transferred on the open market, and cost of water on the transfer market; change over time (trending up/down)	Basic Indicator (State Level): Would use information from DWR and water agencies on the volume of water transferred anually, and sale price/cost of water transferred anually, to asses trends in the value of water on the open market.	34
		% of average annual power demand satisfied by hydropower	Basic Indicator (State Level): Would use information on hydropower production in the Sate to assess the role of water managementin meeting the state's electricity demands.	35
	Reduced likelihood or occurrence of significant social disruption following a disaster	Value of assets within floodplains with equal to or greater than a 0.5% chance of flooding in any given year (200-year floodplains)	Basic Indicator: Would assess the value of assets (built infrastructure) within floodplains using information from DWR, FEMA, CalOES, others.	36
Opportunities for Enriching Experiences	Preserved or enhanced culturally or historically significant sites and communities, including continued and enhanced access to water and land used for sacred ceremonies or cultural practices	Progress toward satewide mercury objectives pertaining to tribal traditional and cultural use, tribal subsistence fishing use, and subsistence fishing use by other cultures or individuals	Basic Indicator (Future): Would assess progress in meeting proposed future mercury objectives and/or requirements (as identified by regional water boards) pertaining to tribal traditional and cultural use, tribal subsistence fishing use, and subsistence fishing use by other cultures or individuals (new beneficial use definitions as of 2017).	37
		Number of qualified historical buildings, historical sites, and designated recreation areas at risk of flooding or sea level rise (with equal to or greater than a 1% and 0.5% chance of being flooded in any given year; and at risk of sea level rise)	Basic Indicator: Would use information from SHPO, NRHP, DWR, and others to identify historic buildings and sites and assess their vulnerability to flooding and sea level rise.	38
	Preserved and increased natural areas with aesthetic or intrinsic value (including view shed)	Change in natural area (acreage) including open space, lands in conservation, Williamson Act enrollment, and habitat convervation	Basic Indicator: Would be a composite indicator assessing the change in natural land area, including open space, lands in conservation (habitat and other conservation purposes), and Williamson Act enrollment, to assess trends in land preservation.	39

SOURCE: California Department of Water Resources

TABLE 3 (CONTINUED)
DWR POTENTIAL "BASIC INDICATORS" FOR ASSESSING SUSTAINABLE WATER MANAGEMENT

Societal Value	Intended Outcome	Potential Sustainability Indicator/Metric	Notes / Description	Ref No.
Opportunities for Enriching Experiences (Continued)	Continued and enhanced access to resources that support education and learning	Number of school districts using water and environmental curriculum in K through 12 programs	Basic Indicator: Would use information from DWR Project Wet, Water Education Foundation, and California Department of Education to assess the number of districts and/or children receiving water-related education in K-12 classrooms.	40
		Number of students enrolled in water and environmental resources management programs within the UC and CSU systems	Basic Indicator (Statewide): Would use information from the UC and CSU registrars offices to track trends in education related to water and natural resource programs.	41
		Number of water agencies that have educational programs for customers	Basic Indicator (Watershed): Would use information from water districts and agencies on community education programs.	42
	Continued or enhanced recreational opportunities in waterways, reservoirs, or natural and open spaces	Change in visitor user days at water-related (rivers, lakes and water bodies, coastal) park lands (State, Federal, Local)	Basic Indicator: Would use information from the California Department of Parks and Recreation, USFS, National Parks System, and local city/county recreation districts to track trends in park visitation.	43
		Average distance to water-related recreational resources	Advanced (Future) Indicator: Would assess accessibility (distance) to water-related recreation resources, using methodology similar to how city/county recreational assessments evaluate the need for investments in community recreational facilities.	44

SOURCE: California Department of Water Resources

TABLE 4
INDICATOR SELECTION SUMMARY

Indicator	Metric	Source*	Data Availability	Included?	Rationale
Goal 1: Achieve resilient water resources through innovation and optimization					
Selected First Indicator and Variations					
Reliability of locally-managed supplies	**Percent of annual use derived from locally managed supplies**	**OWOW 2.0 variant**	**Data is available**	**Yes**	
Increase Local Supply	Proportion of Total Annual use derived from Locally Managed Supplies measured as a ratio	OWOW 2.0 variant	Data availability uncertain		Responsive to actions
Increase Local Supply	Investment in Local Supply Development and Use compared to Import Supply Development and Use				
Selected Second Indicator and Variations					
Efficiency of outdoor water use	**Percent of agencies using parcel-level data to assess outdoor water use**	**SAWPA Team**		**Yes**	
Outdoor water use			Data availability uncertain		DWR verifying method for collecting this data; verified method and data not available in time for this assessment
Additional Indicators Considered for this Goal					
Percent of surface water supplies derived from 303(d) impaired water bodies		DWR SO			Low responsiveness to actions
Groundwater basins with stable or recovering groundwater levels		HE4 from DWR SO	Data is available		Responsive to actions, but other factors also influence the levels of groundwater basins; required some additional interpretation during previous attempts
Groundwater banked in acre-feet		OWOW 2.0; SO 44 variant	Data availability uncertain		Requires a formal banking system; depends on demand; is focused on one source of water supply
Years of sustainable yield in storage		OWOW 2.0; DWR SO variant	Data not adequately available; depends on demand assumptions		
Loss of high recharge areas to development		SWM Team, similar to OWOW 2.0	Data availability uncertain	No	High recharge areas may not be adequately mapped
Water Recycling Volumes			Data availability uncertain	No	Focused on one source of water supply
Goal 2: Ensure high quality water for all people and the environment					
Selected First Indicator and Variations					
Maintenance of groundwater salinity at or below target levels	**Non-exceedance of groundwater salinity standards**	**DWR SO variant**		**Yes**	
High Quality Groundwater	maintained or increased assimilative capacity for salts		Data availability uncertain		These morphed into the selected metric; moderately responsive to actions
High Quality Groundwater	exceedance of groundwater salinity standards	DWR SO			A variant of this became the selected metric
Selected Second Indicator and Variations					
Safety of water for contact recreation	**Percentage of monitored sites where recreational use is possible identified as high risk due to bacterial contamination**	**DWR SO variant; similar to OWOW 2.0**		**Yes**	
High Quality Surface Water	Number of contact exposure warnings issued for harmful algae and bacteria (rivers, lakes, and coastal)	DWR SO; similar to OWOW 2.0	Data availability uncertain		Became the selected indicator

* Indicator sources include: OWOW Plan 2.0 (indicators listed in Table 1 of this appendix); SAWPA Team (generated for this effort); DWR's draft Sustainability Outlook ("DWR SO," indicators listed in Table 3 of this appendix); SWM Team (indicators listed in Table 2 of this appendix); the SAWPA Steering Committee; and CalEnviroScreen.

SOURCE: ESA and TBI

TABLE 4 (CONTINUED)
INDICATOR SELECTION SUMMARY

Indicator	Metric	Source*	Data Availability	Included?	Rationale
Goal 2: Ensure high quality water for all people and the environment (continued)					
Selected Second Indicator and Variations (continued)					
High Quality Source Water	incoming raw water salinity levels at one or multiple treatment plants		Data is available		Moderately responsive to actions; data related to treatment of groundwater uncertain, however, which is why this metric was not carried forward
High Quality Surface Water	decline in water quality (increased salts and/or other constituents) from the headwaters to the mouth				
Additional Indicators Considered for this Goal					
Declining number of stream miles on 303(d) list			Data is available	No	Low responsiveness to actions; uncertain whether or how frequently streams are removed from this list.
Decline in WQ from headwaters to outlet, or just trend in value at outlet			Data availability uncertain	No	Moderately responsive to actions; varies based on locations selected; uncertainty regarding which contaminants to measure
Number of MCL exceedances in the watershed for raw surface water			Data availability uncertain	No	Moderately responsive to actions
Goal 3: Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function					
Selected First Indicator and Variations					
Abundance of vegetated riparian corridor	**Change in area of vegetated riparian corridor**	**SAWPA Team**		**Yes**	
Abundance of Riparian Habitat	number or change in number of acres of riparian vegetation		Data availability uncertain		Became the selected indicator
Abundance of Riparian Habitat	number or change in number of acres of protected riparian vegetation		Data availability uncertain	No	Data available to assess riparian vegetation, but protected status information not available from same source
Degree of aquatic fragmentation		OWOW 2.0; DWR SO	Data is available	No	Not as holistic as acres of riparian corridor; recharge areas no included; excluded due to limit on number of indicators
Selected Second Indicator and Variations					
Abundance of conserved open space	**Change in area of conserved open space**	**OWOW 2.0 variant**		**Yes**	
Abundance of Protected Natural Lands	number or change in number of acres of protected natural lands	OWOW 2.0; DWR SO variant	Data availability uncertain		
Abundance of Protected Natural Lands	number or change in number of acres of natural lands	OWOW 2.0; DWR SO variant	Data availability uncertain		
Abundance of Protected Natural Lands	number of projects from the SAR Parkway and Open Space Plan implemented or being implemented	Steering Committee	Data availability uncertain		Uncertain whether reasonable to focus on this limited geography for a watershed-wide indicator; also not certain "implemented" is equivalent to "being implemented"
Abundance of Protected Natural Lands	# acres or % or increasing trend of acres of certain land cover types based on the NLCD		Data is available		Would have to select land cover types
Additional Indicators Considered for this Goal					
Access to open space		OWOW 2.0	Data availability uncertain		Moderately responsive to actions; Not clear whether this data is collected by land management entities

* Indicator sources include: OWOW Plan 2.0 (indicators listed in Table 1 of this appendix); SAWPA Team (generated for this effort); DWR's draft Sustainability Outlook ("DWR SO," indicators listed in Table 3 of this appendix); SWM Team (indicators listed in Table 2 of this appendix); the SAWPA Steering Committee; and CalEnviroScreen.

SOURCE: ESA and TBI

TABLE 4 (CONTINUED)
INDICATOR SELECTION SUMMARY

Indicator	Metric	Source*	Data Availability	Included?	Rationale
Goal 3: Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function (continued)					
Additional Indicators Considered for this Goal (continued)					
Level of investment (participation or funds) allocated to, or acreage of, aquatic habitats restored or conserved			Data availability uncertain		Responsive to actions; uncertain desired condition; would presumably reduce over time as areas restored
Percent impervious cover or maintaining/decreasing trend		OWOW 2.0	Data availability uncertain		Low responsiveness to actions; was not scored in OWOW 2.0 due to lack of effective imperviousness data; uncertain whether data sources would adequately reflect LID efforts
Goal 4: Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed					
Selected First Indicator and Variations					
Access to clean drinking water	**Difference in the drinking water contaminant index from CalEnviroscreen between least resourced parts of the community and more resourced parts of the community**	**SAWPA Team**		**Yes**	
Access to Clean Water	Drinking Water Contaminant Index from CalEnviroscreen				
Enviroscreen Water Quality Indicator	A combination of distance to groundwater contamination, level of contaminants in drinking water, impaired water bodies	CalEnviroScreen	Data is available		Became the selected indicator
Access to Clean Water	Percent of population served by sewer systems				
Change in number of people who do not have access to clean water and sanitation			Data availability uncertain		Very low already
Selected Second Indicator and Variations					
Resilience to climate change in disadvantaged communities	**Difference in tree and shrub density between least resourced parts of the community and the community as a whole**	**SAWPA Team**		**Yes**	
Community Vulnerability to Climate Change	Change in tree and shrub density		Data is available		
Community Vulnerability to Climate Change	Heat island estimate by impervious area		Data availability uncertain		Low responsiveness to actions
Community Vulnerability to Climate Change	Percent of population within floodplains with equal to or greater than a one percent annual chance of flooding	DWR SO	Data is available		Moderately responsive to actions
Community Vulnerability to Climate Change	Percent of public transportation infrastructure with equal to or greater than a one percent annual chance of flooding				
Additional Indicators Considered for this Goal					
Water affordability			Data availability uncertain		AWWA surveys may have data, but not available in time for assessment
Distribution of benefits from infrastructure investment			Data not adequately available		No existing dataset; uncertainty regarding identify/limit benefits and what qualifies as investment
Extent of geographic areas most vulnerable to impacts of climate change			Data is available		Uncertain whether data will be updated regularly in the future

* Indicator sources include: OWOW Plan 2.0 (indicators listed in Table 1 of this appendix); SAWPA Team (generated for this effort); DWR's draft Sustainability Outlook ("DWR SO," indicators listed in Table 3 of this appendix); SWM Team (indicators listed in Table 2 of this appendix); the SAWPA Steering Committee; and CalEnviroScreen.

SOURCE: ESA and TBI

TABLE 4 (CONTINUED)
INDICATOR SELECTION SUMMARY

Indicator	Metric	Source*	Data Availability	Included?	Rationale
Goal 5: Educate and build trust between people and organizations					
Selected First Indicator and Variations					
Collaboration for more effective outcomes	**Percent of water quality compliance actions carried out in partnership**	**SAWPA Team**		**Yes**	
Collaboration	Number of OWOW Plan projects being undertaken with greater than two participating entities		Data is available		Responsive to actions
Collaboration	Percent of water quality compliance actions carried out in partnership				
Selected Second Indicator and Variations					
Adoption of a watershed ethic	**Gallons of water used per capita per day (total)**	**Variant of OWOW 2.0 and DWR SO**	**Data is available**	**Yes**	**Moderately responsive to actions**
Water Use	Water Use per person per day measured as gallons per capita per day (GPCD) in comparison to state and local targets using one of the following: Total Gross use GPCD (SBX7-7 20% reduction by 2020) Residential GPCD (SWRCB reporting requirement) Indoor GPCD (In current legislation) Outdoor GPCD or compared to MWELO Reference ET targets	OWOW 2.0; DWR SO variant	Data is available		Variant of "Comparison of actual water use to proposed Statewide or local water use targets"
Comparison of actual per capita water use to proposed Statewide or local water use targets		OWOW 2.0; HE-2 4 from DWR SO	Data is available		Responsive to actions; data is available; evolved into indicator
Additional Indicators Considered for this Goal					
Community Participation and Access to Decision-Making	Percent of water management agencies and cities/counties that have ombudsman		Data availability uncertain		Data not currently collected/aggregated regularly or by one entity; responsive to actions; parts of the metric about management response
Community Participation and Access to Decision-Making	Watershed stewardship and water use efficiency activities in less-resourced communities				
Community Participation and Access to Decision-Making	Number and types of interests included in defining issues at land use decision meetings				
Water management agencies and cities/counties that encourage participation	Community partnership committee practices; multi-lingual public information; watershed stewardship activities; numbers and types of interests included in defining issues		Data availability uncertain		Data not currently collected/aggregated regularly or by one entity; responsive to actions; parts of the metric about management response
Watershed Stewardship	Number of and enrollment in/completion of classes, school programs, certification programs, or customer education programs on water use efficiency (Water Sense professionals, eg)		Data availability uncertain		
Watershed Stewardship	Clicks on webpages; reposting on social media; including certain feeds on social media (followers)		Data availability uncertain		Moderate to low responsiveness to actions
Watershed Stewardship	Positive attitudes towards water use efficiency and watershed stewardship (measure by survey)		Data availability uncertain		Responsive to actions; data not currently collected
Watershed Stewardship	Presence of public education (collateral information, classes, school programs, other public programs) on water use efficiency and watershed stewardship	similar to OEE 6 from DWR SO	Data availability uncertain		

* Indicator sources include: OWOW Plan 2.0 (indicators listed in Table 1 of this appendix); SAWPA Team (generated for this effort); DWR's draft Sustainability Outlook ("DWR SO," indicators listed in Table 3 of this appendix); SWM Team (indicators listed in Table 2 of this appendix); the SAWPA Steering Committee; and CalEnviroScreen.

SOURCE: ESA and TBI

TABLE 4 (CONTINUED)
INDICATOR SELECTION SUMMARY

Indicator	Metric	Source*	Data Availability	Included?	Rationale
Goal 5: Educate and build trust between people and organizations (continued)					
Additional Indicators Considered for this Goal (continued)					
Watershed Stewardship	Percentage of water users who receive performance standards/targets from their water retailer		Data availability uncertain		Responsive to actions
Watershed Stewardship	Percentage of water users who receive performance data from their retailer in any form		Data availability uncertain		Responsive to actions
Watershed Stewardship	Percentage of water users who receive real time water use data		Data availability uncertain		Responsive to actions
Watershed Stewardship	Number of public education products				
Data or method used to estimate future water demands			Data availability uncertain		Not currently collected/consolidated in one place
Trend of number and length of project delays due to public protest/ controversy			Data not adequately available		Low responsiveness to actions
Lawsuits dealt with at the RWQCB (addressed in closed session) and/or other water management agencies			Data availability uncertain		Moderately responsive to actions
Goal 6: Improve data integration, tracking and reporting to strengthen decision making					
Selected First Indicator and Variations					
Broaden access to data for decision-making	**Percent of customers who receive relative performance information about their water use**	**SAWPA Team**		**Yes**	
Wider Access by Customers to Water Use Data	% of customers who receive performance information about their water use: relative to last year, other customers, or real-time				
Wider Access to Data for Decision-Making	% of customers who receive performance information about their water use relative to target				
Wider Access to Data for Decision-Making	number of water management and supply agencies sharing data sets voluntarily in regional data repositories or clearinghouses				
Wider Access to Data for Decision-Making	% of elected or appointed officials in the Santa Ana River watershed who sign-up to receive or participate in OWOW progress reports or watershed assessment briefings				
Wider Access to Data for Decision-Making	% of water suppliers utlizing analytical software and hardware to provide feedback on customer usage and non-revenue water (water loss)				
Selected Second Indicator and Variations					
Participation in an open data process	**Percent of water supply agencies participating in a regional data system consistent with the State's Open and Transparent Water Data System (AB 1755)**	**SAWPA Team**		**Yes**	
Data Development, Sharing, and Reporting	number of QA/QC'ed data sets developed and used in the watershed assessment (e.g tracking access to clean water and sanitation for homeless population)				

* Indicator sources include: OWOW Plan 2.0 (indicators listed in Table 1 of this appendix); SAWPA Team (generated for this effort); DWR's draft Sustainability Outlook ("DWR SO," indicators listed in Table 3 of this appendix); SWM Team (indicators listed in Table 2 of this appendix); the SAWPA Steering Committee; and CalEnviroScreen.

SOURCE: ESA and TBI

TABLE 4 (CONTINUED)
INDICATOR SELECTION SUMMARY

Indicator	Metric	Source*	Data Availability	Included?	Rationale
Goal 6: Improve data integration, tracking and reporting to strengthen decision making (continued)					
Selected Second Indicator and Variations (continued)					
Data Development, Sharing, and Reporting	Sharing: A. Number of different types of entities (city, county, water retailers, wholesalers, wastewater, storm water, reginal planning etc) participating in establishing and contributing data to a shared data repository for data relevant to sustainable watershed management. B. % of water suppliers (or water used as % of total use) sharing water data to a shared data repository.				Uncertainty regarding data repository development; selected metric aligns with ongoing statewide data integration efforts
Data Development, Sharing, and Reporting	Reporting: A. OWOW progress and watershed health report is annually produced B. SAWPA/OWOW facilitated data-sets and shared data repository are used to satisfy reporting requirements for regulatory agencies				Uncertainty regarding data repository development; selected metric aligns with ongoing statewide data integration efforts
Number of entities participating in establishing a regional clearinghouse for data relevant to sustainable watershed management			Data availability uncertain		Not currently collected; regional clearinghouse not extant; data protocols not established
Percent of water management agencies reporting selected water data (including use volumes) to a regional data clearinghouse			Data availability uncertain		

* Indicator sources include: OWOW Plan 2.0 (indicators listed in Table 1 of this appendix); SAWPA Team (generated for this effort); DWR's draft Sustainability Outlook ("DWR SO," indicators listed in Table 3 of this appendix); SWM Team (indicators listed in Table 2 of this appendix); the SAWPA Steering Committee; and CalEnviroScreen.

