CHAPTER 2
Methodology

The methodology section summarizes the methods used to evaluate the status and trends of environmental and socioeconomic indicators relative to the adopted TRPA threshold standards. In addition, this section:

1. Defines key terms
2. Outlines the content of indicator summaries
3. Details the methods used to estimate interim targets and dates for threshold standard attainment
4. Provides a summary of data sources

Key Terms

The following terms are referenced throughout this 2015 Threshold Evaluation Report. Familiarity with these terms will aid in a more complete understanding of the document.

Environmental Threshold Carrying Capacity (Threshold Standard) – Threshold standards are defined in the Compact as, "an environmental standard necessary to maintain a significant scenic, recreational, educational, scientific or natural value of the region or to maintain public health and safety within the region." Threshold standards are adopted in resolution 82-11 of the TRPA governing board, and are the shared goals of the region.

Other Standards – Air and water quality standards adopted by local, state or federal agencies that apply to the Region. TRPA evaluates compliance with applicable local, state and federal air and water quality standards as a component of the threshold evaluation.

Interim Target – A goal to be achieved at a major evaluation interval specified for the standard. These targets are an intermediate numeric objective related to a threshold standard that is expected to take several years to achieve.

Major Evaluation Interval – A fixed period of time during which TRPA will monitor and at the end of which TRPA will evaluate and report upon the interim status of a threshold or standard. Such intervals may be different for each threshold or standard.

Indicator – Any measurable physical phenomena within the Tahoe region whose status has a direct relationship to the status of a threshold standard. Indicators are evaluated relative to interim targets, threshold standards, or historical values to determine status and trends.

Compliance Measure – A program, regulation, or measure including, but not limited to, capital improvements, operational improvements, or controls on additional development, to reduce, avoid, or remedy an environmental impact of activities within the Tahoe Region or to promote attainment or maintenance of any threshold or standard.

Definitions of these terms can also be found in the TRPA Code of Ordinances.

Description of Indicator Summaries

Indicator summary sheets organize and concisely convey the status and trend of each threshold standard. The indicator sheets are designed to be standalone documents. As a result of this design, there is considerable overlap between the individual indicator sheets.

The following is a brief description of reporting elements included in the indicator summaries.

Reporting Icon – Following the model established in the 2011 Threshold Evaluation Report, a reporting icon is used to succinctly communicate the status, trend and confidence of each indicator relative to the applicable standard or interim target (Figure 2-1). The determination of status, trend, and confidence for each numeric indicator is based on criteria summarized in Chapter 2.
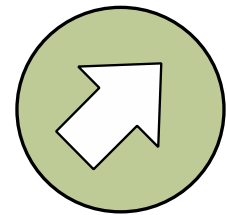
- Status – the background color of the reporting icon characterizes the status of an indicator relative to an adopted standard or interim target
- Trend – an arrow and its orientation convey an indicator's trend relative to an adopted standard or interim target
- Confidence – the ring surrounding the status dot and trend arrow convey the level of confidence the agency has in the determination of both status and trend. A thicker ring represents higher confidence in the determination, while a dashed ring represents lower confidence
- Pie Charts – In instances where a standard applies to more than one indicator, a single indicator sheet is used present the information (i.e. some scenic thresholds have over 200 individual indicators). Where multiple indicators are summarized on a single sheet, a pie chart showing the percentage of indicators in each status category are presented instead. The colors of the pie chart correspond to the status colors shown below in Figure 2-1. For example, if 25 of the 200 noise indicators are "considerably better than target"; the pie chart will show 12.5% of the area in the corresponding dark green color that equates to "considerably better than target" as seen in the pie chart on the right.

The sample reporting icon on the right illustrates the three aspects of the indicator:
1. The light green background shows that the indicator's status is "at or somewhat better than its target."
2. The angled up arrow shows that the indicator's data exhibit a trend of "moderate" improvement relative to the standard or interim target.
3. The thin solid line border indicates "moderate" confidence in the determination of the indicator's status and trend.
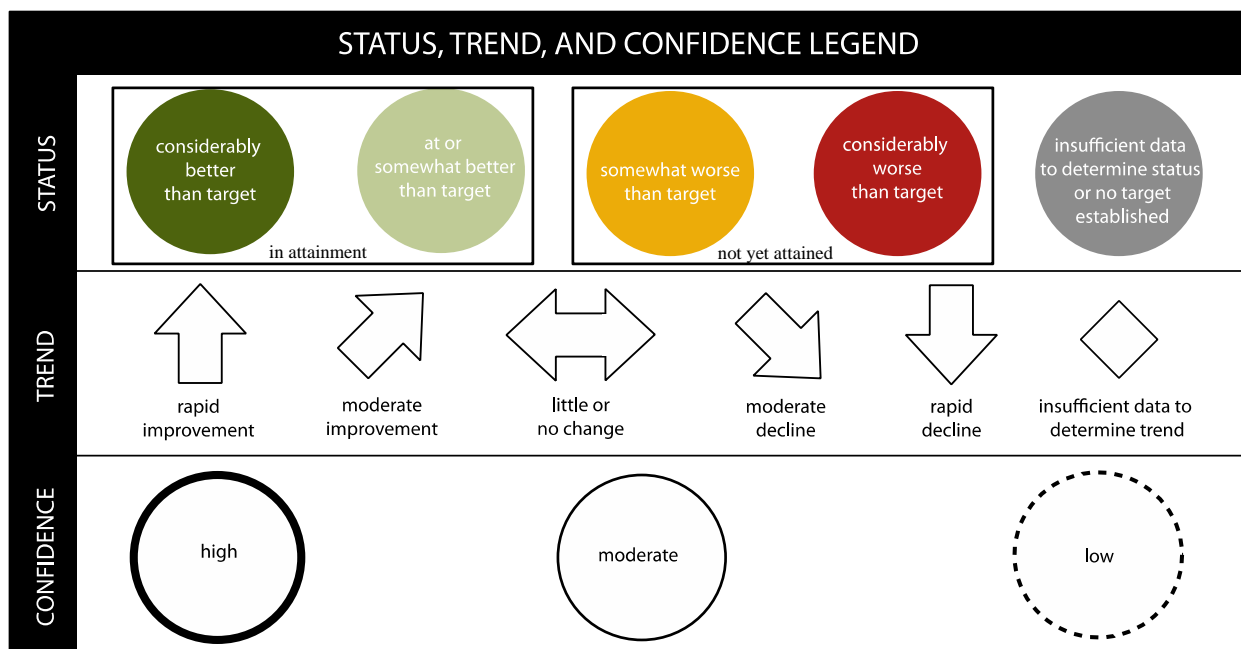
Figure 2-1: *This figure illustrates the colors and symbols used to communicate the three components of a reporting icon: status, trend, and confidence. Each indicator summary presents an analysis of an indicator's current condition and trend relative to a standard. This information is used to guide which status and trend graphics are represented in the reporting icon. An evaluation of data quality and the robustness of the status and trend analysis are used to guide the level of confidence assigned to a reporting icon.*

Data Evaluation and Interpretation– provides general background information on the standard.