SOURCE: ESA and TBI

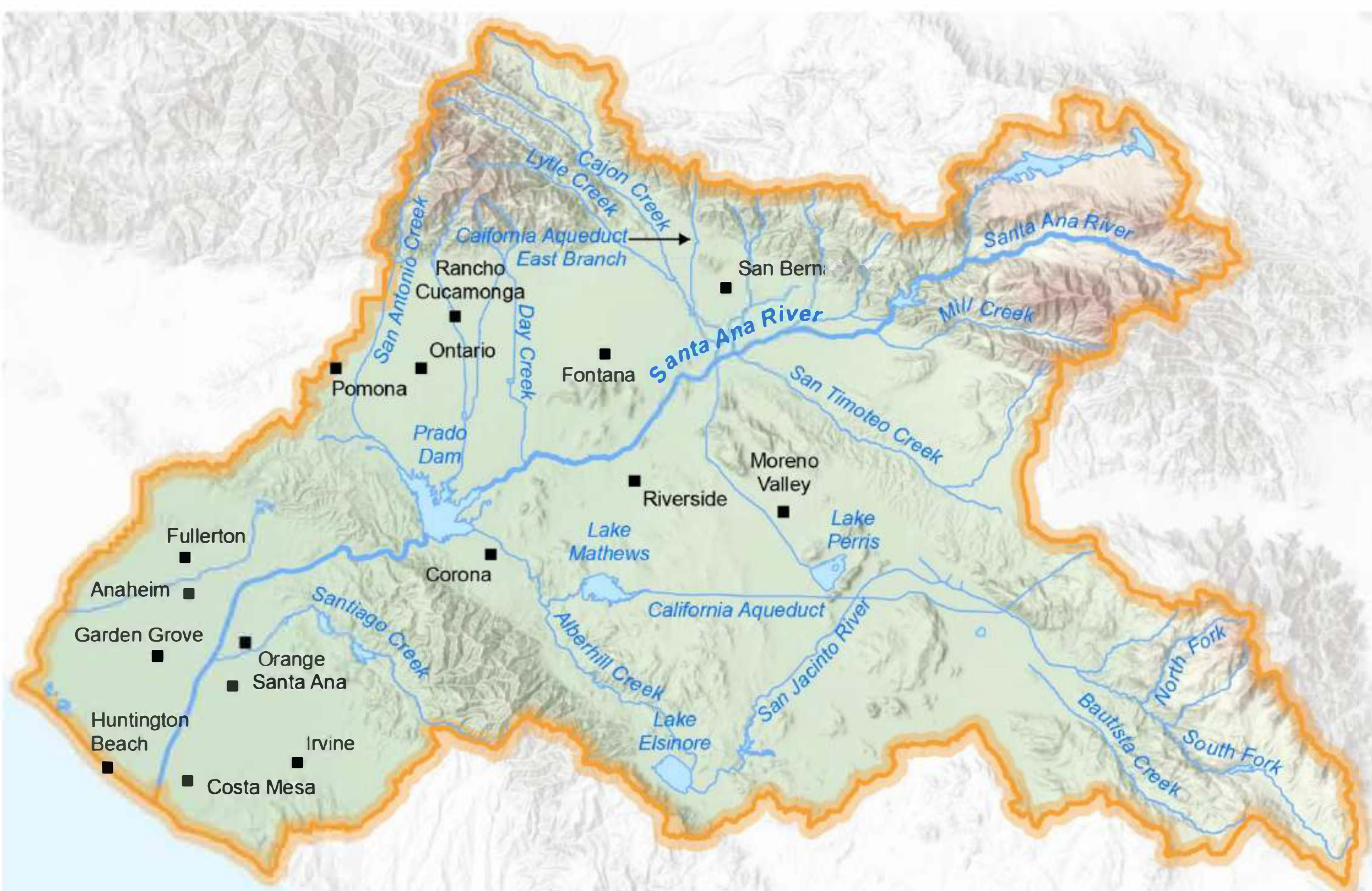
Appendix C
Sustainability Assessment

OWOW PLAN UPDATE 2018
WATERSHED SUSTAINABILITY ASSESSMENT

Prepared for
Santa Ana Watershed Project Authority
and California Department of Water
Resources

January 2019

ESA



OWOW PLAN UPDATE 2018
WATERSHED SUSTAINABILITY ASSESSMENT

Prepared for
Santa Ana Watershed Project Authority
and California Department of Water
Resources

January 2019

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TABLE OF CONTENTS

OWOW Plan Update 2018
Watershed Sustainability Assessment

Page

Attachment A, Assessment Implementation Sheets

List of Tables

Page

FOREWORD

The Sustainability Assessment that follows was developed by Environmental Science Associates (led by Betty Andrews and Karen Lancelle) in collaboration with Peter Vorster of The Bay Institute, working with the Santa Ana Watershed Project Authority. It was made possible with the financial support of the California Department of Water Resources as a pilot effort to demonstrate a regional sustainability assessment as encouraged by recent and current versions of the California Water Plan.

The Sustainability Assessment was crafted to provide feedback to decision-makers and stakeholders of the One Water One Watershed (OWOW) Plan regarding how well Plan goals are being achieved. This feedback will inform where additional or modified emphasis and investment is needed to realize the goals of the OWOW Plan. Unlike the California Water Plan Update 2018, which focused on developing a tool for assessing the effectiveness of water management for sustainability (the Sustainability Outlook), the OWOW Plan Update 2018 developed goals focused on improving watershed sustainability.

Because this assessment was conducted while the California Water Plan Update 2018 and OWOW Plan Update 2018 were being developed, it may not fully conform to the final versions of either document.

The Sustainability Assessment was developed with input from stakeholders and decision-makers, though the engagement was limited due to its parallel execution with the drafting of the OWOW Plan Update 2018. The Sustainability Assessment, as designed, supports collaborative dialogue, prioritization, and further analysis – it is not intended to be a comprehensive and exhaustive analysis of watershed condition. More comprehensive work is done routinely elsewhere, driven by specialty activity and carried out by technical experts. This tool draws from such work, but it does not seek to replicate it nor encompass its full complexity. The simple rating system used supports the purpose of the Sustainability Assessment as a quick reference overview of an extraordinarily complex and multi-faceted system of natural and human processes.

In summary, this Sustainability Assessment is the initial iteration of a tool intended to be useful to the OWOW Plan stakeholders in guiding Plan implementation. Future work can further refine its utility to the region and deepen the connections to the California Water Plan Sustainability Outlook tools as they develop.

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Introduction

This document provides a summary of the watershed sustainability assessment developed and conducted for the OWOW Plan Update 2018. A brief introduction to the assessment is provided, including a discussion of its purpose and goals; background on other watershed sustainability assessments that informed its development; discussion on the principles that were applied during its development; an overview of the indicators and metrics selected for the assessment; a brief introduction to its implementation; and a summary of the assessment findings, first in a table form and then as individual pages presenting each metric evaluated.

A more detailed presentation of the implementation of each metric evaluation is contained in **Attachment A**, including a discussion of data sources, approach to scoring and rating, detailed implementation steps, and considerations for future iterations of the assessment.

Purpose and Goals

The primary purpose of the watershed sustainability assessment for the OWOW Plan Update 2018 is to help promote sustainability within the Santa Ana River watershed by supporting decision making and stakeholder action to achieve the goals of the OWOW Plan. By providing feedback on how well the OWOW Plan goals are being achieved, decision making can adapt to provide increased resources and attention where it is needed.

At the watershed scale, the watershed sustainability assessment supports decision making by demonstrating whether or not existing efforts are showing progress towards meeting goals. It will additionally inform future projects and planning efforts by helping to focus attention on meaningful objectives, identifying activities that are needed to shift key indicators. The sustainability assessment can also support the effectiveness of the Plan itself. It provides a measuring stick for each iteration of the OWOW Plan; if it is found that the effects of implementing the OWOW Plan are successful based on the findings of the sustainability assessment, but fail to address key aspects of sustainability still challenging the watershed, modification of the OWOW Plan's goals and objectives should follow.

At the individual scale, by providing a vehicle for a shared understanding of progress toward the shared goals expressed in the OWOW Plan, the watershed sustainability assessment also helps to build a sense of common purpose among watershed stakeholders, which can multiply the collective effect of their individual decisions, including support for watershed-scale actions.

With sufficient ease of implementation, the performance feedback provided by the assessment can be carried out more often than at each plan update, perhaps even annually, to 1) help refine implementation of the Plan on a time scale that will be regularly meaningful to decision-makers, 2) build momentum around demonstrating progress towards the goals, and 3) serve to reinforce the value of the Plan and its implementation to the stakeholders in the watershed.

Background

Over the past two decades in California, multiple statewide and regional efforts have emerged to develop and apply indicator-based assessment frameworks and tools to help manage water resources for sustainability. Sustainability frameworks and visions were included in the California Water Plan (CWP) updates from 2005 through 2018 and in the 2013 iteration of the One Watershed One Water (OWOW) Program. In addition to these public programs, the Sustainable Water Management Profile, an assessment tool prepared for the Water Foundation, was developed in 2012.

As part of the 2013 iteration of the OWOW Program, also called the OWOW 2.0 Plan, a Sustainability Indicators Framework was used to understand the performance of integrated water management in the watershed. The results were published in Appendix A of the OWOW 2.0 Plan as an "Assessment of the Health of Santa Ana River Watershed." The Sustainability Indicators Framework was designed to integrate sustainability indicators and performance measures into a single reporting system.

The sustainability assessment frameworks developed since 2010 and the other frameworks applied at the watershed scale over the last 20 years in California were analyzed, along with the draft California Water Plan Update 2018 "Sustainability Outlook[1]," to develop an assessment framework with metrics and indicators for the OWOW Plan Update 2018.

Development

As described in the Background section above, statewide and regional efforts to develop sustainability assessment tools have been ongoing for more than a decade. Assessment development for the OWOW Plan Update 2018 intentionally utilized concepts and indicators identified by these previous and concurrent efforts as a potential source for indicators and metrics aligned with the OWOW Plan's goals and objectives, which were developed through local collaborative watershed planning efforts. The intent of this strategic approach was to develop an assessment that reflected the best thinking related to managing water for sustainability while ensuring that the assessment results would be locally meaningful and time- and cost-effective to repeat on a regular basis.

The development of a sustainability assessment for the OWOW Plan Update 2018 recognized that pursuit of sustainability is a process. It also reflected the understanding that, while the pursuit of sustainability is often considered as overcoming a combination of technical challenges, in most settings it is more appropriately recognized as overcoming a combination of political challenges. Watershed sustainability assessment tools are powerful if used to specifically respond to these political challenges. Technical assessment of a thousand nuanced aspects of water sustainability does not address political challenges; it.is simply a collection of what various specialists already know, and it obscures the holistic picture that is needed to harness political will. These considerations influenced the approach to development of the OWOW Plan Update 2018

[1] The proposed Sustainability Outlook includes a still-developing suite of indicators that can be used to assess conditions and trends in water and watershed management.

sustainability assessment as well as the selection of its indicators and metrics. The list of indicators and metrics needed to be relatively short, and the metrics themselves needed to be easy for stakeholders to understand, directly responsive to actions to achieve the goals of the OWOW Plan, and practical to evaluate on a regular basis.

The assessment was developed based on the OWOW Plan Update 2018 goals and objectives (goals listed in **Table SA-1**). The OWOW Plan Update 2018 describes how collaborative watershed planning, water and land management, and project implementation support improved sustainability, resilience, and quality of life throughout the Santa Ana River Watershed through 2040.

TABLE SA-1
OWOW PLAN UPDATE 2018 GOALS

Achieve resilient water resources through innovation and optimization.	Ensure high quality water for all people and the environment.
Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function.	Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed.
Educate and build trust between people and organizations.	Educate and build trust between people and organizations.

Components of the assessment framework include indicators and metrics, valuation or scoring, and presentation of results in the form of a rating.

Indicators and their associated metrics were selected by reviewing indicators previously identified for other projects (and regions) and screening them to reflect the Santa Ana River watershed and adopted criteria related to ease of implementation. OWOW stakeholder feedback was sought at multiple stages during the assessment development process. Sets of potential indicators were shared during local stakeholder meetings to solicit feedback and share progress.

The array of potential indicators was narrowed to a select group for further consideration based on four main criteria: easy to understand; responsive to actions; easy to implement; and meaningful to stakeholders.

The assessment reports on trends (that is, scores are relative to past performance) instead of scoring each indicator with either an absolute value or based on its relationship to a target condition (i.e., wanted or unwanted conditions). A three-bin set of results -- a positive trend, a negative trend, or a neutral condition – were elected for the assessment because these three outcomes are easy to understand, limit the number of scoring thresholds to be assigned, and are adequate to indicate movement toward Plan goals.

Table SA-2 lists the selected indicators and metrics associated with each of the six OWOW Plan Update 2018 goals and provides a short rationale for each.

TABLE SA-2
SELECTED INDICATORS FOR OWOW UPDATE GOALS

Goal	Indicator	Metric	Rationale
Achieve resilient water resources through innovation and optimization	Maximization of locally-managed supplies	Percent of total annual supply sourced or managed locally	Water that is sourced locally or imported and stored locally is more reliable than water that is imported and must be immediately used. Maximizing local supplies and storage in the region will make us more resilient and effective managers of an increasingly variable water supply.
	Efficiency of outdoor water use	Percent of watershed population in agencies using parcel-level data to assess outdoor water use	Implementing innovative technology and data management can increase irrigation efficiency and help make landscapes less irrigation dependent. Landscape irrigation is the single largest use of water in the watershed and improving its efficiency will significantly increase watershed resilience.
Ensure high quality water for all people and the environment.	Maintenance of groundwater salinity at or below target levels	Non-exceedance of groundwater salinity standards	Management of water quality in the groundwater basins of the watershed is essential to preserving their utility. Groundwater basins are the watershed's most important local water storage tool, and salinity levels are a primary consideration for maintaining a high-quality, reliable water supply.
	Safety of water for contact recreation	Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination	Bathers in our streams, lakes, and coastal waters must be protected from undue health hazards from water quality impairment.
Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	Abundance of vegetated riparian corridor	Area of vegetated riparian corridor	Active engagement in conserving and restoring riparian vegetation is necessary to retaining and enhancing the values supported by this resource. Vegetation within the riparian corridors of the watershed provides valuable habitat for a large number of species, including those with special status. It also provides beauty and shade for people recreating alongside streams and lakes.
	Abundance of conserved open space	Area of conserved open space	Deliberate management and protection is necessary to maintain the recreational and ecosystem values of open space.
Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	Equitable access to clean drinking water	Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community	Ensuring that all people in the watershed have clean drinking water is essential to human health and prosperity within the watershed.
	Proportionate implementation of climate change adaptation strategies	Relative value of tree and shrub density between less resourced parts of the community and more resourced parts of the community	Targeted implementation of climate change adaptation strategies that address the potential for increased dangerous heat, a climate change impact predicted in the watershed, will reduce the extent to which vulnerable people are inequitably impacted.
Educate and build trust between people and organizations.	Collaboration for more effective outcomes	Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation	Collaborative action with shared outcomes must be prioritized by water managers because many of the complex challenges facing the watershed cannot be overcome by a single organization.

TABLE SA-2
SELECTED INDICATORS FOR OWOW UPDATE GOALS

Goal	Indicator	Metric	Rationale
	Adoption of a watershed ethic	Total gallons of potable water used per capita per day	Helping conservation become a way of life in California involves education and civic action. As more water users learn how precious our water and watershed are, many of the challenges will be more easily overcome.
Improve data integration, tracking and reporting to strengthen decision-making	Broaden access to data for decision-making	Percent of watershed population in agencies whose residential customers receive relative performance information about their water use	Everyone who uses water is a decision-maker. Informing people how they are using water relative to past and/or budgeted use, will improve decisions, increase efficiency, and make us more resilient.
	Participation in an open data process	Percent of watershed population in agencies participating in establishment of a regional data sharing system	Our ability to create data is outstripping our ability to make effective use of it. Ensuring that data produced is meaningful, is applied to decision-making, and is shared freely without jeopardy is a critical next step for the management of the watershed's supply and demand.

Implementation

After selecting the metrics, a few additional decisions remained to be made for their implementation. The decisions included:

determining the extent of change that would count toward the trend evaluation (e.g., what change in area of open space would be sufficient to consider a trend to be positive),

how to handle assessment of metrics for which a simple trend assessment approach was not appropriate (e.g., groundwater quality in a managed, maximum benefit environment),

which data sources to use and how (e.g., should comparisons be made to the prior year alone or to a multi-year average), and

methods to combine results for discrete elements (e.g., groundwater basins) to reflect an overall score.

These choices were influenced by data quality and availability as well as expert judgment and assessment of meaningfulness to assessment consumers. In many cases earlier data was not available to address the trend. If such comparable data was not available, the metric value was assessed qualitatively based upon expert judgement, and contextualized using other data.

Target conditions (wanted or unwanted conditions) were not established for this assessment. To be meaningful in a planning context, target conditions must be developed through a collaborative process by the OWOW Plan 2018 Update stakeholders. While at this time the indicators are not evaluated relative to target conditions, this could be carried out in the future, should those conditions be identified.

Two types of scoring emerged, based on the metric being assessed. A positive or negative trend based on either decrease or increase in the metric value was an appropriate basis for scoring for most metrics (such as total gallons of potable water used per capita per day). In other cases, a good-bad scoring approach was used. The good-bad scoring approach was developed to address metrics for which a binary valuation (either a condition is good or bad) exists and is a more appropriate basis for establishing an assessment rating. For example, increases in groundwater salinity from one year to the next would not necessarily be considered a negative trend if the salinity remains below water quality target levels. Further, maintenance of a consistent salinity level below the water quality target was appropriately considered a positive outcome, despite not reflecting a trend in salinity levels.

Attachment A includes a description of the implementation approach for each indicator and metric, along with information about data used, method of implementation, results, the rating, and recommendations for future implementation.

Outcomes

The OWOW Sustainability Assessment Summary presents the outcomes of this assessment in a tabular form. The rating represents the evaluation of management action effectiveness in the pursuit of sustainability. The Sustainability Assessment Summary provides a succinct visual high-level “status update” of the watershed and feedback on OWOW Plan effectiveness. **Table SA-3** provides a key to the rating system used to summarize findings.

A series of Assessment Summary Sheets follow the Sustainability Assessment Summary table and present each metric, rationale, and findings in a simplified graphical format.

TABLE SA-3
RATING SYSTEM KEY

Rating	Quantitative Assessment Rating	Qualitative Assessment Rating
Positive		
Neutral		
Negative		

OWOW Sustainability Assessment Summary

Goal	Indicator	Metric	Rating*	Scoring
Achieve resilient water resources through innovation and optimization	Maximization of locally-managed supplies'	Percent of total annual supply sourced or managed locally		Trend scoring approach. Potentially fully scorable data set if data can be rectified. Qualitative trend assessment - inadequate data available.
	Efficiency of outdoor water use	Percent of watershed population in agencies using parcel-level data to assess outdoor water use		Trend scoring approach. One partial data set: incomplete assessment of all watershed retailers and how parcel-level data is actually used. Qualitative trend assessment - only one data point.
Ensure high quality water for all people and the environment	Maintenance of groundwater salinity at or below target levels	Non-exceedance of groundwater salinity standards		Good-bad scoring approach. Fully scoring using quantitative data. Compare most recent (2015) to average triennial quantitative data 2003-2012.
	Safety of water for contact recreation	Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination		Good-bad scoring approach. Fully scoring using quantitative data.
Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	Abundance of vegetated riparian corridor	Area of vegetated riparian corridor		Trend scoring approach. Fully scoring based on quantitative data. Compare to average of prior 5 years of data.
	Abundance of conserved open space	Area of conserved open space		Trend scoring approach. Fully scoring based on quantitative data. Compare 2017 to 2016 data.
Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	Equitable access to clean drinking water	Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community		Trend scoring approach. Qualitative trend assessment - only one data point.
	Proportionate implementation of climate change adaptation strategies	Relative value of tree and shrub density between less resourced parts of the community and more resourced parts of the community		Trend scoring approach. Qualitative trend assessment - only one data point.
Educate and build trust between people and organizations	Collaboration for more effective outcomes	Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation		Good-bad scoring approach. Fully scoring based on quantitative data. Compare 2017 to 2016 data.
	Adoption of a watershed ethic	Total gallons of potable water used per capita per day		Trend scoring approach. Fully scoring based on quantitative data. Compare to average of prior 10 years of data.
Improve data integration, tracking and reporting to strengthen decision-making	Broaden access to data for decision-making	Percent of watershed population in agencies whose residential customers receive relative performance information about their water use		Trend scoring approach. Qualitative trend assessment - only one data point.
	Participation in an open data process	Percent of watershed population in agencies participating in establishment of a regional data sharing system		Trend scoring approach. Qualitative trend assessment - inadequate data available.

* A face with hat indicates that the rating results from a qualitative assessment.

OWOW SUSTAINABILITY ASSESSMENT

Summary Sheets

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GOAL:

Achieve resilient water resources through innovation and optimization

SAWPA

Indicator:
Maximization of locally-managed supplies

Metric:
Percent of total annual supply sourced or managed locally

- Sufficient quantitative data was not available to assess this metric, and qualitative information was not available to determine whether the rating should be positive or negative. The metric was therefore given a qualitative neutral rating.
- Data from individual SAWPA wholesalers and the MWD service area for the last 10+ years show an increasing reliance on locally managed supplies resulting from the long-term trend of increased recycled water and groundwater recovery production in combination with demand reductions, increased efficiencies, and opportunistic recharge of local and imported water.
- A cooperative effort by SAWPA water supply agencies with the State and local agencies to whom the data is reported is needed to produce the quality data necessary to quantitatively assess this metric.

Why Evaluate this Indicator?

Water that is sourced locally or imported and stored locally is more reliable than water that is imported and must be immediately used. Maximizing local supplies and storage in the region will make us more resilient and effective managers of an increasingly variable water supply.

Insufficient Data

GOAL:

Achieve resilient water resources through innovation and optimization

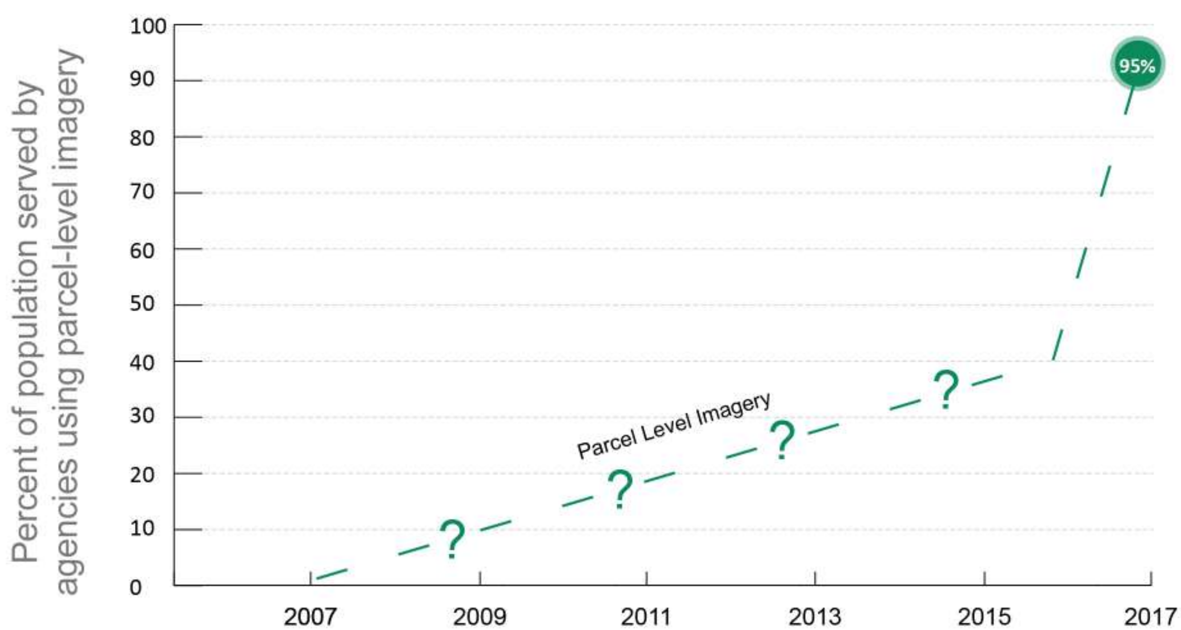
SAWPA

Indicator:	Metric:
Efficiency of outdoor water use	Percent of watershed population in agencies using parcel-level data to assess outdoor water use

- By 2017, the water supply and management agencies that together encompass 95% of the watershed's population requested the use of SAWPA-procured 2015 aerial imagery, which can be used for parcel-level assessments of outdoor water use. The retail water suppliers that encompass 74% of the watershed's population also either use or requested the use of the imagery.
- Quantitative information about the use of imagery procured prior to 2015 was not available and thus the trend assessment is qualitative.
- Beginning in 2007, SAWPA has obtained aerial imagery on behalf of the Santa Ana watershed, a noteworthy example of cooperative procurement to reduce costs for individual water suppliers and to assist them to improve the implementation, measurement of, and education about outdoor water use efficiency programs and conservation rate structures.

Why Evaluate this Indicator?

Implementing innovative technology and data management can increase irrigation efficiency and help make landscapes less irrigation dependent. Landscape irrigation is the single largest use of water in the watershed and improving its efficiency will significantly increase watershed resilience.



GOAL:

Ensure high quality water for all people and the environment.

SAWPA

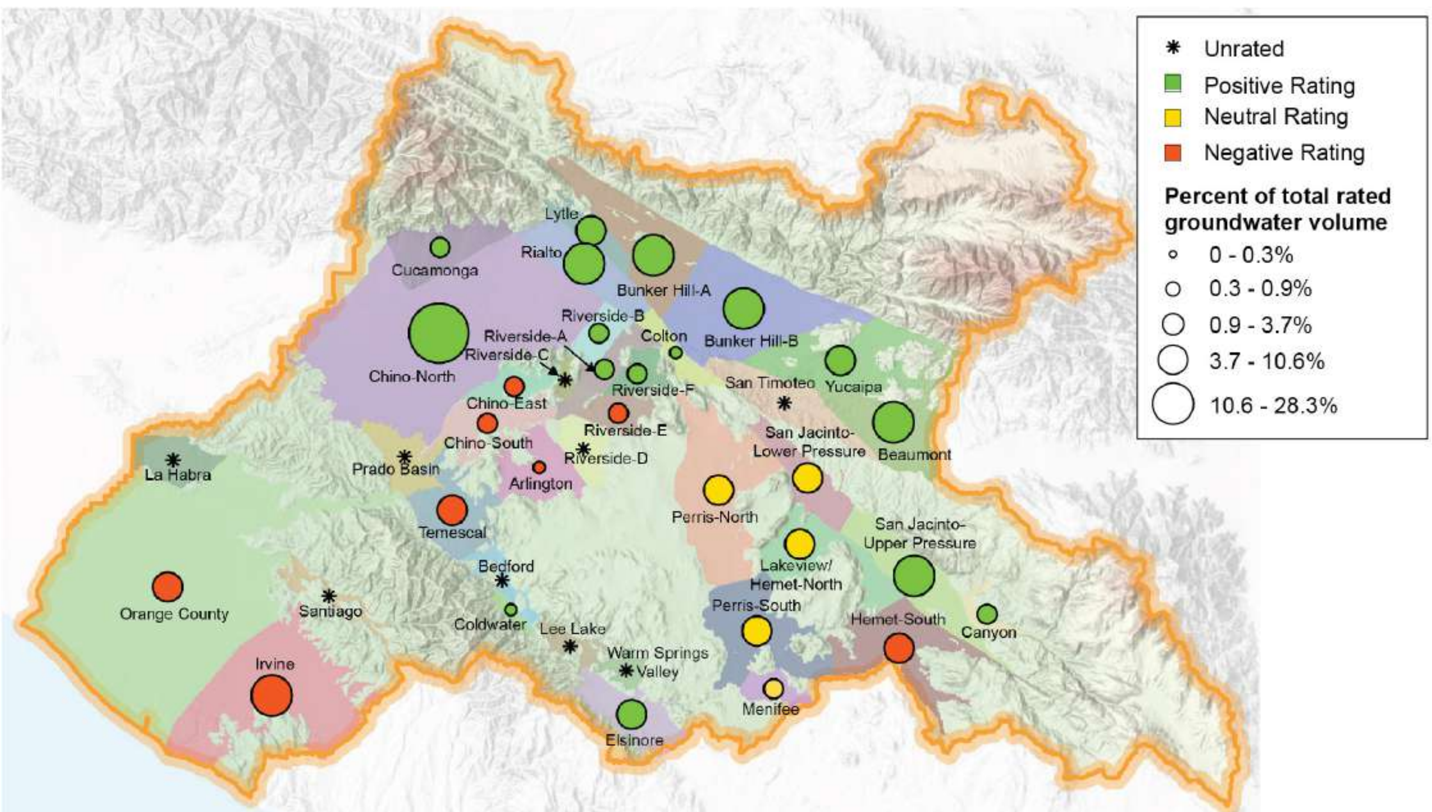
Indicator:
Maintenance of groundwater salinity at or below target levels

Metric:
Non-exceedance of groundwater salinity standards

- Of the 29 (out of 37 total) managed groundwater zones for which sufficient data exists for evaluation 55%, have salinity levels at the level of the salinity standard or better; when the results are weighted by volume in storage in each zone, the result rises to 71%.
- Overall, 82% of the rated groundwater volume either meets the water quality standard, or fails to meet the standard but has significantly improved compared to recent historic values.
- Salinity within the groundwater basins of the watershed has increased somewhat since 2012, just prior to the conditions described in the last OWOW Plan.

Why Evaluate this Indicator?

Management of water quality in the groundwater basins of the watershed is essential to preserving their utility. Groundwater basins are the watershed's most important local water storage tool, and salinity levels are a primary consideration for maintaining a high-quality, reliable water supply.



GOAL:

Ensure high quality water for all people and the environment.

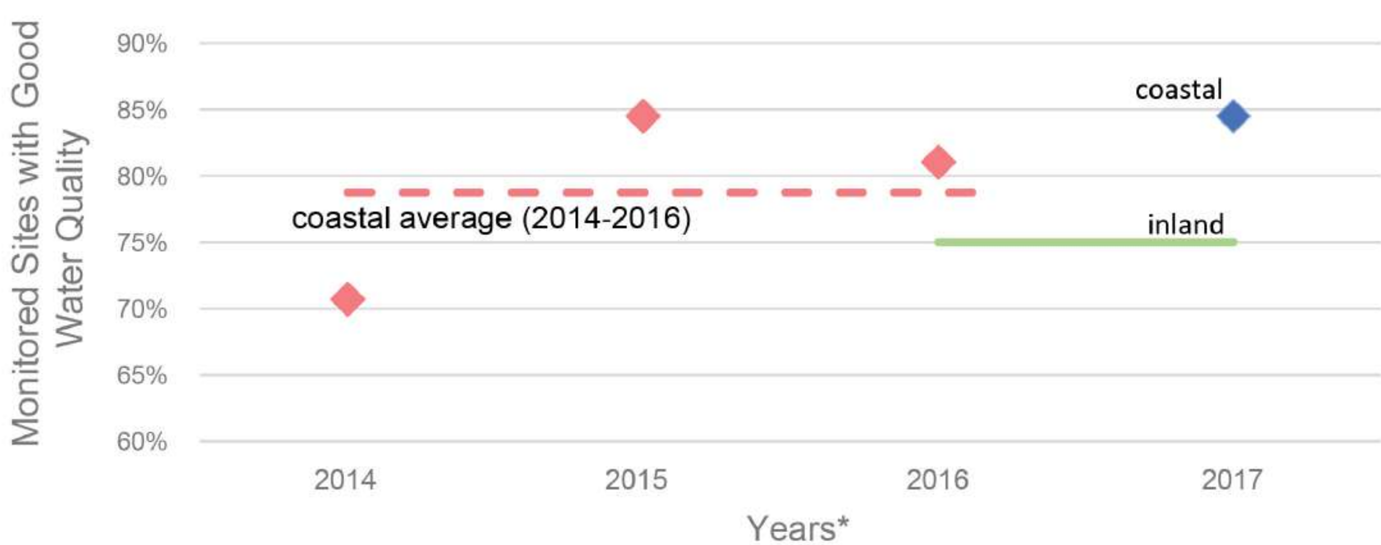
SAWPA

Indicator:	Metric:
Safety of water for contact recreation	Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination

- In 2017-2018, 84% of coastal sites received a good (A or A+) rating during dry season flows, while an additional 12% were lower quality, but improving, whereas only 63% of inland sites were generally compliant with the water quality objective and an additional 13% (one site) was noncompliant but showed significant improvement. Overall, this was determined to indicate a positive rating.
- The average 2017-2018 coastal dry season water quality grades were better than the average for the preceding three years; average inland water quality compliance was the same compared to the preceding year, the only other year for which data was available, but showed improved water quality.
- Since the last OWOW Plan was issued in 2014, coastal dry season water quality grades have improved overall.

Why Evaluate this Indicator?

Bathers in our streams, lakes, and coastal waters must be protected from undue health hazards from water quality impairment.



*Runoff Year (Apr - Mar); year identified is that which includes the majority of months in the sequence.

GOAL:

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function

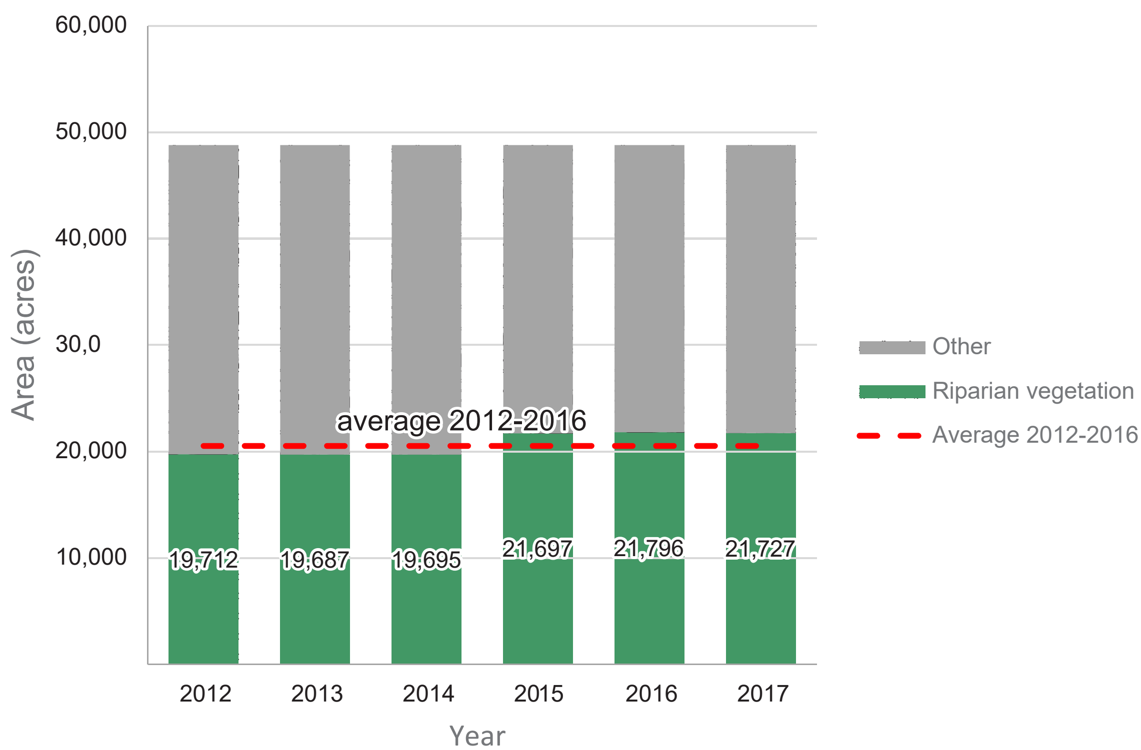
SAWPA

Indicator:	Metric:
Abundance of vegetated riparian corridor	Area of vegetated riparian corridor

- In 2017, there are an estimated 21,727 acres of vegetated riparian corridor in the watershed, which is 1,209 more acres than were estimated for the preceding five-year period, 2012-2016. Due to this significant increase in area of vegetated riparian corridor, the indicator was given a positive rating.
- Riparian vegetation covers just under half of the riparian corridors in the watershed.
- Since 2013, the conditions that formed the basis for the last OWOW Plan, the estimated area of vegetated riparian corridor in the watershed has increased by 2,040 acres.

Why Evaluate this Indicator?

Active engagement in conserving and restoring riparian vegetation is necessary to retaining and enhancing the values supported by this resource. Vegetation within the riparian corridors of the watershed provides valuable habitat for a large number of species, including those with special status. It also provides beauty and shade for people recreating alongside streams and lakes.



GOAL: Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function

SAWPA

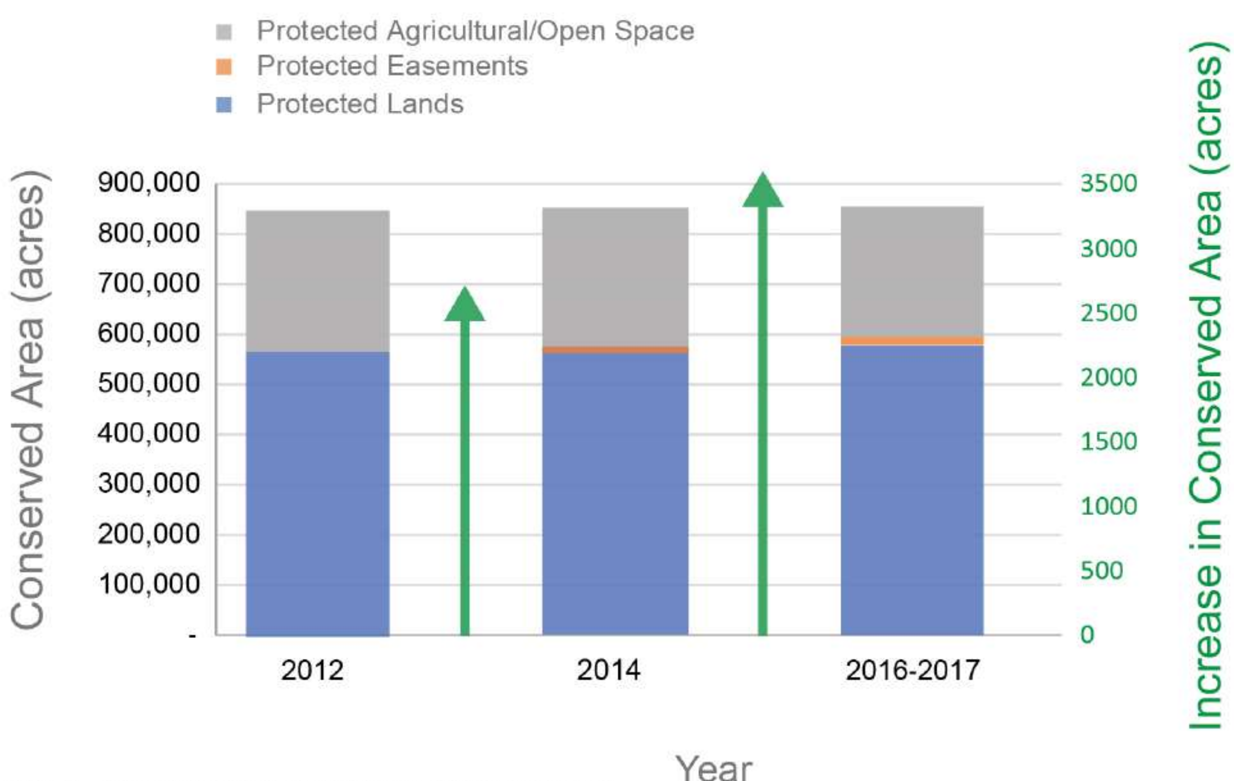
Indicator: Abundance of conserved open space

Metric: Area of conserved open space

- The estimated area of conserved open space in the watershed has increased by 3,633 acres since 2014, the most recent year for which data is available for comparison. Due to this significant increase in area of conserved open space, the indicator was given a positive rating.
- The 855,501 acres of conserved open space estimated for 2016-2017 is just under half of the area within the watershed.
- Since 2012, just before the last OWOW Plan was completed, more than 6,000 acres of conserved open space have been added to the roster of such lands in the watershed.

Why Evaluate this Indicator?

Deliberate management and protection is necessary to maintain the recreational and ecosystem values of open space.



NOTE: Protected easement data not available for 2012.