- <u>Relevance</u> – describes why it is important to measure and analyze the status and trend of an indicator. Generally, the relevance of an indicator is based on its ability to inform us about the status of a threshold standard, and/or a standard based on state or federal standards that aim to protect human health or environmental quality.
- <u>TRPA Threshold Category</u> – identifies the topic area that the standard and associated indicator and indicator reporting category are affiliated with. TRPA has established nine threshold categories: water quality, air quality, soil conservation, wildlife, fisheries, scenic resources, noise, recreation, and vegetation.
- <u>TRPA Threshold Indicator Reporting Category</u> – indicator reporting categories or indicator themes are subcategories of threshold categories, which provide a narrowing of topical focus. An indicator reporting category can include from one to several standards and associated indicators.
- <u>Adopted Standards</u> – identifies the specific standards that the indicator summary addresses. TRPA has adopted more than 100 standards for various indicator reporting categories and threshold categories. For air and water quality standards, the indicator summary will address the attainment status of each standard (TRPA, state or federal), typically focusing on the status of the indicator relative to the most conservative standard.
- <u>Type of Standard</u> – identifies the type of standard evaluated in the indicator summary, numerical standards, management standards, and policy statements using the three types specified in Resolution 82-11. Local, state, and federal air and water quality standards considered in this evaluation are numerical. There are numerous examples in TRPA Resolution 82-11 where a standard is labeled as a management standard, but also identifies numeric targets. In this evaluation, management standards with numeric targets are evaluated in the same way as numerical standards. In such instances, the type of standard is labeled as a "management standard with a numeric target."
- <u>Indicator (Unit of Measure)</u> –Any measurable physical phenomena within the Tahoe region

whose status has a direct relationship to the status of a threshold standard. For example, parts per million (ppm) is a standardized measurement used to describe the concentration of a pollutant in an air or water sample.

- Human & Environmental Drivers – briefly describes the known human and natural factors and activities that influence the Region's ability to meet the adopted threshold standard or otherwise influence the variation in an indicator.

Monitoring and Analysis – Summarizes information on data collection and analysis

- Monitoring Partners – provides a list of agencies and entities that fund, collect and analyze monitoring data.
- Monitoring Approach – provides a general description of the sampling design used to carry out the monitoring. Included is a description of the spatial distribution of sampling, sampling frequency, lab procedures, and references to data sources, monitoring plans, and protocols used to guide monitoring.
- Analytic Approach – provides a general description of the protocols used to analyze the data to arrive at status and trend determinations.

Indicator State – Presents the results of the analysis and the determination of status and trend for the indicator.

- Status – describes the status of the indicator relative to the standards addressed in the indicator summary and the supporting rationale for the status determination. Details on methods used to determine status are included in Chapter 2.
- Trend – describes the magnitude and direction of change associated with the indicator through time relative to the standard. This section may also include a description of long-term versus more recent trends to explore potential effects of significant policy or management events in the Tahoe Region or major trajectory shifts. The narrative also provides a rationale for the trend determination. Details on methods used to determine trend are included in Chapter 2.
- Confidence – describes how much confidence there is in the determination of status and trend, and reasons why the confidence level is assigned. Details on methods used to determine confidence are included in Chapter 2 of this report.

Implementation and Effectiveness – Summarizes information on the actions taken to promote attainment, their effectiveness, and, where indicators are out of attainment relative to the adopted standard, establishes interim targets to measure progress towards attainment.

- Programs and Actions Implemented to Improve Conditions – describes major regulations, programs and/or actions that currently exist to beneficially affect the subject indicator. TRPA broadly refers to such regulations, program and activities as "compliance measures" (Code of Ordinances, 16.3).
- Effectiveness of Programs and Actions – uses best available information to describe and interpret the evidence to support or refute the effectiveness of implemented programs, actions, and compliance measures for achieving and maintaining the subject threshold standard.
- Interim Target – is a numeric goal or target expressed in terms of the applicable measurement unit reflecting the level of an indicator value that TRPA expects can be achieved at a major evaluation interval specified for that standard. In most cases in this report, interim targets are estimated indicator values expected to be achieved by the next major evaluation date in 2019. Details on methods used to estimate interim targets are included in Chapter 2, Methodology.
- Target Attainment Date – is a date when the adopted threshold standard will be achieved.