GOAL:

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed

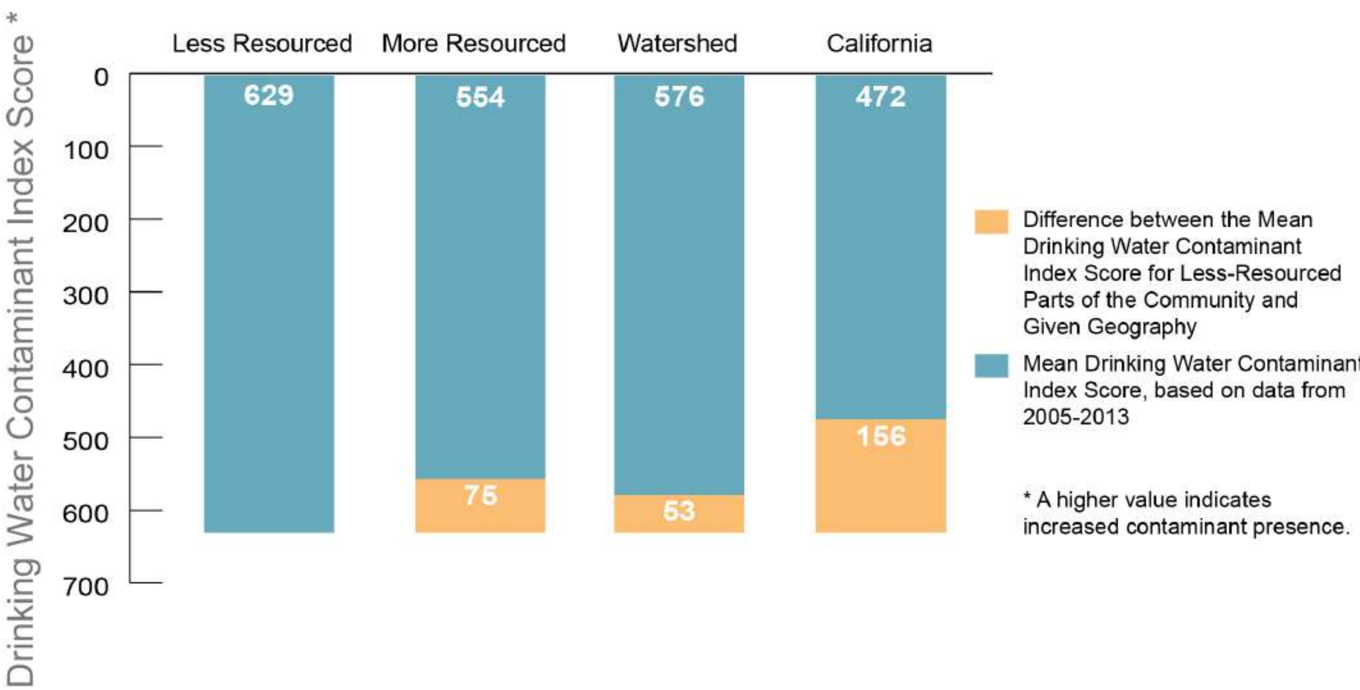
SAWPA

Indicator:	Metric:
Equitable access to clean drinking water	Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community

- Drinking water quality in less-resourced areas is somewhat worse than drinking water quality in more-resourced areas (mean drinking water quality index scores of 629 and 554, respectively), as calculated in 2017 based on 2005-2013 data. The indicator was given a qualitative neutral rating due to lack of previous data.
- No quantitative trend was assessed due to lack of previous data.
- Both the less-resourced and more-resourced parts of the community have lower drinking water quality than the statewide average (California mean drinking water quality index score is 472).

Why Evaluate this Indicator?

Ensuring that all people in the watershed have clean drinking water is essential to human health and prosperity within the watershed.



GOAL:

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed

SAWPA

Indicator:

Proportionate implementation of climate change adaptation strategies

Metric:

Relative value of tree and shrub density between less resourced parts of the community and more resourced parts of the community

- The mean tree and shrub density of less-resourced residential parts of the community (9.9%) is slightly less than the tree and shrub density for the watershed as a whole and in more-resourced residential parts of the community (10.1% and 10.2%, respectively). The indicator was given a qualitative neutral rating due to lack of previous data.
- No quantitative trend was assessed due to lack of previous data.
- The mean tree and shrub density of less-resourced and more-resourced parts of the community is less than the Green View Index value for the City of Los Angeles (15.2%).

Why Evaluate this Indicator?

Targeted implementation of climate change adaptation strategies that address the potential for increased dangerous heat, a climate change impact predicted in the watershed, will reduce the extent to which vulnerable people are inequitably impacted.

Less-Resourced Areas

9.9%

62 square miles of tree and shrub area

Watershed Overall

10.1%

237 square miles of tree and shrub area

More-Resourced Areas

10.2%

175 square miles of tree and shrub area

Los Angeles

15.2%

Educate and build trust between people and organizations

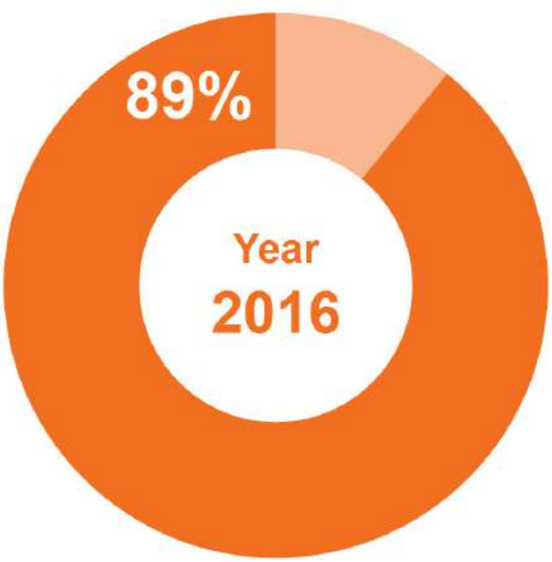
GOAL:

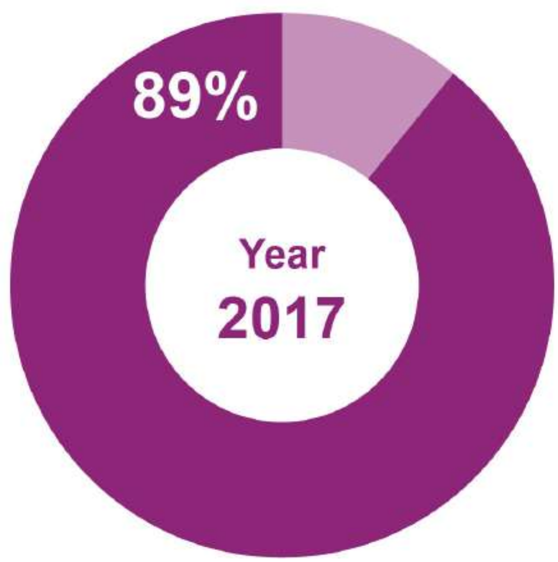
Indicator:	Metric:
Collaboration for more effective outcomes	Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation

- In 2017, 89% of regulated entities participated in TMDL implementation in the watershed (based on financial or in-kind contributions), the same percentage of regulated entities participated in 2016. Based on this significant continued participation, a positive rating was given.
- Nearly all of the TMDL implementation plans are being conducted in part through a collaborative entity, such as a SAWPA Task Force or the Newport Bay Watershed Executive Committee.
- Participation has remained at about the same level since 2014 , when the last OWOW Plan was adopted.

Why Evaluate this Indicator?

Collaborative action with shared outcomes must be prioritized by water managers because many of the complex challenges facing the watershed cannot be overcome by a single organization.





Educate and build trust between people and organizations

GOAL:

Indicator:

Adoption of a watershed ethic

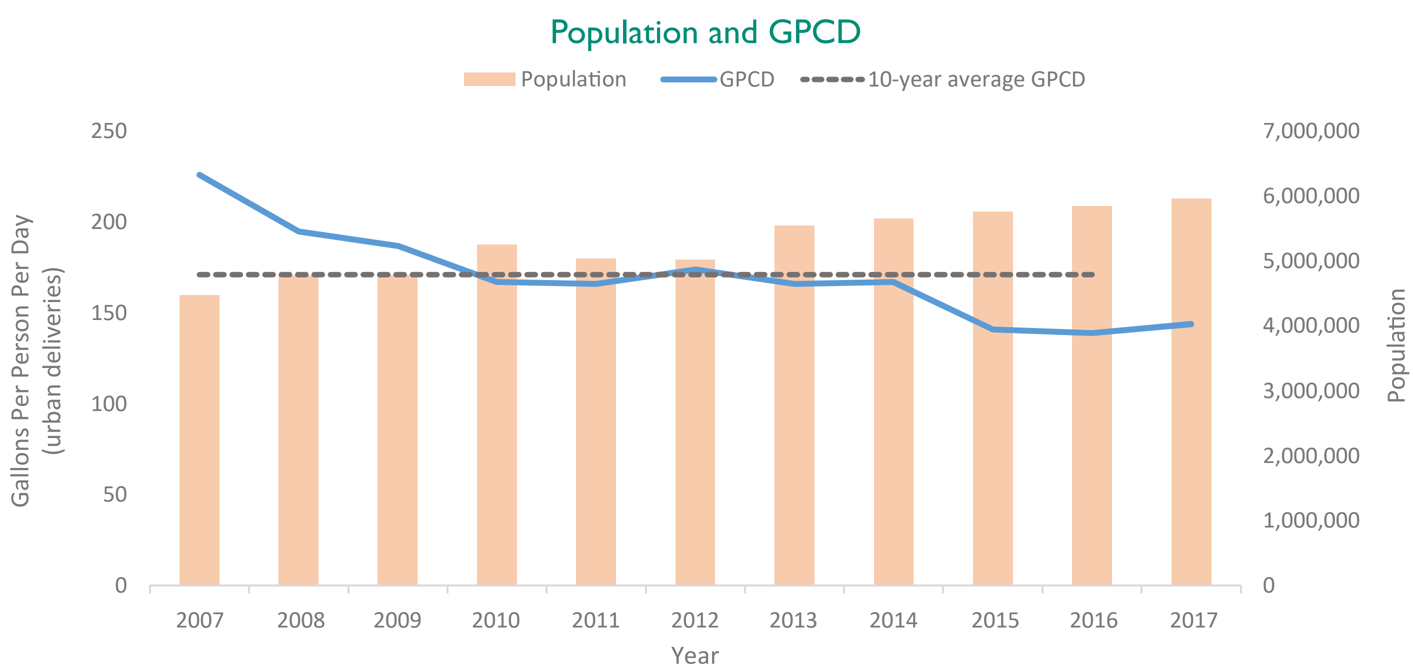
Metric:

Total gallons of potable water used per capita per day

- Compared with the previous 10-year average, total gallons of water delivered per capita per day in the watershed in 2017 declined by 16%. Based on this more efficient water use, a positive rating was given.
- Between 2016 and 2017, the rate of water use per capita increased by about 3%.
- Since 2013, when the OWOW 2.0 Plan was drafted, the rate of water use per capita has declined by 13%.

Why Evaluate this Indicator?

Helping conservation become a way of life in California involves education and civic action. As more water users learn how precious our water and watershed are, many of the challenges will be more easily overcome. Total GPCD was the metric selected for this indicator because the data is available and its value is moderately responsive to management actions.



GOAL: Improve data integration, tracking and reporting to strengthen decision-making

SAWPA

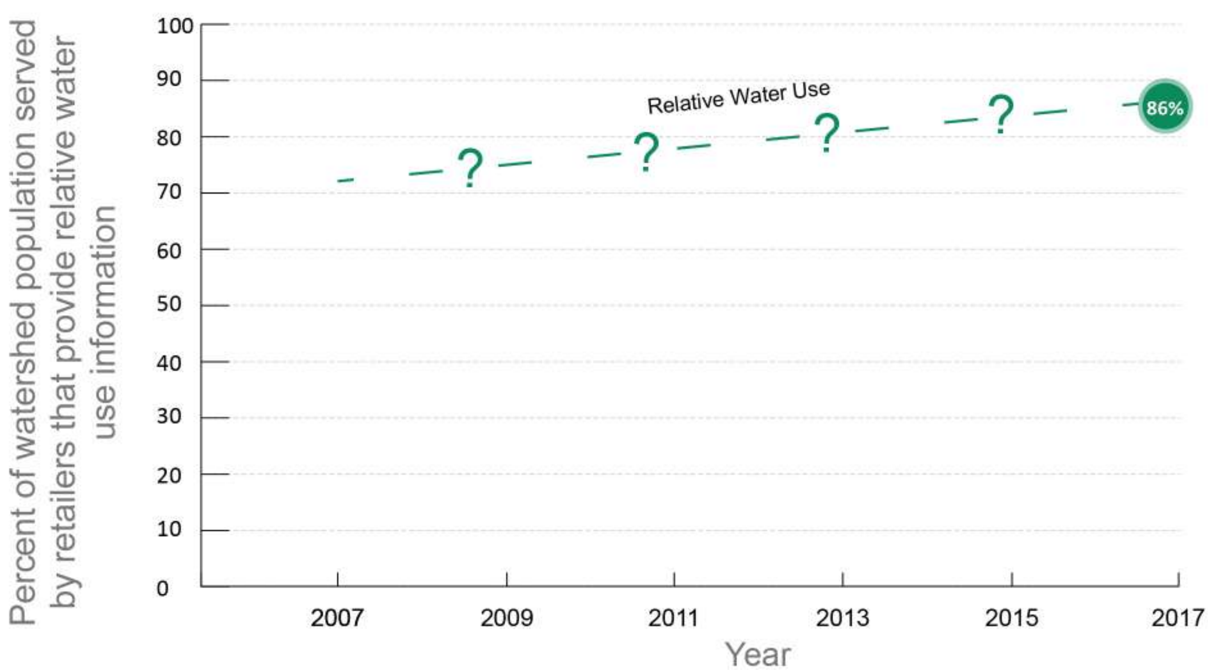
Indicator:
Broaden access to data for decision-making

Metric:
Percent of watershed population in agencies whose residential customers receive relative performance information about their water use

- 86% of watershed's population are served by retailers that provide residential customers information on their bill about how their current water use compares to past water use and/or water use budgets or targets.
- Data about the relative water use information provided in previous years was not readily available from the retailers so only a qualitative trend assessment can be made.
- Since 2014 adoption of the OWOW Plan, increased adoption of budget-based rates as well as drought water use restrictions stimulated retailers to provide more relative water use information to residential customers. On this basis, a qualitative positive rating was given.

Why Evaluate this Indicator?

Everyone who uses water is a decision-maker. Informing people how they are using water relative to past and/or budgeted use, will improve decisions, increase efficiency, and make us more resilient.



GOAL:

Improve data integration, tracking and reporting to strengthen decision-making

SAWPA

Indicator:	Metric:
Participation in an open data process	Percent of watershed population in agencies participating in establishment of a regional data sharing system

- Sufficient quantitative data was not available to assess this metric, and qualitative information was not available to determine whether the rating should be positive or negative. The metric was therefore given a qualitative neutral rating. Assessment of this metric can start to occur when water management agencies in the SAWPA region commit to the establishment of a regional trust framework needed for data sharing and management.
- The majority of the watershed population are in wholesale and retail water supply agencies that have taken initial steps to establish regional data sharing by engaging with the implementation of the Open and Transparent Water Data Act (AB 1755) and/or participating in the California Data Collaborative.
- Progress since 2014 adoption of the OWOW Plan includes the 2016 passage of AB 1755 and the development of the recommendations in the Data Management Pillar in the OWOW 2018 update.

Why Evaluate this Indicator?

Our ability to create data is outstripping our ability to make effective use of it. Ensuring that data produced is meaningful, is applied to decision-making, and is shared freely without jeopardy is a critical next step for the management of the watershed's supply and demand.

Insufficient Data

ATTACHMENT A

Assessment Implementation Sheets

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Achieve resilient water resources through innovation and optimization	
INDICATOR	**METRIC**
Maximization of locally-managed supplies	***Percent of total annual supply sourced or managed locally***

Implementation Approach

This indicator and associated metric attempts to quantitatively assess progress on regional and local water management efforts to become more resilient, given the changing climate and the resulting increased variability in imported water supplies. These efforts include increasing recycled water use to replace and increase potable supplies, increasing recovered groundwater, increasing utilization and recharge of surface water runoff, optimizing local groundwater basin storage and utilization with coordinated operation and wetter year recharge of imported supplies, and demand reduction measures. The metric quantifies the locally-sourced supply for the retailers in the watershed plus the water recharged into groundwater basins, including water imported in wetter years used for groundwater recharge (i.e., imports not immediately used to meet retailer demand as this becomes a locally managed supply for later use), on an annual basis. The summed annual production and recharge is divided by the total annual production and recharge (including imported water to meet retailer demand) to calculate the percentage of total supply met from the locally-managed supply. The primary source for the retail supplier production is the State Water Resources Control Board's Large Water System Drinking Water Program Electronic Annual Report (SWRCB EAR). Groundwater recharge data can be obtained from wholesalers, special districts, flood control agencies, and watermasters of adjudicated groundwater basins.

Output

The metric output is the percentage of the watershed's total annual supply, including recharge, that is met by locally-sourced and -managed supply, including recharge as defined above.

Data Sources

The retailer supply data was limited to the 53 retail water suppliers that have over 3,000 water meters or that serve customers over 3,000 acre-feet of potable water (i.e., retailers required to prepare Urban Water Management Plans); these 53 retailers serve nearly 98% of the Santa Ana River watershed's population.[1] The primary data source for the retailer supply prior to 2013 is the Department of Water Resources (DWR) voluntary Public Water System Statistics (PWSS) Survey.[2] Starting in 2013, the PWSS data was extracted from the mandatory data reports filed by drinking water suppliers to the SWRCB Large Water System Drinking Water Program Electronic Annual Report (SWRCB EAR). The EAR form requires retailers to report their monthly and

1 San Antonio Water Company (SAWCO) also files an Urban Water Management Plan. They wholesale water to qualifying retailers in the Inland Empire Utility Agency service area, but this agency was not included in the current retailer supply compilation. IEUA's annual water use report quantifies the sales and transfer of surface and groundwater to the IEUA retailers.

2 The PWSS survey data is used for the regional water supply and demand balances in the California Water Plan. See https://water.ca.gov/Programs/Water-Use-And-Efficiency/Land-And-Water-Use/Public-Water-Systems-Statistics-Surveys.

Achieve resilient water resources through innovation and optimization	
INDICATOR	**METRIC**
Maximization of locally-managed supplies	*Percent of total annual supply sourced or managed locally*

annual calendar year supply (disaggregated by the groundwater, surface water, untreated, recycled production, purchased water, and sales to other agencies) and metered water deliveries by customer class.

Detailed Implementation Steps

A detailed description of the implementation steps is not provided since the quantitative metric assessment could not be completed with current and historic data due to data deficiencies. Improvements in the systems used to capture data is expected to allow assessment of this metric in the future.

Once metric quantification is possible, trend assessment should compare current data to recent historic data by using the average value for the previous ten years to define recent historic conditions. This approach will help to distinguish variability in water supply due to annual water availability fluctuation from progress in increasing locally-sourced supply.

Implementation Challenges

The calculation of the metric is a percentage of total supply calculation once the data is compiled and accurately disaggregated by the source. Nonetheless, compiling accurate data can be quite challenging. In the 2007 to 2012 period, the PWSS survey did not have data for 6 to 7 of the 53 retailers.[3] The SWRCB EAR does not provide sufficient guidance for the retailers to report their supply sources in a consistent manner. Many of these discrepancies can be seen when comparing the data in the EAR reports with the data reported for a comparable year in their Urban Water Management Plans (UWMPs). Inconsistencies in the data reported to the EAR (described in more detail in the Implementation Challenges section below) stymied the assessment of this metric.

Observations about the EAR dataset made during the conduct of the current assessment include the following:

1. While most retailers report their imported water as purchased water, it appears that some of them report their purchased water as surface water production (reflecting perhaps that the source is from surface runoff to the Delta).[4]

2. Most retailers report groundwater from the desalters, which pump, treat, and sell saline groundwater, as purchased water, and thus it is lumped with the imported water.

3. Some, but not all, retailers report local surface supplies as purchased water while others report it as surface water.

4. At least one retailer that is also a wholesaler reported purchases and sales that appear to result in double-counting when compared to their retailer reports.

[3] The missing retailer data in the 2007-2012 period was not for the same set of 6 or 7 retailers in each year.

[4] The retailers in Orange County that purchase imported water directly from MWD reported their purchases as surface water. The reporting of each of the 53 retailers, however, was not examined in detail.

Achieve resilient water resources through innovation and optimization	
INDICATOR	**METRIC**
Maximization of locally-managed supplies	*Percent of total annual supply sourced or managed locally*

5. The EAR also has an "untreated" supply category which can be over 60 thousand acre-feet in some years, but it does not designate the source of that water.

6. The recycled production cannot be not disaggregated to determine whether it is sold to other users, or used for other purposes, such as to offset potable uses (e.g., landscaping), or used for habitat.

In addition, both the EAR and PWSS had quality control issues, with approximately 10 percent of the retailers having records requiring adjustment. In some cases, reported monthly totals and annual totals did not align. Some data values were clear outliers, potentially indicating inaccurate data entry. Units were also sometimes mismatched (for example, gallons entered into a column which should have been reported in acre-feet).

Results

Because the SWRCB Drinking Water annual report form had incomplete information for the retailers' supply reporting, resulting in numerous data inconsistencies, and procuring 2007 to 2017 data from the individual retailers was not feasible, no quantitative results are provided for this metric for either current or recent historic conditions.

Trend Discussion

While a more complete picture of locally-sourced or locally-managed supplies for the Santa Ana River watershed is not available, partial and regional data suggest that this metric may be increasing. Data from individual SAWPA wholesalers and for the larger MWD service area from the last 10 years indicate an increasing use of locally-managed supplies resulting from the investments in increased recycled water and groundwater recovery production in combination with demand reductions in this region.

For the current assessment, where data is lacking to show a trend, a qualitative neutral status is identified as the rating.

Going Forward

A cooperative effort by the watershed's water supply and management agencies, in concert with the State and local agencies to whom the data is reported, is needed to produce the quality data to quantitatively assess this metric. Currently there are opportunities and alignment of interests to rectify the data issues that inhibit the efficient quantification of this metric. DWR relies upon the retailer data reported to the SWRCB EAR for the regional water supply and demand assessments for the California Water Plan. DWR is aware of the data issues with the SWRCB EAR and the time-consuming effort to extract and confirm quality of the data for the California Water Plan and regional efforts, such as the OWOW Plan Update 2018. In addition, DWR is promoting and supporting regional data management efforts to develop indicators of sustainability, such as these OWOW indicators, as part of their implementation of the Open and Transparent Water Data

Achieve resilient water resources through innovation and optimization	
INDICATOR	**METRIC**
Maximization of locally-managed supplies	*Percent of total annual supply sourced or managed locally*

legislation (AB 1755).[5] DWR efforts align with OWOW plan goals to improve data integration, tracking and reporting as well as the Data Management Pillar's recommendations to establish data management and trust frameworks. Because of these alignments and opportunities, it is recommended that the watershed's water supply and management agencies engage with the State and regional agencies to whom the supply and demand data is reported to help produce quality data for this metric.

Assuming the retailer supply data reported SWRCB EAR can be accurately disaggregated by source, the data should be evaluated for consistency with comparable data reported in Urban Water Management Plans and wholesaler and watermaster annual reports. Individual wholesalers, such as Inland Empire Utility Agency (IEUA), compile annual reports with supply and demand data for their retailers, but it was not feasible in the allotted time for this assessment to determine if the wholesalers generally would be a source of retailer supply data. The groundwater recharge data sources—wholesalers, flood control agencies, special districts, and watermaster reports—were not examined for this effort once it became apparent that the data challenges would prevent metric analysis. Compilation of the groundwater recharge data will require careful evaluation for consistency with other regional reports reporting similar data.

References

Department of Water Resources (DWR), Public Water Systems Statistics Data from 2007 to 2016.

State Water Resources Control Board (SWRCB), Large Water System Drinking Water Program Electronic Annual Report, data for 2017.

5 As part of AB1755, DWR is also supporting efforts to automate some of the quality control review, such as mismatched units, which are not unusual and can be detected and corrected with software developed for those purposes.

Achieve resilient water resources through innovation and	
INDICATOR	**METRIC**
Efficiency of outdoor water use	*Proportion of watershed population in agencies using parcel-level data to assess outdoor water use*

Implementation Approach

This indicator focuses on outdoor water use from landscape irrigation because it is estimated to be the largest source of demand in the SAWPA watershed. Parcel-level data can be obtained using tax assessor parcel databases and with aerial imagery. For this assessment, the metric evaluated participation in SAWPA's procurement and distribution of parcel-level vegetation data for the Santa Ana River watershed in the 2015-2017 period. The metric is currently limited to a one-time measurement of program participation by the water supply agencies.

Output

The output for this metric is expressed as the percentage of the total watershed population served by agencies that had license agreements with SAWPA to receive the parcel level imagery and vegetation data.

Data Sources

In 2015 SAWPA procured high-resolution aerial imagery of the watershed. That imagery in combination with high-accuracy land survey and parcel data was analyzed to produce accurate measurements of landscape vegetation for the 1.4 million urbanized parcels within the Santa Ana River watershed. This data was made available to retail and wholesale water suppliers and other water management agencies in the watershed. The data was distributed in 2016 and 2017 to the agencies which had a license agreement with SAWPA.

The population of the participating retail agencies was obtained from the population reported to the State Water Resources Control Board (SWRCB) Large Water System Drinking Water Program Electronic Annual Report. Wholesalers and SAWPA member agency population was obtained from the websites of the individual wholesalers and SAWPA.

Detailed Implementation Steps

This initial effort was a straightforward process of obtaining from SAWPA the list of wholesale and retail water suppliers who had license agreements to receive the imagery and landscaped vegetation measurements. The metric calculation involved summing the population of the participating agencies and dividing it by the watershed population. A separate calculation was made for the participating retail suppliers and for the wholesalers and SAWPA member agencies.

Implementation Challenges

This indicator and metric initially intended to survey all 53 qualifying retailers and the wholesalers in the watershed to assess whether they were using or had used any kind of parcel-

Achieve resilient water resources through innovation and optimization	
INDICATOR	**METRIC**
Efficiency of outdoor water use	*Proportion of watershed population in agencies using parcel-level data to assess outdoor water use*

level data to quantify landscape water use and measures to improve its efficiency. The qualifying retailers are those which had over 3,000 water meters or that served customers over 3,000 acre-feet of potable water (i.e., retailers required to prepare Urban Water Management Plans). That effort was not undertaken in this initial effort because of time constraints.

Results

TABLE A.2-1
PROCUREMENT OF SAWPA AERIAL IMAGERY AND PARCEL-LEVEL VEGETATION DATA

Entity Type	Number of Entities	Percent of watershed population served
Wholesale water suppliers, SAWPA member agencies	6	95%
Retail water suppliers	36	74%

By 2017, all five SAWPA member agencies (four wholesalers and the Orange County Water District) plus the Municipal Water District of Orange County (wholesaler), which together serve 95% of the watershed's population, requested the SAWPA-procured 2015 aerial imagery and data. The imagery and data was also requested by 36 retail water suppliers, which serve 74% of the watershed's population. Although this effort did not systematically survey all the water agencies on the use of the data, information provided by SAWPA indicated that 16 of the participating retailers (nearly half) used the data to assess parcels for rate structure investigations.[1]

Trend Discussion

This effort provided a one-time snapshot of the participation in the SAWPA program to procure and distribute parcel-level data. No quantitative information was obtained on participation in SAWPA's cooperative program to procure aerial imagery in previous years; therefore, only a qualitative trend assessment can be made. Previous OWOW plans identified the need to shift the focus of water efficiency programs from indoor to outdoor water use. SAWPA is a leader in leveraging resources and providing support for regional water use efficiency efforts. In a September 2018 report to the Southern California Water Committee, the California Data Collaborative cited SAWPA's cooperative purchasing program for aerial imagery as an example of overcoming technology barriers through collaboration (p.30)[2]:

> Beginning in 2007, SAWPA has procured aerial imagery on behalf of the Santa Ana watershed, allowing local jurisdictions to utilize the imagery and analysis for water-related research and planning. In order to determine the watershed's imagery needs, SAWPA collects information from jurisdictions to understand the imagery requirements with regard to resolution and use before putting together a series of specifications for vendors. SAWPA is

1 10 of the 16 agencies adopted or are in the process of adopting water budget-based rate structures.

2 California Data Collaborative 2018 California water efficiency: leading the way into the future: A report to the SCWC Water Energy Task Force September 10 2018.

Achieve resilient water resources through innovation and optimization	
INDICATOR	**METRIC**
Efficiency of outdoor water use	*Proportion of watershed population in agencies using parcel-level data to assess outdoor water use*

able to tell each participating agency the precise costs for a variety of imagery options, allowing them to make an informed decision based on their available budgets. SAWPA is then able to charge a small administrative fee of 2.5% to participating agencies, far lower than the savings enjoyed through the cooperative purchasing process alone.

Going Forward

This effort did not survey the water management agencies to determine how they used the imagery and whether other parcel-level data is used for managing outdoor water use and developing conservation rate structures. A more complete assessment of the watershed’s use of parcel-level data, by surveying retailers and wholesalers in the watershed, is recommended.

Although this effort only resulted a one-time snapshot, it provides the potential to identify a trend, given SAWPA’s decade-long history of aerial imagery procurement and continued development and expansion of their program. SAWPA is currently developing an online web application and cloud services to provide water retailers access to aerial imagery and landscape measurement data.

References

State Water Resources Control Board (SWRCB), Large Water System Drinking Water Program Electronic Annual Report, data for 2017.

California Data Collaborative, California water efficiency: leading the way into the future: A report to the SCWC Water Energy Task Force September 10 2018.

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Ensure high quality water for all people and the environment.	
INDICATOR	**METRIC**
Maintenance of groundwater salinity at or below target levels	*Non-exceedance of groundwater salinity standards*

Implementation Approach

The salinity of groundwater is evaluated using the water quality modeling analysis conducted for the Triennial Basin Plan review for the Santa Ana Regional Water Quality Control Board (RWQCB). This analysis is used to establish the assimilative capacity for salt, or the ability to accept additional salt inputs without impairing water quality, for 37 different groundwater management zones within the Santa Ana River watershed. This is determined by the difference between estimated ambient water quality in terms of total dissolved solids, or TDS, and a water quality target established for each groundwater management zone. Ambient water quality shown for any given year is based on data for the 20 years prior to and including that year. The water quality target established for each groundwater management zone was set at the greater of the following: the water quality objective (WQO) established by the RWQCB, or 500 mg/l of total dissolved solids. Where established, the “maximum benefit” WQO was used as the WQO. The 500 mg/l criterion was adopted as the recommended maximum criterion for consumer acceptance established by the State. This criterion protects all municipal beneficial uses.

Conditions for each groundwater management zone were considered “good” if water quality objectives were substantially met and “bad” if they were not, for both recent and prior conditions. The evaluation was then made to determine whether the sequencing of prior to recent conditions warranted a positive, neutral, or negative trend result according to **Table A.3-1**.

TABLE A.3-1
GOOD-BAD ASSESSMENT SYSTEM

Prior Conditions	Recent Conditions	Result
GOOD	GOOD	+1
BAD	GOOD	+1
GOOD	BAD	-1
BAD	BAD	0 (if appreciably better)
BAD	BAD	-1 (if similar or worse)

The trend results were then weighted by the volume of groundwater estimated in storage in each groundwater management zone. Weighted results were then totaled to produce an overall score, which was rated using the criteria shown in **Table A.3-2**.

Ensure high quality water for all people and the environment.	
INDICATOR	**METRIC**
Maintenance of groundwater salinity at or below target levels	*Non-exceedance of groundwater salinity standards*

TABLE A.3-2
RATING SYSTEM

Result	Criterion
Positive	Score ≥ 0.50
Neutral	0.40 < Score < 0.50
Negative	Score ≤ 0.40

Output

The targeted output for each metric is a weighted average "good/bad"-based score for all current groundwater management zones under current conditions.

The "good/bad"-based scoring system is reflective of trends but configured to highlight conditions status relative to regulatory or generally-accepted water quality standards. If those standards are met, conditions are considered to be "good." This approach is considered more appropriate than suggesting that continued improvement beyond those standards was needed, as a simple trend analysis might imply.

Data Sources

The salinity of groundwater was evaluated using the analysis conducted for the Triennial Basin Plan review, specifically the Triennial Recomputation of Ambient Water Quality for the Santa Ana River Watershed for the Period 1996-2015 (DBS&A 2017), available at: https://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/docs/SMP/2017/AWQ-Tech-Memo_9-22-2017.pdf. Table 2-2 in this document provided estimated groundwater volumes used for weighting the results, while Table 3-1 in the document provided WQOs, assimilative capacity, and salinity over time, expressed as Total Dissolved Solids, or TDS.

In all cases, the "maximum benefit" water quality objectives were used for the basins that had them.

Detailed Implementation Steps

Analyses prepared to support the Triennial Review of the Basin Plan for salinity were reviewed to obtain the needed salinity data. TDS concentrations in each of the groundwater management zones for the most recent analysis (representing ambient conditions for the 20-year period ending in 2015) were evaluated to determine whether water quality targets were met. If so, a condition assessment of "good" was made for that basin. If not, the condition assessment was "bad."

A prior triennial estimate of ambient conditions was then assessed. Because each triennial assessment represents the ambient conditions of the preceding 20-year period, the 2015 analysis represents the period from 1996-2015. The triennial estimate ending halfway through the 20-year period of this most recent assessment (2006) was therefore selected for historical comparison, so that the two periods being compared have only 10 years of overlap. The TDS concentrations from the 2006 triennial assessment, covering the years 1987-2006, were compared to the water quality

Ensure high quality water for all people and the environment.	
INDICATOR	**METRIC**
Maintenance of groundwater salinity at or below target levels	*Non-exceedance of groundwater salinity standards*

targets; if that standard was met in a given zone, then recent historic conditions were assessed as "good." If not, they were assessed as "bad."

The most recent assessment results were then compared to those representing recent historic conditions to generate results per Table A.3-1. For the purposes of applying Table A.3-1, a score had to improve by more than 10 milligrams/liter to be considered "appreciably better." Those results were then weighted by groundwater volume and summed to provide the overall score for the metric. Weights for the results were established using groundwater volumes from Table 2-2 of the DBS&A report (2017).[1] The score was then evaluated using the criteria in Table A.3-2.

Implementation Challenges

The primary challenge associated with evaluating this metric is that data are only generated every three years, and then only for a period ending two years prior to the year in which values are published. Thus, annual updates may not be possible, and assessments may always rely on data from conditions two or more years prior to the current year.

An additional challenge is that some water quality estimates are missing. Because the basins that lacked enough data were assumed to be less important sources of water supply, basins missing an estimate of water quality under historic or current conditions were omitted from the analysis. Only 29 out of 37 groundwater management zones had enough data to produce findings.

Results

TABLE A.3-3
FINDINGS

Time Frame	Good Conditions	Bad Conditions
Current (1996-2015)	16 zones	13 zones
Recent Historic (1987-2006)	19 zones	10 zones

Using the findings above in **Table A.3-3** and the rubric established in Table A.3-1, results were generated for each groundwater management zone and modified by applying weights based on the groundwater volume in storage within each management zone. When these results were summed, a score of 0.53 was produced. This score yields a positive rating, based on the Rating System defined in Table A.3-2.

Trend Discussion

Because more than half (53 percent) of the groundwater volume in the groundwater management zones of the Santa Ana River watershed exists in four of the groundwater management zones, the

[1] An exception was made for the Orange County groundwater management zone, which was weighted using its active management volume of 500,000 acre-feet (OCWD, 2015) instead of the modeled aquifer volume of 23,600,000 acre-feet.

Ensure high quality water for all people and the environment.	
INDICATOR	**METRIC**
Maintenance of groundwater salinity at or below target levels	*Non-exceedance of groundwater salinity standards*

score for this metric will be primarily driven by what happens in these four groundwater management zones: Beaumont, Bunker Hill-B, Chino-North, and Irvine. In the current analysis, all but Irvine were found to warrant a positive rating, helping to keep the overall rating in the positive zone. The decline in the number of groundwater management zones in good condition from recent historic to current conditions, a drop from 19 to 16, may be due in significant part to the reduction in both natural recharge and use of imported water for groundwater recharge during the 2011-2016 drought.

Historical ambient water quality conditions in the groundwater management zones (based on 1954-1973 data) were typically better than current conditions.

Going Forward

The use of a 500,000 acre-foot management volume for the Orange County Groundwater Management zone should be revisited for appropriateness.

It may be possible to obtain information prior to the publication of the supporting analysis for the triennial review sufficient to perform analysis of this metric more often than once every three years—provided it is determined prudent to perform an assessment based on pre-publication data. The Triennial Review analysis of the 1999-2018 period may begin in late 2017 or early 2018 and may begin with the review of recent monitoring results that may be sufficient to allow 2016, 2017, or 2018 data to be assessed on an interim basis relative to historic assessment results, prior to the completion of modeling analysis. This opportunity can be evaluated.

The hypothesis that a 10-year period of non-overlap between 20-year periods of estimated ambient water quality is appropriate to use for a water quality trend analysis can also be revisited.

References

Daniel B. Stephens & Associates, Inc. [DBS&A]. 2017. Technical memorandum: Recomputation of ambient water quality in the Santa Ana River Watershed for the Period 1996 to 2015. Prepared for the Santa Ana Watershed Project Authority Basin Monitoring Program Task Force under contract.

Orange County Water District [OCWD]. 2015. Groundwater Management Plan 2015 Update, June 17.

Ensure high quality water for all people and the environment	
INDICATOR	**METRIC**
Safety of water for contact recreation	***Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination***

Implementation Approach

The safety of water for contact recreation was evaluated using routinely-collected monitoring datasets collected for inland and coastal water quality at sites used for recreation involving water contact. Conditions at each site were considered “good” if water quality objectives were substantially met and “bad” if they were not, for both recent and prior conditions. The evaluation was then made to determine whether the sequencing of prior to recent conditions warranted a positive, neutral, or negative trend finding according to **Table A.4-1**.

TABLE A.4-1
GOOD-BAD ASSESSMENT SYSTEM

Prior Conditions	Recent Conditions	Result
GOOD	GOOD	+1
BAD	GOOD	+1
GOOD	BAD	-1
BAD	BAD	0 (if appreciably better)
BAD	BAD	-1 (if similar or worse)

The “good/bad”-based scoring system is reflective of trends but configured to highlight conditions status relative to regulatory or generally-accepted water quality standards. If those standards are met, conditions are considered to be “good.” This approach is considered more appropriate than suggesting that continued improvement beyond those standards was needed, as a simple trend analysis might imply. The good-bad assessment results were then averaged to produce an overall score (Score = Average of the findings), which was rated using the criteria in **Table A.4-2**.

TABLE A.4-2
RATING SYSTEM

Rating	Criterion
Positive	Score ≥ 0.80
Neutral	0.60 < Score < 0.80
Negative	Score ≤ 0.60

Separate scores are produced for inland and coastal water quality, separate ratings established, and then combined, using equal weighting for each. To combine the ratings for coastal and inland areas, the following system is applied:

Ensure high quality water for all people and the environment	
INDICATOR	**METRIC**
Safety of water for contact recreation	*Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination*

> Positive trend: One score shows a positive trend and the other score shows a positive or neutral trend.
>
> Neutral trend: Either both scores show a neutral trend or one is positive and one is negative.
>
> Negative trend: One score shows a negative trend and the other score shows either a negative or neutral trend.

Output

The targeted output for each metric is an average "good/bad"-based score for all current sites under current conditions.

Data Sources

Inland water quality monitoring data and compliance analysis was obtained from the Santa Ana River Watershed Bacteria Monitoring Program Annual Report (accessible from https://www.waterboards.ca.gov/santaana/water_issues/programs/planning/Bacteria_Monitoring_Program.html). Coastal water quality information is based on data and analysis used to generate the *Beach Report Card* (the 2017-2018 report is accessible at https://healthebay.org/wp-content/uploads/2018/07/BRC_2017-2018_07-12-18.pdf) and was obtained directly from Heal the Bay.

Inland water quality

The inland water quality monitoring data used for this metric was that associated with high-frequency use primary contact recreation sites, which are designated as Priority 1 sites and REC1 Tier A waters in the Santa Ana River Basin Plan.

> Eight monitoring sites, identified as REC1 Tier A waters, are included for Priority 1 monitoring. This includes four lakes: Big Bear Lake, Lake Perris, Canyon Lake, and Lake Elsinore; and four flowing water sites: SAR Reach 3 (two sites), Lytle Creek, and Mill Creek Reach 2. Five sites are located in Riverside County and two sites are located in San Bernardino County.
>
> …
>
> Dry weather sample collection occurs during both warm, dry (April 1 – October 31) and cool, wet (November 1 – March 31) season periods…. Priority 1… sites were monitored weekly for twenty consecutive weeks during the warm, dry season and for five consecutive weeks during the cool, wet season.
>
> …
>
> The compliance analysis compares the E. coli geomeans to the Santa Ana Basin Plan geomean WQO of 126 MPN/100 mL.
>
> (SAWPA, 2018)

Ensure high quality water for all people and the environment	
INDICATOR	**METRIC**
Safety of water for contact recreation	*Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination*

Notes:

1. SAR stands for Santa Ana River.
2. A geomean or geometric mean is the *n*th root of the product of *n* numbers.
3. WQO stands for Water Quality Objective.
4. MPN stands for Most Probable Number, or the count of organisms present. The acronym "mL" stands for milliliters, or a one thousandth of a liter.

Because there are so few sites, they are identified in **Table A.4-3** below.

TABLE A.4-3
INLAND WATER QUALITY SITES

Site ID	Name
P1-1	Canyon Lake at Holiday Harbor
P1-2	Lake Elsinore
P1-3	Lake Perris
P1-4	Big Bear Lake at Swim Beach
P1-5	Mill Creek Reach 2
P1-6	Lytle Creek (Middle Fork)
WW-S1	Santa Ana River Reach 3 at MWD Crossing
WW-S4	Santa Ana River Reach 3 at Pedley Avenue

More details on the methodology and basis for the site selection are available in the Annual Report.