Recommendations– Provides recommendations for modifying standards, indicators, and evaluation approach

- <u>Analytic Approach</u> – summarizes recommendations for how the available data could be analyzed differently to gain additional insight into status or trends.
- <u>Monitoring Approach</u> – makes recommendations for altering the existing data collection methodologies.
- <u>Modification of the Threshold Standard or Indicator</u> – provides recommendation for revision of the standard.
- <u>Attain or Maintain Threshold</u> – identifies additional actions or policies that TRPA and partner agencies could take to attain or maintain the threshold standard. TRPA refers to these actions as "supplemental compliance measures."

Evaluation of Management Standards and Policy Statements

When TRPA adopted threshold standards in 1982, the revised Bi-State Compact had just been approved, the Regional Plan was not in place, and the science needed to establish certain numerical standards did not exist or was in early stages. In instances where a numerical threshold standard could not be identified, some threshold standards were set forth in TRPA Resolution 82-11 as "management standards." Management standards without numeric targets cannot be evaluated in the same way as numerical standards. As a result, the following qualitative evaluation questions are addressed:

- *Has TRPA included provisions and requirements in permit-processing that adhere to the management standard in Resolution 82-11?*
- *Have TRPA and/or other agencies adopted programs that satisfy the management standard?*
- *Is there evidence to suggest these actions are effective in achieving the intent of the management standard?*

There are many instances in Resolution 82-11 where management standards provide management directives and numerical targets together. In these instances, the management standards are evaluated similarly to a numerical standard if data are available and of sufficient quality.

Policy statements provide specific direction in developing the Regional Plan. Policy statements are not numerical standards or management standards, rather they are principles intended to guide decisions toward desired outcomes or values. To evaluate policy statements, the following questions are addressed:

- *Have TRPA and/or other agencies adopted policies, regulations or implemented other programmatic efforts to satisfy the policy statement adopted in Resolution 82-11?*
- *Is there evidence to suggest these actions are effective at achieving the intent of the policy statement?*

A qualitative evaluation and narrative description of the policy statement's implementation is included as an element of each threshold category chapter in this report.

The status of management standards and policy statements are summarized in a format similar to that used for numerical indicator summaries, differing only in that they do not characterize trends or confidence.

Table 2-1. *Reporting icon categories characterize the implementation status of TRPA adopted management standards and policy statements.*

Status Category	Description	Reporting Icon
Implemented	The management standard or policy statement has been integrated into the Regional Plan and is consistently applied to a project design or as a condition of project approval as a result of project review process. Examples of programs or actions can be identified to support the management standard's implementation. Adopted programs or actions support all aspects of the management standard or policy statement's implementation, or address all major threats to implementation.	**I**
Partially Implemented	The management standard or policy statement has been integrated into the Regional Plan, but is not consistently applied during the project review process. No more than two examples of programs or actions can be identified to support the management standard's implementation and/or adopted programs or actions support some aspects of the management standard or policy statement's implementation, or address some major threats to implementation.	**PI**
Not Implemented	The management standard or policy statement has not been integrated into the Regional Plan and is not applied during the project review process. No examples of programs or actions can be identified to support implementation.	**NI**

Peer Review of the 2015 Threshold Evaluation

The 2015 Threshold Evaluation is the sixth evaluation report completed by TRPA and the second to undergo an independent scientific peer review (Appendix D). The purpose of the peer review is to ensure the scientific rigor of the report and to seek external recommendations to improve the quality of information presented to the TRPA Governing Board and the public. TRPA responses to peer review comments are in Appendix E of this report.

Threshold Standards and Local, State, and Federal Air and Water Quality Standards

Under its Regional Plan, TRPA must evaluate and report at least every four years on the progress toward attainment of threshold standards or interim targets, as well as the attainment of applicable local, state and federal air and water quality standards.

TRPA threshold standards are detailed in resolution 82-11. Many state and federal air and water quality standards apply to the Tahoe Basin (Table 2-2). Only air and water quality standards for which data exist or those evaluated and reported by a state or federal agency are included in the current report. There are no unique air and water quality standards adopted by local agencies for the Lake Tahoe Region.