Coastal water quality

Coastal water quality scores were based on more than 50 monitoring sites along the coast of the watershed compiled in the Beach Report Card. The Beach Report Card uses data compiled from "routine beach water quality sampling conducted by county health agencies, sanitation departments, and dischargers. Water samples are analyzed for three fecal indicator bacteria (FIB) that indicate pollution from numerous sources, including human and animal waste. These FIB are total coliform, fecal coliform (Escherichia coli), and Enterococcus spp." These data are analyzed for three different time periods over the April-March period:

Summer dry season (April-October)

Winter dry season (November – March)

Year-round wet conditions (April – March)

Based on the monitoring data, a score of A+, A, B, C, D, or F is given to each site for each of the three seasons identified above. The assessment used only the dry season scores, as these are more indicative of conditions that affect most beachgoers.

Ensure high quality water for all people and the environment	
INDICATOR	**METRIC**
Safety of water for contact recreation	*Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination*

More details on the methodology and basis for the site selection are available in the annual Report Card.

The assessment approach used for both beach and inland sites relies on determining, for each site, whether improvements or degradation have occurred based on a comparison of current (as recent as available) versus prior period conditions. As a roll-up score, the average finding (for all positive, neutral, and negative findings) is used to generate a score. The beach and inland water quality findings are each assessed independently.

Detailed Implementation Steps

Inland water quality

The most recent Santa Ana River Watershed Bacteria Monitoring Program Annual Report was reviewed for its dry weather *E. coli* Priority 1 site results. "Good" scores were assigned to all sites with readings over the course of the year that produce a geomean exceedance frequency of 0% - 10%. A finding of "bad" was assigned to all other sites.

The most recent results were compared to those of the prior year to generate findings according to **Table A.4-1** and then those findings were averaged to produce a score. The score was then evaluated using the criteria in **Table A.4-2**. For the purposes of applying Table A.4-1, a score must improve by more than 10% to be considered "appreciably better."

Because dry weather flows are not expected to vary significantly due to year-to-year hydrologic variability, and because the current sites have only been evaluated and reported on in a consistent fashion for two years, prior year findings were used as a point of comparison instead of comparing to a multi-year average of prior year findings.

Coastal water quality

The most recent Beach Report Card evaluation was obtained for the relevant sites. Values are assigned as shown in **Table** A.4-**4**.

TABLE A.4-4
BEACH GRADES AND VALUATION

Grade	Numeric Range	Value
A, A+	100%-90%	4
B	89%-80%	3
C	79%-70%	2
D	69%-60%	1
F	<60%	0
–	–	0

Ensure high quality water for all people and the environment	
INDICATOR	**METRIC**
Safety of water for contact recreation	*Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination*

A grade of A or A+ receives an assessment of "good"; all other grades receive an assessment of "bad." The current assessment was then compared to the average value of dry season grades for the prior 3 years. For this multi-year average of two grades per year, any value of 7 or above was considered "good."

The most recent results were compared to those of the prior year to generate findings according to Table A.4-1 and then those findings were averaged to produce a score. The score was then evaluated using the criteria in Table A.4-2. For the purposes of applying Table A.4-1, a score had to improve by more than one point in value, equivalent to one letter grade, to be considered "appreciably better."

Implementation Challenges

1. For both inland and coastal water quality, data bridges the calendar year—each report runs from April through March—which is not fully consistent with the time periods assessed for other metrics.

2. For both data sets, changes in location and the approach to assessing data can be expected to occur from time to time. This was addressed by using only reasonably consistent datasets for comparison and was not seen to be a significant impediment in the current assessment.

3. A limited data set was available for each metric, as both sites and methodologies have evolved over time. For inland water quality, data was available for only the two most recent years. This was determined to be adequate, as dry season water quality is hypothesized to not be significantly affected by hydrologic variability. For coastal water quality, data was available for both summer and winter dry periods for only four years, allowing only a 3-year average as a point of comparison for trend analysis between current and recent historic conditions.

4. The coastal data set is missing some grades. These were assessed as having zero value, consistent with an "F" grade.

Results

TABLE A.4-5
ASSESSMENT RESULTS AND RATING

Metric	Score	Rating
Inland	0.63	Neutral
Coastal	0.81	Positive
Combined		**Positive**

Trend Discussion

Inland water quality

Six out of eight inland water quality sites showed "good" results for both the 2017-2018 and 2016-2017 assessment years, with both the Santa Ana River sites producing results that were

Ensure high quality water for all people and the environment	
INDICATOR	**METRIC**
Safety of water for contact recreation	*Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination*

classified as "bad." However, one of the two sites exhibited significantly reduced (improved) exceedance values, dropping from 82% to 53%.

While a longer-term comparable dataset is not readily available, experts note that while measured bacteria concentrations have been increasing, the total load has not been, even as population has continued to grow. A significant driver in those concentration increases has been the increase in stormwater and recycled water diversions for groundwater recharge (Tim Moore, personal communication).

Coastal water quality

A total of 49 out of 58 or 85%of coastal water quality sites were identified as having "good" water quality in 2017-2018, compared to 41-49 or 71 – 85% of sites in the preceding three years (2014-2017). Only two sites identified as having "bad" water quality in 2017-2018 had failed to improve appreciably, compared to average conditions over the prior three years.

Going Forward

Inland water quality results should be scrutinized in future years to assess whether the hypothesis that dry season water quality is not significantly affected by hydrologic variability is supported.

Coastal water quality trend findings should be based on a longer multi-year average than three years, as they are hypothesized to be significantly affected by hydrologic variability. The multi-year basis for comparison should be extended to 5 years or more, as data becomes available.

References

Heal the Bay, 2018. 2017-2018 Beach Report Card.

SAWPA (Santa Ana Watershed Project Authority), 2017. Santa Ana River Watershed Bacteria Monitoring Program Annual Report: 2016-2017 FINAL REPORT.

SAWPA (Santa Ana Watershed Project Authority), 2018. Santa Ana River Watershed Bacteria Monitoring Program Annual Report: 2017-2018 FINAL REPORT.

Preserve and enhance recreational areas, open space, habitat,	
INDICATOR	**METRIC**
Abundance of vegetated riparian corridor	***Area of vegetated riparian corridor***

Implementation Approach

The abundance of vegetated riparian corridor was evaluated using an analysis approach developed by the US Forest Service in conjunction with the School of Forest Resources & Environmental Science at Michigan Technological University. Software developed to implement this process uses readily-available streams, topography, and hydrologic data to identify an estimated riparian corridor area for a given stream network, and then uses an annually-generated national land cover dataset to calculate the areas of different land cover types within the riparian corridor. Within the defined riparian corridor, lands with forest, shrubland, wetlands, and open water are defined as vegetated riparian area. Areas with land cover defined as crops, developed, or barren are excluded. This process is executed within the SAWPA boundary to determine the vegetated riparian area within the Santa Ana River watershed.

Trends for vegetated riparian area are evaluated by comparing the most recent results for vegetated riparian area to the average for the five previous years. This multi-year averaging approach was taken to reduce the influence of hydrologic variability on baseline land cover conditions. The trend is used to identify the rating. Thresholds used to identify the trend are shown in **Table A.5-1** below.

TABLE A.5-1

TREND RATING SYSTEM

Rating	Criterion
Positive	Result ≥ 1,000 acres
Neutral	-1000 acres < Result < 1,000 acres
Negative	Result ≤ -1,000 acres

Output

The output of the analysis process is the area of vegetated riparian corridor.

Data Sources

The analysis process uses stream gage data to estimate 50-year flood levels for a range of stream sizes, or orders, based on a stream’s relationship to its headwaters and incoming tributaries. Additionally, it uses multiple nationally-generated datasets, as shown in **Table A.5-2**. The land cover dataset is generated annually to provide estimates of crop acreages of major commodities using satellite imagery at a 30-meter resolution.

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	
INDICATOR	**METRIC**
Abundance of vegetated riparian corridor	*Area of vegetated riparian corridor*

TABLE A.5-2
DATA SOURCES

Data Type	Source Name	URL
Stream gage data	USGS stream gaging network	*https://maps.waterdata.usgs.gov/mapper/index.html*
Stream network	USGS National Hydrography Dataset	*http://nhd.usgs.gov*
Topographic data	The National Map	*http://nhd.usgs.gov/*
Land cover data	CropScape	*https://nassgeodata.gmu.edu/CropScape/*

Detailed Implementation Steps

Directions for data preparation are available at: https://docs.wixstatic.com/ugd/d5da6c_dd8e6178b3114dac9e2a5e3c1f99abe4.pdf.[1] A toolbox for implementation is available at www.riparian.solutions.

Implementation notes:

Use no spaces or special characters in watershed feature class names; make sure field types (double, long integer) are correct.

Make sure all input data share the same projected coordinate system using meter linear units. When reprojecting rasters, it is important to maintain the same pixel/cell size for projected rasters.

Create separate file geodatabases to store vector data and raster data (e.g., project_vector.gdb and project_raster.gdb). If everything is stored in a single geodatabase file, Arcmap may delete all rasters during script processing to free up resources.

The toolbox includes a utility to check the input files to ensure projections and field names/types are correct for processing.

Determine 50-year flood heights for stream order/levels within study area using this guide - https://docs.wixstatic.com/ugd/d5da6c_5e1ba4a770804211834b1e6a513ed960.pdf.

For the current analysis, data from 17 gages were used and the 50-year flood estimates from the worksheets for each stream order were averaged to generate the model 50-year curve. Three estimates were excluded as outliers that seemed to be drastically affecting the model fit. The more plausible polynomial (2nd order) model fit was used to generate the "FloodData" required—that is, a modeled 50-yr flood height for each stream order in the data set. The "FloodData" and related riparian buffers generated for the current analysis need not be regenerated until at least 10

1 For this analysis, the standard approach was applied without accounting for soil types, which were not expected to be helpful for defining riparian corridors in this region.

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	
INDICATOR	**METRIC**
Abundance of vegetated riparian corridor	*Area of vegetated riparian corridor*

years of additional gage data are available, additional gages with at least 10 or more years of data become available, or additional stream vectors are added.

The watershed area, at about 2.6 million acres, includes more than 100 subwatersheds at the "HUC-12" level. The tool loops through each subwatershed in turn, first generating a buffer around the stream vectors, creating a buffer feature class within a new geodatabase for each subwatershed. A script was used to combine all the subwatershed geodatabases into a single file. This produced the riparian corridor extents dataset. The land cover datasets from CropScape were then overlain to extract the land cover areas within the riparian corridors. Within the defined riparian corridor, lands with forest, shrubland, wetlands, and open water were defined as vegetated riparian area. Areas with land cover defined as crops, developed, or barren were excluded. Total vegetated riparian areas within the riparian corridor extents were calculated.

TABLE A.5-3
LAND COVER DATASETS USED

Time Frame	CropScape
Current	2017
Recent Historic	2012-2016

Implementation Challenges

Riparian corridors are approximately defined, though in a way that provides consistency in approach. Similarly, the land cover data is being generated for a different purpose than tracking the abundance of riparian vegetation and no doubt imperfectly characterizes these land cover conditions, but at least is generated in a relatively consistent fashion. From time to time, changes in methodology or satellite imagery characteristics used to generate the land cover dataset may trigger changes in results from one year to the next that are not driven by changes on the ground.

Results

TABLE A.5-4
ANALYSIS RESULTS (ACRES)

Time Frame	Riparian Vegetation	Other
Current (2017)	21,727	27,060
Recent Historic (2012-2016)	20,518	28,268

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	
INDICATOR	**METRIC**
Abundance of vegetated riparian corridor	*Area of vegetated riparian corridor*

Trend Analysis

The data shown in **Table A.5-4** above was analyzed to determine the change in acres from the calculated recent historic average to current conditions. The result is presented in **Table A.5-5** below.

TABLE A.5-5
TREND ANALYSIS RESULTS

Time Frame	Change (acres)
Recent Historic (2012-2016) to Current (2017)	1,209

Because the average annual change from recent historic to current conditions exceeds 1,000 acres, the trend analysis and therefore the rating for this metric is positive.

Going Forward

No recommendations.

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function

INDICATOR	METRIC
Abundance of conserved open space	*Area of conserved open space*

Implementation Approach

Multiple data sources are used to identify the area of conserved open space. Conserved open space is defined as including lands owned in fee title for open space purposes, conservation easements, and agricultural lands that are restricted from development under the Williamson Act. Conservation easements are deed-based restrictions on private land that limit its uses to those compatible with maintaining it as open space. Williamson Act restrictions provide landowners with a tax break when they enroll their agricultural or open space lands in the program, which requires that the lands be kept in agriculture or open space for a rolling 10-year period.

GIS datasets representing these land areas are developed by others and are readily available. These datasets are intersected with the SAWPA boundary to identify the total area of land within these categories within the watershed. Comparison of the most recent data to recent historical data is used to identify the trend for this metric, and the trend is used to identify the rating. Thresholds used to identify the trend are shown in **Table A.6-1** below.

TABLE A.6-1
RATING SYSTEM

Rating	Criterion
Positive	Result ≥ 1,000 acres
Neutral	-1,000 acres < Result < 1,000 acres
Negative	Result ≤ -1,000 acres

Output

This analysis generates an estimate of the area of conserved open space within the Santa Ana River watershed, including lands owned in fee title for open space purposes, conservation easements and agricultural lands restricted from development.

Data Sources

Lands identified in the California Protected Areas Database (CPAD), California Conservation Easement Database (CCED), and Williamson Act lands are used to represent the total area of conserved open space. Both CPAD and CCED are maintained by the California-based nonprofit organization GreenInfo Network. Williamson Act lands are tracked by county tax assessors' offices.

Lands identified in CPAD are compiled from data provided by approximately 1,100 public agencies or nonprofit organizations. It is known to be incomplete and is subject to continual updating. Until recently, data entry did not include the time of acquisition of the land. The most

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	
INDICATOR	**METRIC**
Abundance of conserved open space	*Area of conserved open space*

recent dataset available is from August 2017. Prior datasets have been released one to two times per year, dating back to the first release in May, 2008.

Lands identified in CCED were compiled from multiple sources (approximately 215 public agencies or nonprofit organizations). It is known to be incomplete and is subject to continual updating. Until recently, data entry did not include the time of acquisition of the easements. The first version of the dataset was released in April 2014. It was used to represent recent historic conditions. The second and most recent dataset was released in December 2016.

Because Williamson Act datasets are associated with tax assessment, these datasets are expected to be both current and complete.

Detailed Implementation Steps

Recent and historic CPAD and CCED datasets were downloaded from http://www.calands.org/data.

Williamson Act datasets were obtained from the three primary counties in the Santa Ana River Watershed: Orange, Riverside, and San Bernardino. (Data for Los Angeles County, which contains a very small part of the watershed, was not included.) No data was available for 2016 Orange County Williamson Act lands; these were counted as zero.

TABLE A.6-2
RELEASE DATASETS USED

Time Frame	CPAD	CCED	Williamson Act
Current	August 2017	December 2016	2016
Recent Historic*	March 2014	April 2014	2014
Older Historic	July 2012	Not Available	2012

* The analysis used 2014 to represent recent historic conditions, as that was the most recent prior data for the CCED dataset.

Datasets were overlain with the SAWPA boundary and any overlapping areas of the datasets within that were clipped to avoid double-counting. Total acreages were identified for “current” and “recent historic” time periods. A difference in the total land area classified as conserved open space in current conditions compared to recent historic conditions was identified as the score. The result was evaluated according to the criteria shown in Table A.6-1 to determine the rating.

Implementation Challenges

1. Data incompleteness – Both the CPAD and CCED datasets are known to be incomplete. The addition of missing data causes the apparent area of conserved open space to grow when no changes in land protection have occurred. Efforts are underway to address this issue by adding acquisition dates to the dataset, but enhancing the dataset will take time and relies in significant part on voluntary actions. It would be possible in the future for actors within the Santa Ana River watershed boundary to make a concerted investment in improving both

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	
INDICATOR	**METRIC**
Abundance of conserved open space	*Area of conserved open space*

CPAD and CCED within the watershed to improve the quality of the data used to evaluate this metric.

2. Irregular release dates – Both CPAD and CCED are released periodically but irregularly. As a result, "current" conditions may not be very current, and datasets added together mix different snapshots in time.

Results

TABLE A.6-3
ANALYSIS RESULTS

Time Frame	CPAD (square miles)	CCED (square miles)	Williamson Act (square miles)	Total (square miles)	Total (acres)
Current (2016-2017)	905	24	407	1,337	855,501
Recent Historic (2014)	880	18	433	1,331	851,868
Older Historic (2012)	887	NA	440	1,327	849,010

Trend Analysis

The data shown in **Table A.6-3** above was analyzed to determine the average annual change in acres. Because the most current dataset covers a 2-year span, an assumption of 2.5 years for the time period from recent historic to current conditions was made. The results are presented in **Table A.6-4** below.

TABLE A.6-4
TREND ANALYSIS RESULTS

Time Frame	Years Assumed for Averaging	Average Annual Change (acres)
Recent Historic (2014) to Current (2016-2017)	2.5	1,453
Older Historic (2012) to Recent Historic (2014)	2	1,429

Because the average annual change from recent historic to current conditions exceeds 1,000 acres, the trend analysis and therefore the rating for this metric is positive.

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	
INDICATOR	**METRIC**
Abundance of conserved open space	*Area of conserved open space*

Going Forward

As noted above under implementation challenges, there is an opportunity for players within the Santa Ana River watershed to improve the quality of the data on which this metric relies. The CPAD and CCED datasets both accept input to improve datasets. In particular, adding information on when acquisitions were made would greatly improve the utility of this dataset for assessment purposes.

References

GreenInfo Network, California Protected Areas Database (CPAD) and California Conservation Easement Database (CCED). http://www.calands.org/data.

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	**METRIC**
Equitable access to clean drinking water	***Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community***

Implementation Approach

To assess this indicator and metric, one existing dataset compiled by the state Office of Environmental Health and Hazard Assessment (OEHHA) was overlaid with a dataset compiled by the state Department of Water Resources (DWR) in a geographic information system (GIS). Both datasets were available by census tract. The purpose was to understand the extent to which drinking water contamination is an environmental justice issue in the watershed and whether that issue is increasing or decreasing over time.

The rating system used for this indicator and metric is reflective of trends but configured to primarily highlight the change in water quality in less-resourced parts of the community. An improvement in water quality in the less-resourced parts of the community (LR), along with no decline in water quality in more-resourced parts of the community (MR), was considered a positive trend. Other combinations of the change in index value for less-resourced and more-resourced parts of the community were considered either neutral or negative trends. Unless drinking water quality in less-resourced parts of the community improves, the rating cannot be a positive trend. In summary,

> Positive trend: LR result shows an improving trend and MR result shows an improving trend or neutral trend.
>
> Neutral trend: LR and MR results both show a neutral trend.
>
> Negative trend: At least one result shows a worsening trend.

The rating system shown in **Table A.7-1** identifies the rating given to changes in the LR or MR result. For example, in order to show an improving trend, the LR result would need to improve by over 10% between current and historic conditions. Anything less than 10% change in the LR result would show a neutral trend for the LR.

TABLE A.7-1
TREND RATING SYSTEM

Rating	Criterion
Positive	Result ≥ 10% decrease
Neutral	-10% < Result < 10%
Negative	Result ≥ 10% increase

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	**METRIC**
Equitable access to clean drinking water	*Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community*

Output

The output for this metric consists of a combination of the trend in mean drinking water quality index scores of the less-resourced parts of the community and the more-resourced parts of the community.

Data Sources

California Water Code Section 79505.5(a) defines a "disadvantaged community" as a community with annual median household income that is less than 80 percent of the statewide annual median household income. The Department of Water Resources (DWR) uses data from the U.S. Census Bureau American Community Survey to characterize areas (census tracts) throughout California where people would be considered as members of "disadvantaged communities" in accordance with the Water Code definition. Areas where people who would be considered members of disadvantaged communities as identified in the DWR data were considered less-resourced parts of the watershed community for purposes of this analysis. All other census tracts within the watershed were considered more-resourced parts of the community.

Data from CalEnviroScreen version 3.0, based on 2005-2013 data and completed in 2017, was used in this assessment.[1] The temporal range of data used represented three compliance periods, and was selected due to the fact that some water supply systems only test once during a cycle. The next version of CalEnviroScreen is planned for release in 2019; with that version the indicator will be based on data from 2008 through the current compliance period. The indicator score is calculated using average contaminant concentrations over the three compliance periods.

The drinking water contaminant index combines information about 13 contaminants and 2 types of water quality violations that are sometimes found when drinking water samples are tested.[2] The index values across California range from less than 165 to over 812. A higher value indicates increased contaminant presence. The following five steps were used in CalEnviroScreen to calculate the index.

1. Establish drinking water system boundaries.
2. Associate water contaminant data with each drinking water system, and calculate average contaminant concentrations.
3. Reallocate each drinking water systems' average water contaminant concentrations to census tracts.

[1] CalEnviroScreen 3.0 geodatabase can be downloaded from https://oehha.ca.gov/calenviroscreen/maps-data/download-data.

[2] The contaminants are arsenic, cadmium, hexavalent chromium, dibromochloropropane (DBCP), lead, nitrate (NO3), perchlorate, radium 226 and 228, total trihalomethanes (THM), tetrachloroethylene (PCE), trichloroethylene (TCE), 1,2,3-trichloropropane, and uranium. The two violation types evaluated were maximum contaminant level (MCL) violations and total coliform rule violations.

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	**METRIC**
Equitable access to clean drinking water	*Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community*

4. Rank census tracts to obtain percentile score for each contaminant and tract.
5. Calculate census tract contaminant index, which is the sum of the percentiles for all contaminants.

Contaminant data from the following sources were used to calculate the index:

- CDPH drinking water systems geographic reporting tool
- CDPH Public water system location data in the PICME database
- US EPA Safe Drinking Water Information System
- CDPH Water Quality Monitoring Database
- SWRCB GAMA Domestic Well Project
- SWRCB and USGS GAMA Priority Basin Project

Detailed Implementation Steps

The most recent drinking water contaminant and disadvantaged community data was downloaded from the CalEnviroScreen website. Using GIS, census tracts within the SAWPA boundary were identified and evaluated. All areas within disadvantaged communities were identified as less-resourced, and areas outside of disadvantaged communities were identified as more-resourced. The average index value was identified for both less- and more-resourced areas.

Data for recent historic conditions was not evaluated during the current assessment, as comparable data did not exist.

Implementation Challenges

CalEnviroScreen 3.0 used the same compliance data as CalEnviroScreen 2.0 (data collected over the three compliance periods during 2005-2013), and CalEnviroScreen 1.0 used a different metric to evaluate water quality (the indicator was “impaired water bodies,” and the metric was summed number of pollutants across all water bodies designated as impaired within each zip code). In CalEnviroScreen 1.0, a score was assigned to each zip code instead of each census tract, each zip code was scored based on the sum of the number of individual pollutants found within and/or bordering it, and the score was based on surface water quality, not necessarily on drinking water. For this reason, a trend analysis for this indicator was not completed with this implementation of the assessment.

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	**METRIC**
Equitable access to clean drinking water	*Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community*

Results

TABLE A.7-2
WATER CONTAMINANT INDEX RESULTS

Estimated Population	Mean Water Contaminant Index Score	Total Tracts	Total Area (square miles)	Percent (Number) of Tracts Above the Mean Watershed Index Score
Less-Resourced Parts of the Community				
1,716,533	628.53	335	717.4	56.6 (188)
More-Resourced Parts of the Community				
4,341,250	554.13	799	2,122.4	42.0 (335)
Watershed				
6,057,783	575.97	1,131	2,839.9	N/A

SOURCE: CalEnviroScreen Version 3.0

Recent historic data was not available, since the CalEnviroScreen 3.0-type analysis was only completed for one period. For this reason, the assessment is qualitative, and the rating is neutral.

Trend Analysis

The mean contaminant index score for less-resourced parts of the community is higher than the mean score for more-resourced parts of the community, indicating a higher degree of contamination, and the difference in scores is statistically significant, as discussed below. In addition, more-resourced parts of the community include fewer tracts above the mean watershed index score than are present in less-resourced parts of the community. The mean index score for more-resourced parts of the community is below the mean index score for the entire watershed.

Statistical analysis conducted with an independent two-sample t-test on equal samples of less-resourced tracts (n= 332) and more-resourced tracts (n= 332) documents a statistically significant difference in water quality values between the two groups: $t(661) = 3.49$, $p = 0.001$. Less-resourced tracts exhibited higher values (mean = 628.5; median = 686.7) than more-resourced tracts (mean = 563.1; median = 515.8), although the effect size is moderately small (Cohen's d = 0.27) (Gail and Sullivan, 2012).

Going Forward

While a trend was not evaluated with this implementation of the assessment, as noted previously, OEHHA plans to release CalEnviroScreen 4.0 in 2019, which would be updated to use compliance data from the 2008-current period.

Mean values were used in this assessment to determine statistical significance; however, the use of median values may be more appropriate and should be evaluated for use in future assessments.

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	**METRIC**
Equitable access to clean drinking water	*Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community*

References

Gail M. Sullivan, Richard Feinn, (2012) Using Effect Size—or Why the P Value Is Not Enough. Journal of Graduate Medical Education: September 2012, Vol. 4, No. 3, pp. 279-282.

California OEHHA, CalEnviroScreen 3.0 geodatabase can be downloaded from https://oehha.ca.gov/calenviroscreen/maps-data/download-data.

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Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	**METRIC**
Proportionate implementation of climate change adaptation strategies	***Relative value of tree and shrub density between less resourced parts of the community and more resourced parts of the community***

Implementation Approach

The relative value of tree and shrub density between different parts of the community was evaluated using tree and shrub density data available at the parcel level from Santa Ana Watershed Project Authority (SAWPA) and Department of Water Resources (DWR) data available by census tract. These data were overlaid in a geographic information system (GIS). To the extent that residential parcels in less-resourced parts of the community have lower tree and shrub density, this indicator measures the equitable implementation of vegetation planting as a climate change adaptation strategy.

The rating system used for this indicator and metric is reflective of trends but configured to primarily highlight the change in water quality in less-resourced parts of the community. An improvement in water quality in the less-resourced parts of the community (LR), along with no decline in water quality in more-resourced parts of the community (MR), was considered a positive trend. Other combinations of the change in index value for less-resourced and more-resourced parts of the community were considered either neutral or negative trends. Unless drinking water quality in less-resourced parts of the community improves, the rating cannot be a positive trend. In summary,

Positive trend: LR result shows an improving trend and MR result shows an improving trend or neutral trend.

Neutral trend: LR and MR results both show a neutral trend.

Negative trend: At least one result shows a worsening trend.

The rating system shown in **Table A.8-1** identifies the rating given to changes in the LR or MR result. For example, in order to show an improving trend, the LR result would need to improve by over 10% between current and historic conditions. Anything less than 10% change in the LR result would show a neutral trend for the LR.

TABLE A.8-1
TREND RATING SYSTEM

Rating	Criterion
Positive	Result ≥ 10% decrease
Neutral	-10% < Result < 10%
Negative	Result ≥ 10% increase

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	**METRIC**
Proportionate implementation of climate change adaptation strategies	*Relative value of tree and shrub density between less resourced parts of the community and more resourced parts of the community*

Output

The targeted output for this metric consists of a combination of the trend in median tree and shrub density in the less-resourced parts of the community and the more-resourced parts of the community.

Data Sources

SAWPA generated the tree and shrub data used for this indicator based on aerial imagery collected in 2015. The tree and shrub data covers areas cumulatively containing approximately 99% of the watershed population. The tree and shrub data for residential parcels was overlaid with the less-resourced tracts and more-resourced tracts in the watershed (identified using the DWR data) to see if the changes in density are occurring more frequently in either tract type.

California Water Code Section 79505.5(a) defines a “disadvantaged community” as a community with annual median household income that is less than 80 percent of the statewide annual median household income. The Department of Water Resources (DWR) uses data from the U.S. Census Bureau American Community Survey to characterize areas (census tracts) throughout California where people would be considered as members of “disadvantaged communities” in accordance with the Water Code definition. Areas where people who would be considered members of disadvantaged communities as identified in the DWR data were considered less-resourced parts of the watershed community for purposes of this analysis. All other census tracts within the watershed were considered more-resourced parts of the community.

Detailed Implementation Steps

Tree and shrub data was collected for residential parcels within the SAWPA boundary, and the DWR disadvantaged communities dataset was downloaded from the DWR Disadvantaged Communities Mapping Tool. The tree and shrub data were overlaid with DWR disadvantaged communities data in GIS, and tree and shrub density was calculated by dividing the tree and shrub area by the total area of less-resourced parts of the community (the total area of disadvantaged communities mapped in the watershed).

> Tree and shrub density (as a percentage) = total tree and shrub area in disadvantaged communities, square miles / total disadvantaged communities area, square miles

The same calculation was completed for more-resourced parts of the community (all areas in the watershed that are not mapped as part of the DWR disadvantaged communities), and the relative values of tree and shrub density for the less-resourced and more-resourced areas was calculated. The statistical significance of this difference was evaluated; if the difference was not statistically significant, the metric value is zero and the rating is neutral.

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	**METRIC**
Proportionate implementation of climate change adaptation strategies	*Relative value of tree and shrub density between less resourced parts of the community and more resourced parts of the community*

Data for recent historic conditions was not evaluated during the current assessment, as comparable data did not exist.

Implementation Challenges

The tree and shrub data used for this analysis was generated by imagery analysis of aerial photos from 2015. This is the most recent data available. Analysis of earlier or more recent aerial imagery has not occurred. However, given the utility of the data, SAWPA anticipates collection and genesis of this type of data will continue in the future. In the future, SAWPA would then be able to assess the trend within the Santa Ana region.

Results

TABLE A.8-2
TREE AND SHRUB DENSITY RESULTS

	Less-Resourced Areas	More-Resourced Areas
Number of parcels, residential	347,238	1,070,308
Number of census tracts, residential	319	749
Total Area, residential (square miles)	627	1,718
Total Tree and Shrub Area, residential (square miles)	62	175
Tree and Shrub Density (percent)	9.89	10.19
SOURCE: SAWPA		

Table A.8-2 presents the results of this analysis for the 2015 data. As shown in Table A.8-2, tree and shrub density is slightly higher (0.3 percent) in more-resourced tracts than it is in less-resourced tracts. This difference, while small, is statistically significant.

Descriptive statistics derived from equal samples of less-resourced tracts (n= 319) and more-resourced tracts (n= 319) indicate that more-resourced tracts have slightly more tree and shrub coverage (mean = 12.9%; median = 11.5%) than less-resourced tracts (mean = 11.2%; median = 10.3%). The means described here differ slightly from the means reported in Table A.8-2 due to the sample size used for the statistical analysis. Although statistical analysis conducted with an independent two-sample t-test assuming unequal variance (more-resourced = 0.009; less-resourced = .003) indicates that the difference in coverage is statistically significant (t(501) = 2.71, p = 0.007), the effect size calculated using Cohen's *d* (0.22) indicates the magnitude of difference between the two groups is small.[1]

[1] Gail M. Sullivan, Richard Feinn, (2012) Using Effect Size—or Why the P Value Is Not Enough. Journal of Graduate Medical Education: September 2012, Vol. 4, No. 3, pp. 279-282.

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	**METRIC**
Proportionate implementation of climate change adaptation strategies	*Relative value of tree and shrub density between less resourced parts of the community and more resourced parts of the community*

Trend Analysis

As noted above, there are no earlier analogous tree and shrub data available. The trend in tree and shrub density overall, as well as trends within less-resourced or more-resourced areas of the watersheds, therefore cannot be assessed at this time. As a result, the trend is shown as a qualitative neutral rating.

A similar type of index has been calculated for the City of Los Angeles based on data collected around the same time[2] and provides an interesting point of comparison. The Green View Index differs from the SAWPA tree and shrub density data in that it uses Google Street View panoramas instead of satellite imagery, and rates the percentage of canopy coverage in an area on a scale from 1 to 100 based on these street-level perspectives. The SAWPA tree and shrub density data only included residential areas, as described above, and so may exclude some areas that the Green View Index would include (such as commercial streets) while also including some areas the Green View Index would exclude (such as vegetated areas located closer to the center of city blocks). For purposes of comparison, the City of Los Angeles was considered the most similar geography to which the Green View Index has been applied. As of 2015, the Green View Index for the City of Los Angeles was 15.2%.

Going Forward

As more data relevant to climate change adaptation becomes available, another metric may better reflect the proportionality of conditions or implementation of climate change adaptation strategies in the region across less- and more-resourced parts of the community.

While mean values were used in this assessment to determine statistical significance, the use of median values may be more appropriate in the future.

[2] The Green View Index was developed by the Massachusetts Institute of Technology Senseable City Lab. The Green View Index is calculated using Google Street View panoramas. http://senseable.mit.edu/treepedia/cities/los%20angeles.

Educate and build trust between people and organizations	
INDICATOR	**METRIC**
Collaboration for more effective outcomes	***Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation.***

Implementation Approach

Collaboration for more effective outcomes was assessed by reviewing the list of entities regulated in adopted total daily maximum load (TMDL) orders in the Santa Ana Region and identifying how many are participating in collaborative efforts to comply with the TMDL requirements. Participation is indicated by financial or in-kind contributions. Conditions for collaboration were considered "good" if the number of participants was substantially the same as the number of regulated entities and "bad" if the number was not, for both recent and prior conditions. An evaluation was then made to determine whether the sequencing of prior to recent conditions warranted a positive, neutral, or negative trend finding according to **Table A.9-1**.

The "good" – "bad"-based scoring system is reflective of trends but configured to highlight conditions status relative to full participation rather than expecting continued improvement beyond full participation. Participation by equal to or greater than 80% of the regulated entities was considered "good."

TABLE A.9-1
GOOD-BAD ASSESSMENT SYSTEM

Prior Conditions	Recent Conditions	Result
GOOD	GOOD	Positive
BAD	GOOD	Positive
GOOD	BAD	Negative
BAD	BAD	Neutral (if appreciably better)
BAD	BAD	Negative (if similar or worse)

Desired Output

The targeted output was the percentage of entities regulated by adopted TMDLs who have made financial or in-kind contributions to TMDL implementation in the past year.

Data Sources

The Santa Ana Region's website summarizing TMDLs for the region, along with the region's Water Quality Control Plan, were reviewed to identify TMDLs in the implementation phase. Financial or in-kind contributions determined by reviewing:

- SAWPA Task Force contribution records
- Newport Bay Watershed Executive Committee reports

Educate and build trust between people and organizations	
INDICATOR	**METRIC**
Collaboration for more effective outcomes	*Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation.*

Detailed Implementation Steps

The Santa Ana Region Basin Plan was reviewed to identify the TMDLs in an implementation phase in the region. The total number of entities regulated by the TMDLs was determined by reviewing the list of permittees identified in each relevant order from the RWQCB. Recent records of contributions to TMDL implementation efforts were collected from SAWPA and the Newport Bay Watershed Executive Committee reports. A list of entities that have contributed to these efforts in the past year was compiled from these sources. The list of entities that have contributed to implementation of each TMDL (entities are counted once for each TMDL – that is, if the same entity is named in two TMDLs, it is counted twice) was compared with the list of entities named in the relevant order from the RWQCB, and a percentage of entities participating was calculated based on the comparison. The percentage of entities participating was converted into a good or bad score, and the trend was determined based on the comparisons shown in **Table A.9-1**.

Implementation Challenges

In some cases, the adopted orders included entities that no longer exist, or that have already completed their implementation activities (and so no longer participate despite the ongoing TMDL implementation plan).

In some cases, the data does not change annually. The cost-sharing agreement for the Newport Bay Sediment TMDL was last updated in 2014. The same agencies have been splitting the cost of implementing projects to address sediment and related water quality issues since 2014. The cost-sharing agreement for all other TMDLs for Newport Bay and San Diego Creek had been entered into in 2015 and was undergoing revision as of summer 2018.

Results

Positive trend

89% participation (62 out of 70 entities) in 2017

89% participation (62 out of 70 entities) in 2016

Trend Discussion

In the Santa Ana region, 70 participants are named in adopted TMDLs in the implementation phase, summarized in **Table A.9-2**. This number does not include entities named in the recently adopted selenium TMDL for San Diego creek or entities named as part of the completed Agricultural Nutrient Management Program in Newport Bay. Of these entities named in the orders, 62 participated (as measured by financial contributions to implementation projects) in TMDL implementation-related efforts in 2017. The same number participated in 2016. This amounts to a participation rate of 89 percent for both years; therefore, in both years collaboration was in “good” condition.

Educate and build trust between people and organizations	
INDICATOR	**METRIC**
Collaboration for more effective outcomes	*Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation.*

Nearly all of the TMDL implementation plans are being implemented in part through a collaborative entity, such as a SAWPA Task Force, the Newport Bay Watershed Executive Committee, and the Orange County Stormwater Program.

Going Forward

In the future, SAWPA may want to track the percent of TMDL activities implemented in partnership annually, which could provide similar, more complete information about collaboration relevant to water management in the watershed. SAWPA could conduct an annual survey of TMDL permittees to identify projects undertaken as part of TMDL implementation plans during the year. SAWPA could then more clearly identify which of the TMDL projects were completed by two or more entities (instead of one entity), reflecting collaboration in the watershed.

References

Newport Bay Watershed Executive Committee, *Central Orange County Watershed Management Area Executive Action Plan 2017-22*, September 20, 2017.

Santa Ana Watershed Project Authority, Task Force Contribution Data.

Educate and build trust between people and organizations	
INDICATOR	**METRIC**
Collaboration for more effective outcomes	*Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation.*

TABLE A.9-2
303(D) LIST WATER BODIES IN THE REGION WITH TMDL IMPLEMENTATION PLANS AND PARTICIPATING AGENCIES/DISCHARGERS

Water Body	Pollutants	303(d) Listing Status	Collaborative Entity	Entities Included in TMDL (total number) [a]	TMDL Entities Contributing Financially or In-Kind (total number), 2017 or last year information is available [a]
Big Bear Lake	Noxious aquatic plants, nutrients	5B, being addressed by USEPA approved TMDL	Nutrient TMDL working group	**US Forest Service**, **Caltrans**, San Bernardino County, San Bernardino County Flood Control District, City of Big Bear Lake, Big Bear Mountain Resorts (6)	San Bernardino County, San Bernardino County Flood Control District, City of Big Bear Lake and Mammoth Mountain *formerly the Ski Resorts* (4)
Canyon Lake	Nutrients (nonpoint source)	4a, addressed by USEPA approved TMDL *Resolution R8-2004-0037*	SAWPA Task Force	**US Forest Service**, March Air Reserve Base, March Joint Powers Authority, Caltrans, California Department of Fish and Game, County of Riverside, cities of Lake Elsinore, Canyon Lake, Hemet, San Jacinto, Perris, Moreno Valley, Murrieta, Riverside, and Beaumont, Eastern Municipal Water District, Elsinore Valley Municipal Water District, **concentrated animal feeding operators** and other agricultural operators within San Jacinto watershed (19)	March Air Reserve Base, March Joint Powers Authority, Caltrans, California Department of Fish and Game, County of Riverside, cities of Lake Elsinore, Canyon Lake, Hemet, San Jacinto, Perris, Moreno Valley, Murrieta, Riverside, Beaumont, **Menifee**, and **Wildomar**, Eastern Municipal Water District, Elsinore Valley Municipal Water District, San Jacinto Agricultural Operators (19)
Chino Creek Reach 1A	Indicator bacteria	5B, being addressed by USEPA approved TMDL *Resolution R8-2005-0001*	SAWPA Task Force (Middle Santa Ana River [MSAR] Task Force)	**US Forest Service**, the County of San Bernardino, the County of Riverside, the cities of Ontario, Chino, Chino Hills, Montclair, Rancho Cucamonga, Upland, Rialto, Fontana, Norco, Riverside, Corona, Pomona and Claremont, and agricultural operators in the watershed (17)	San Bernardino County Flood Control, the County of Riverside, the cities of Ontario, Chino, Chino Hills, Montclair, Rancho Cucamonga, Upland, Rialto, Fontana, Norco, Riverside, Corona, Pomona, Claremont, **Eastvale, Jurupa Valley**, and agricultural operators in the watershed *represented by the Chino Basin Watermaster Agricultural Pool* (18)
Chino Creek Reach 1B	Indicator bacteria	5B, being addressed by USEPA approved TMDL	SAWPA Task Force (MSAR Task Force)	Same as Chino Creek Reach 1A	
Chino Creek Reach 2	Indicator bacteria	5B, being addressed by USEPA approved TMDL	SAWPA Task Force (MSAR Task Force)	Same as Chino Creek Reach 1A	
Lake Elsinore	Nutrients, Organic enrichment/low dissolved oxygen	5B, being addressed by USEPA approved TMDL	SAWPA Task Force (combined with Canyon Lake)	Combined with Canyon Lake	
Mill Creek (Prado Area)	Indicator bacteria	5B, being addressed by USEPA approved TMDL	SAWPA Task Force (MSAR Task Force)	Same as Chino Creek Reach 1A	

Educate and build trust between people and organizations	
INDICATOR	**METRIC**
Collaboration for more effective outcomes	*Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation.*