Evaluation of Numerical Standards and Management Standards with Numeric Targets

Numerical standards and management standards with numeric targets are quantitative expressions of desired environmental conditions or program goals.

The threshold evaluation report assesses indicator status and trend relative to numerical standards or management standards with numeric targets. In addition, this evaluation estimates the level of confidence in status and trend determinations. The following questions are central to the evaluation of numerical standards and management standards with numeric targets:

- *What is the status of the indicator relative to the adopted standard or interim target?*
- *How has the indicator changed over time?*
- *What is the level of confidence in the assessment of indicator status and trend?*

To standardize determinations across indicators, multiple assessors, criteria for indicator status, trend, and confidence determinations for numerical standards are specified in this evaluation. Results of an indicator's status, trend, and confidence determinations are reported and represented using icons that quickly communicate essential results. The reporting icon represents a four step approach using the following criteria:

1. Identify indicator and associated standards.
2. Determine indicator status relative to the identified standard.
3. Evaluate the observed trend in indicator.
4. Assign a combined confidence rating to the indicator status and trend determinations.

These four steps are described in more detail below.

1. **Identify Indicator and Standard:** Three sources guided indicator identification: TRPA Resolution 82-11 (adopted threshold standards), Exhibit C (inserted as Appendix B in this Report); past TRPA threshold evaluation reports; and state and federal air and water quality standards (Table 2-2).

Table 2-2. Sources of applicable state and federal air and water quality standards.

Jurisdiction	State or Federal Implementing Agency	Implementing Document	Source
Air Quality			
Nevada	Nevada Division of Environmental Protection – Bureau of Air Quality Planning	Nevada Administrative Code - 445B.22097	http://www.leg.state.nv.us/nac/nac-445b.html
California	California Air Resources Board	California Health & Safety Code section 39606	http://www.arb.ca.gov/research/aaqs/caaqs/caaqs.htm
United States of America	Environmental Protection Agency	Clean Air Act	https://www.epa.gov/criteria-air-pollutants/naaqs-table
Water Quality			
Nevada	Nevada Division of Environmental Protection – Bureau of Water Quality Planning	Nevada Administrative Code, Chapter 445A.118-445A.225	http://www.leg.state.nv.us/nac/nac-445a.html#NAC445ASec1905
California	California Water Boards Lahontan Region	Lake Tahoe Basin Plan	http://www.swrcb.ca.gov/rwqcb6/water_issues/programs/basin_plan/docs/ch5_laketahoebasin.pdf

2. **Determination of Indicator Status:** This evaluation generally follows the methods used in the 2011 Threshold Evaluation Report. Using these methods, the evaluation assigns a status to an indicator relative to the adopted standard. The background color of the reporting icon communicates the indicator "status" or estimate of current condition. For numerical standards, the status of an indicator is classified into "better" or "worse" categories based on the percent divergence of the current indicator value from the standard or interim target (Figure 2-2). For most indicators, the current value is taken directly from the value recorded in the most recent year. In some cases, the average value calculated from all data collected during the evaluation period is used. When an average value is used, it is noted and explained on the indicator sheet.
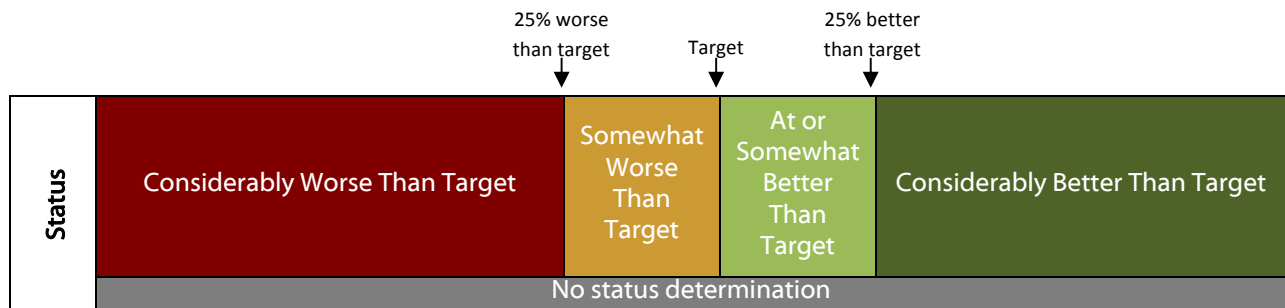