Water Body	Pollutants	303(d) Listing Status	Collaborative Entity	Entities Included in TMDL (total number) [a]	TMDL Entities Contributing Financially or In-Kind (total number), 2017 or last year information is available [a]
Newport Bay [b]	Fecal coliform	5B, being addressed by USEPA approved TMDL *Resolution 99-10*	Newport Bay Watershed Executive Committee	County of Orange, the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest and Newport Beach and **agricultural operators in the Newport Bay watershed** (9)	County of Orange, **Orange County Flood Control District,** the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest, Newport Beach, **Laguna Hills,** and **Laguna Woods, Irvine Ranch Water District,** and the **Irvine Company** (13)
	Nutrients	5B, being addressed by USEPA approved TMDL *Resolution 98-100*	Urban Stormwater Permittees - Environmental Monitoring Division of OC Public Works/Environmental Resources implements monitoring programs (Orange County Stormwater Program)	County of Orange, the Orange County Flood Control District, and the 34 cities of Orange County *referred to as the Co-Permittees of the Areawide Urban Stormwater Permit (3)*	County of Orange, the Orange County Flood Control District, and the 34 cities of Orange County (3)
			Agricultural Nutrient Management Program completed 2000-2003	Orange County Farm Bureau, UC Cooperative Extension, and agricultural operators (agricultural nutrient management program) (3)	*Agricultural Nutrient Management Program completed 2000-2003*
	Sediment	5B, being addressed by USEPA approved TMDL	Newport Bay Watershed Executive Committee	County of Orange, the Cities of Irvine, Tustin, Lake Forest, **Costa Mesa, Santa Ana**, and Newport Beach (7)	County of Orange, **Orange County Flood Control District**, the Cities of Irvine, Tustin, Lake Forest, Newport Beach, **the Irvine Company** (7)
Newport Bay, upper	Diazinon and Chlorpyrifos	5B, being addressed by USEPA approved TMDL *Resolution R8-2003-0039*	Newport Bay Watershed Executive Committee	County of Orange, the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest, and Newport Beach, and **agricultural operators in the Newport Bay watershed** (9)	County of Orange, **Orange County Flood Control District,** the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest, Newport Beach, **Laguna Hills,** and **Laguna Woods, Irvine Ranch Water District,** and the **Irvine Company** (13)
Prado Park Lake	Indicator bacteria	5B, being addressed by USEPA approved TMDL	SAWPA Task Force (MSAR Task Force)	Same as Chino Creek Reach 1A	
San Diego Creek Reach 1	Nutrients	5B, being addressed by USEPA approved TMDL	Newport Bay Watershed Executive Committee	Same as Newport Bay Addressed as part of Newport Bay Nutrients TMDL, listed previously	
	Pesticides	5B, being addressed by USEPA approved TMDL	Newport Bay Watershed Executive Committee	Same as Newport Bay Addressed as part of Newport Bay Diazinon and Chlorpyrifos TMDL, listed previously	
	Siltation/Sediment	5B, being addressed by USEPA approved TMDL	Newport Bay Watershed Executive Committee	Same as Newport Bay Addressed as part of Newport Bay Sediment TMDL, listed previously	

Educate and build trust between people and organizations

INDICATOR	METRIC
Collaboration for more effective outcomes	*Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation.*

Water Body	Pollutants	303(d) Listing Status	Collaborative Entity	Entities Included in TMDL (total number) [a]	TMDL Entities Contributing Financially or In-Kind (total number), 2017 or last year information is available [a]
	Selenium	5B, being addressed by USEPA approved TMDL	No	MS4 permittees, other NPDES permittees (groundwater cleanup/dewatering permittees), IRWD (operator of IRWD constructed treatment wetlands), UC Irvine (operator of UCI San Joaquin Marsh Reserve wetlands) (4)	Order adopted in 2017
San Diego Creek Reach 2	Nutrients	5B, being addressed by USEPA approved TMDL	Newport Bay Watershed Executive Committee	Same as Newport Bay Addressed as part of Newport Bay Nutrients TMDL, listed previously	
	Sediment/siltation	5B, being addressed by USEPA approved TMDL	Newport Bay Watershed Executive Committee	Same as Newport Bay Addressed as part of Newport Bay Sediment TMDL, listed previously	
Santa Ana River Reach 3	Indicator bacteria	4a, addressed by USEPA TMDL	SAWPA Task Force (MSAR Task Force)	Same as Chino Creek Reach 1A	

NOTES:

a Bolded text in these columns identifies entities that are not listed in both columns.
b Newport Bay Watershed Executive Committee cost sharing agreements for TMDLs were entered into in 2014 (for Sediment TMDL) and 2015 (for all other TMDLs).

SOURCE: Newport Bay Watershed Executive Committee, *Central Orange County Watershed Management Area Executive Action Plan 2017-22*, September 20, 2017; Santa Ana Watershed Project Authority Task Force Contribution Data.

Educate and build trust between people and organizations

INDICATOR	METRIC
Adoption of a watershed ethic	*Total gallons of potable water used per capita per day*

Implementation Approach

This indicator and metric were assessed using water use and population data from the SWRCB Large Water System Drinking Water Program Electronic Annual Report and from the Department of Water Resources (DWR) Public Water Systems Statistics (PWSS) survey.

Annual water use generally fluctuates in response to water year type (wet or dry). In order to separate changes in water use due to adoption of a watershed ethic from responses to annual water availability, for trend analysis and scoring purposes the value of this metric is compared with the average value calculated over the last ten years. The percent difference between the two values is the result used for rating according to the criteria shown in **Table A.10-1** below.

TABLE A.10-1
TREND RATING SYSTEM

Rating	Criterion
Positive	Result ≥ 10% decline
Neutral	-10% < Result < 10%
Negative	Result ≥ 10% increase

Output

The output for this metric is the average gallons per capita per day (GPCD) for the watershed for the most recent year compared to the average GPCD of the previous 10 years of data.

Data Sources

Prior to 2013, DWR collected the water agency data used in this indicator (via the voluntary PWSS survey). Starting in 2013, the PWSS data was derived from the mandatory reports by water suppliers to the SWRCB Large Water System Drinking Water Program Electronic Annual Report, which was expanded to include the water use data previously submitted to the PWSS. The assessed water suppliers were limited to those which had over 3,000 water meters or that served customers over 3,000 acre-feet of potable water (i.e., retailers required to prepare Urban Water Management Plans). As of 2013, these 53 suppliers serve approximately 98 percent of the watershed's population. Between 2007-2012, at least 46 out of the 53 retailers reported their water use and population to DWR's PWSS. While the retailers that did not report during the 2007-2012 period changed annually, the populations excluded were generally split between inland and coastal areas such that the GPCD reported between 2007-2012 is not skewed by local climate conditions. Because the GPCD is calculated based upon the water use and population of the reporting agencies and there was not a geographic skew in the 2007-2012 data, it was determined that comparing the GPCD for the most recent year with the average calculated over the 2007-2016 was appropriate.

Educate and build trust between people and organizations	
INDICATOR	**METRIC**
Adoption of a watershed ethic	*Total gallons of potable water used per capita per day*

While total production data is available in the PWSS data, inconsistencies and potential double-counting were noted in the data. For this reason, the average GPCD was calculated using total urban delivered water instead of total water production data. The result of the trend calculation is similar using total production data.

Detailed Implementation Steps

The total GPCD for most users in the watershed was calculated based on the reported total annual potable water delivered for urban uses (residential, commercial, industrial, urban land irrigation, and other urban uses) reported in the PWSS data for each retailer, along with the total population served by each retailer.

Total annual GPCD = (urban water deliveries)*(conversion factor to convert from acre-feet to gallons) / (Population*365 [or 366 for leap year])

The 2007-2016 average GPCD was calculated by calculating the average population between 2007-2016 and the average of total delivered urban water (as defined above) during 2007-2016, then substituting those average values into the total annual GPCD equation.

Some quality control processing of the data was required to ensure data were consistent and comparable. Data quality control steps included confirming the units (acre feet versus million gallons, for example), confirming the annual value by cross-checking against a sum of monthly values, and identifying outlier data by comparing against previous years' data.

Implementation Challenges

While multiple years of data were available for this indicator, the data quality varied. Approximately 10 percent of the records used to calculate the GPCD had a quality control issue requiring adjustment. In some cases, monthly data was unavailable for select retailers. Reported monthly totals and annual totals did not align. Some data values were clear outliers, potentially indicating inaccurate data entry. Units were also sometimes mismatched (for example, gallons entered into a column which should have been reported in acre-feet).

Results

GPCD (urban water deliveries) in 2017 compared with the ten-year average (2007-2016):

Positive trend (decline of 16%, from 171 to 144)

Trend Analysis

The last available total GPCD data records water use during 2017. In 2017, on average, 144 gallons of water was delivered to urban uses per capita in the watershed each day. This rate of usage is less than the ten-year average (2007-2016) of 171 gallons per capita per day, and represents a decline of approximately 16 percent relative to the ten-year average.

Educate and build trust between people and organizations	
INDICATOR	**METRIC**
Adoption of a watershed ethic	*Total gallons of potable water used per capita per day*

As shown in Table **A.10-2**, this is the high end of the range of year over year percent change for the period 2007-2016, and is similar in magnitude of decline to the decrease in use between 2014-2015, when mandatory restrictions on water use were enacted statewide. For these reasons, this is considered a significant decline in water use (or increase in water conservation). Between 2016 and 2017, total urban delivery GPCD increased by approximately four gallons per day (or about three percent), within range of interannual variability.

TABLE A.10-2
GALLONS PER CAPITA PER DAY

Year	Retailers	Population	Year over year change (percent)	Gallons per Capita per Day (GPCD) a
Annual				
2007	46	4,476,497	n/a	226
2008	47	4,776,264	-13	195
2009	47	4,785,041	-4	187
2010	49	5,253,274	-10	167
2011	47	5,036,077	-1	166
2012	47	5,028,565	5	174
2013	53	5,544,576	-5	166
2014	53	5,657,352	0	167
2015	53	5,765,113	-16	141
2016	53	5,846,144	-1	139
2017	53	5,967,921	3	144
Averages				
Average of the Previous Ten Years of Data (2007-2016)a	50	5,216,132	-	171

NOTES:
[a] Prior to 2013, urban delivered water information was not required for all water retailers; for this reason, the urban delivered water volumes from 2007 to 2012 do not include data from all of the retailers that began reporting in 2013.

SOURCE: Department of Water Resources, Public Water Systems Statistics data from 2007 to 2016; State Water Resources Control Board (SWRCB), Large Water System Drinking Water Program Electronic Annual Report, data for 2017.

Going Forward

Future implementation of this metric could compare the annual value to a ten-year moving average value. As consistent data is collected, the period of the moving average could extend (for example, up to fifteen years instead of ten).

Given that the PWSS data is collected from the SWRCB Large Water System Drinking Water Program Electronic Annual Report, future implementation of this indicator would likely collect data directly from the SWRCB system instead of using the PWSS dataset. Quality control testing

Educate and build trust between people and organizations	
INDICATOR	**METRIC**
Adoption of a watershed ethic	*Total gallons of potable water used per capita per day*

of the reported data (in either the SWRCB system or the PWSS system) would allow for improved accuracy of this indicator in the future.

A validation step not taken with this implementation but potentially valuable in future implementations would be to compare the values from this data to the values reported in the Urban Water Management Plans of relevant agencies.

References

Department of Water Resources (DWR), Public Water Systems Statistics data from 2007 to 2016.

State Water Resources Control Board (SWRCB), Large Water System Drinking Water Program Electronic Annual Report, data for 2017.

Improve data integration, tracking and reporting to strengthen decision-making	
INDICATOR	**METRIC**
Broaden access to data for decision-making	***Percent of watershed population in agencies whose residential customers receive relative performance information about their water use***

Implementation Approach

This indicator recognizes that since everyone who uses water is a decision-maker, it is important to have broad and easy access to data for decision-making. Residential customer bills provide prior month water use consumption for billing purposes, but they also provide the opportunity to transmit information on how the billed usage compares to past usage, conservation or efficiency targets, or water budget amounts. The underlying assumption for this indicator is that informing water consumers how they are using water relative to past or targeted/budgeted use will improve decisions and increase efficiency. The metric for the current assessment is a simple yes/no survey of the watershed's retail water supply agencies to determine if their residential customers' bills provide relative performance information (i.e., quantitative contextual water use information the customer can compare to their current measured water use).

Output

The metric is expressed as the percentage of the total watershed population served by retail supply agencies that provide customers relative performance information about their water use on their bills.

Data Sources

The assessment is limited to the 53 retail water suppliers that have over 3,000 water meters or that serve customers over 3,000 acre-feet of potable water (i.e., retailers required to prepare Urban Water Management Plans). The population of the surveyed agencies was obtained from the population reported to the State Water Resources Control Board (SWRCB) Large Water System Drinking Water Program Electronic Annual Report. These 53 retailers serve nearly 98% of the Santa Ana River watershed's population.

The assessment was based upon information about residential customer billing found on agency web-sites, retrieved by contacting the retail agency directly by phone or email, and through information provided by their wholesale supplier.

Detailed Implementation Steps

The retailers were assessed to determine if relative water use information is provided to the customers on a bill (either hard copy or made available in a customer on-line account), or in an app, and which informs the customer about how their current measured water use compares to any of the following:

Improve data integration, tracking and reporting to strengthen decision making	
INDICATOR	**METRIC**
Broaden access to data for decision-making	*Percent of watershed population in agencies whose residential customers receive relative performance information about their water use*

a) previous water use, such as the same month in the previous year, or the previous month's usage – ideally at least 3 or months, or

b) a water use target or usage/budget tier used for billing, or

c) their neighborhood use or use by similar customers.

The following steps were taken to procure the information, which was recorded on a spreadsheet as a yes/no answer based upon the above criteria.

1. Examine the retailer web-site for information about residential customer bills. A search of "how to read your bill" often displayed a copy of a generic bill.

2. If the generic bill was not available, some retailer sites described the water use information available to a customer an on-line account would provide.

This method procured the yes/no information from 38 out of the 53 retailers.

Eleven out of the 15 retailers that did not provide enough information on their web-site to make a yes/no determination were contacted by senior staff of their respective wholesale supply agency. Lisa Morgan-Perales of Inland Empire Utilities Agency (IEUA), senior water resource analyst, reached out to four IEUA retailers. All the IEUA retailers responded by phone or email after a little prodding by Lisa; agency staff who were reached by phone provided useful context information such as how their billing systems were about to be updated or that conservation targets were added to the bill during the drought. Joe Berg, Director of Water Use Efficiency Coordinator at Municipal Water District of Orange County (MWDOC), contacted seven MWDOC retailers; four of them eventually responded by email after follow-up was conducted.

The four remaining retailers were contacted by phone and email by a SAWPA intern. Two out of the four responded.

Implementation Challenges

It was expected that most retailers would provide some kind relative performance information on their residential bills. Initially the survey intended to also evaluate the different methods retailers used to provide relative water use and real-time water use information to customers, including traditional billing apps, such as Water Smart or DropCountr, or real-time usage based upon AMI/AMR systems. It was quickly determined that gathering such data would be too time-consuming without developing a formal survey with the input of SAWPA wholesalers and retailers. The time and effort to procure responses from the retailers that did not provide the needed information on their website was more than initially expected, and it was still not successful in yielding responses from five of the retailers. Although a few of the retailer websites

Improve data integration, tracking and reporting to strengthen decision making	
INDICATOR	**METRIC**
Broaden access to data for decision-making	*Percent of watershed population in agencies whose residential customers receive relative performance information about their water use*

required considerable amount of searching to determine the yes or no answer, it was fortunate that the determination could be made from the websites of 70% of the retailers.

Results

The assessment found that 84% of watershed's population[1] are served by retailers that provide residential customers information on their bill about how their current water use compares to past water use and/or water use budgets or targets. The percentage is likely higher than 84%, since about 8% of the watershed population are in retail agencies that did not respond to the assessment/survey.

Trend Analysis

This is the first time the retail agencies were assessed on this topic, therefore there is no previous information available to quantitatively assess a trend for this metric. In the past decade, evidence from a few retailers suggests the adoption of conservation-focused rate structures, including water budget-based rates, mandatory water use restrictions during the drought, and retail agency efforts to promote water efficiency and meet legislative mandates to reduce per-capita use likely stimulated retailers to provide more relative water use information to residential customers, although many retailers already provided basic information about past water use on their residential customer bills.

Going Forward

The next assessment of retailers about the relative water use information provided to customers should be conducted as a survey. Consideration should be given to including multi-family residential and non-residential customer classes, as well as surveying the different methods retailers use to provide that information to the different customer classes. It would likely require a simple but well-publicized survey instrument as well identification of the right staff person at the retail supplier to whom the survey should be sent. The watershed wholesalers should also be involved in promoting the survey. The survey questions could also be designed for possible inclusion on the State Water Resources Control Board's Large Water System Drinking Water Program Electronic Annual Report (SWRCB EAR), which currently includes questions about retailer rate structures and affordability.

1 About 2% of the population are served by retailers too small to assess.

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Improve data integration, tracking and reporting to strengthen	
INDICATOR	**METRIC**
Participation in an open data process	***Percent of watershed population in agencies participating in establishment of a regional data sharing system***

Implementation Approach

The Data Management Pillar recognized that the first step in the process of creating a "federated" regional data sharing system in the SAWPA region is the establishment of a regional trust framework designed to establish trust between agencies as well as trust in the functionality of data management systems. Because a commitment to establish the trust framework has not yet been made, this metric cannot be quantitatively assessed. Once the commitment is made, the metric will be assessed by calculating the percentage of the total watershed population in the service areas of water supply and water management agencies participating in the trust framework.[1] After the first step of the commitment to the trust framework, the second step, establishing the regional data framework and data sharing system will be assessed. The assessment of this second step will be based upon calculating the percentage of the total watershed population by retail water suppliers that are participating in the establishment regional data sharing system. The retailer engagement is essential for federated regional data sharing since their supply and demand data are core data in the assessment of water management in region. The two steps of this metric can be combined into one score by averaging the percentage values of the two steps.

Output

The metric's first step is expressed as the percentage of the total watershed population served by the agencies that have committed to participating in the trust framework. The metric's second step is the percentage of the total watershed population served by retail water suppliers participating in the establishment of a regional data sharing system. The calculated percentages from the two steps are averaged to result in one score.

Data Sources

Information on commitment to a trust framework may ultimately be available from a formal source, but in the meantime will require communication with leaders of trust framework organizations. Similarly, identification of retail water suppliers participating in the establishment of a regional data sharing system will require communication with leaders of any emerging regional data sharing organizations.

The population of the participating retail agencies can be obtained from the population reported to the State Water Resources Control Board (SWRCB) Large Water System Drinking Water

1 The water management agencies could wastewater, flood control, and groundwater management agencies.

Improve data integration, tracking and reporting to strengthen decision making	
INDICATOR	**METRIC**
Participation in an open data process	*Percent of watershed population in agencies participating in establishment of a regional data sharing system*

Program Electronic Annual Report. The participating retail agencies is not limited to the retailers that have over 3,000 water meters or that serve customers over 3,000 acre-feet of potable water (ones that file Urban Water Management Plans). The population of wholesale supply agencies and other water management agencies can be obtained from the websites of the individual agencies and SAWPA.

Detailed Implementation Steps

A detailed description of the implementation steps cannot be provided since the quantification of the metric could not be completed at this time.

Implementation Challenges

It could be a challenge to engage the small, less-resourced retail water agencies, including cities, to engage in establishing a trust framework, data management framework and a data sharing system. The better-resourced state, regional and local management agencies and regulators to whom retail suppliers are required to report need to effectively make the case that the effort will eventually create time and labor efficiencies if it reduces duplicative reporting and increases the quality of collected and reported data.

Results

The metric cannot be quantitatively assessed at this time.

Trend Analysis

Even though a trend for this metric cannot be established due to an absence of progress for this metric, it is notable that the majority of the watershed population are in wholesale and retail water supply agencies that have taken initial steps towards establishing regional data sharing systems by engaging with the implementation of the Open and Transparent Water Data Act (AB 1755) and/or participating in the California Data Collaborative.

For the current assessment, where data is lacking to show a trend, a qualitative neutral status is identified as the rating.

Going Forward

The region should look for opportunities to help stimulate the establishment of a trust framework and a federated data sharing system for the watershed. One opportunity is encouraging the watershed's water supply retailers to engage with DWR's Public Water System Statistics survey and the State Water Resources Control Board's Large Water System Drinking Water Program Electronic Annual Report (SWRCB EAR) about the water supply and demand data those reports require, to ensure that it is more usable for both State and regional planning efforts. Another opportunity may be developing a constituency for an AB 1755 use case in the watershed to 1) assist SAWPA's effort to track the progress of the OWOW Plan towards its goals with indicators and metrics, and 2) implement a California Water Plan Sustainability Outlook for the watershed, for which DWR has been supportive.