Figure 2-2: Categories of indicator status and the colors assigned to each category. Status determinations are based on the percent divergence of the most current indicator value from the standard or interim target.

Three types of numerical standards are commonly used in the Lake Tahoe Basin:

- "*Achieve the Minimum*" Standards – standards that mandate a minimum numeric level for a given indicator such as depth of lake transparency, or number of special interest wildlife species population sites.
- "*Not to Exceed*" Standards – standards that mandate indicator condition or level not exceed a maximum numeric value such as ozone concentration or community noise levels.
- "*Maintain within a Range*" Standards – standards that mandate maintaining a value that is between a minimum and maximum numeric level for a given indicator such as percent cover of forest vegetation in stages other than mature.

The categorization of standards influences the calculation and interpretation of attainment status. Whenever possible, the "percent to target" approach is used to determine the level of standard attainment or non-attainment. Percent to target yields a simple expression of how close an indicator is to a standard or target. Attainment occurs when an indicator is equal to or better than the established standard or target. This approach is commonly used to assess attainment of socioeconomic and environmental goals, or overall system performance (e.g., Chesapeake Bay Program[1]), because it is based on straightforward calculations and is readily understood. One criticism of the approach is that it communicates indicator status relative to the standard in a linear fashion over the entire range of the indicator. For some indicators this many not be consistent with the underlying physical conditions that affect indicator status. For example, a change in Lake Tahoe transparency from a depth of 75 feet to 74 feet requires only a very small increase in the number of suspended particles when compared to a change in transparency from a depth of five feet to four feet, because of the behavior of light transmission through a column of water. At shallower depths, substantially more suspended particles would be required to influence one's ability to detect a change in transparency from five feet to four feet. In most cases, however, the distance between an indicator value and the standard or interim target represents only a portion of the full potential range of indicator values.

To calculate percent to target, the indicator measurement from the most current evaluation year is divided by the standard or interim target and multiplied by 100.

*Percent to Target = Most Current Years' Measurement/Target * 100*

A hypothetical example calculation of percent to target for annual average pelagic lake transparency is:

$$23.7/29.7*100 = 80\%$$

The percent to target calculation reveals that 2014 annual average pelagic lake transparency is 80 percent of the target, or 20 percent below the target. Thus, annual lake transparency would be categorized as "somewhat worse than target" because it is less than 25 percent away from and below the interim target.

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[1] *http://www.chesapeakebay.net/*

For "*achieve the minimum*" standards, the following categories are used to determine the color (and level of attainment) of the reporting icon:

- **Dark Green** – "Considerably Better than Target" - the value is greater than 25 percent better than the standard or interim target
- **Light Green** – "At or Somewhat Better than Target" - the value is greater than or equal to the standard or interim target, but not more than 25percent better
- **Yellow** – "Somewhat Worse than Target" – the value is less than the standard or interim target but at least 75 percent of the standard or interim target
- **Dark Red** – "Considerably Worse than Target" – the value is less than 75 percent of the standard or interim target

For the "*not to exceed*" standards, the following categories are used to determine the color (and level of attainment) of the reporting icon:

- **Dark Green** – "Considerably Better than Target" - the value is below 75 percent of the standard or interim target
- **Light Green** – "At or Somewhat Better than Target" - the value is below the standard or interim target but within 25 percent of the value
- **Yellow** – "Somewhat Worse than Target" – the value is higher than the desired standard or interim target but within 25 percent of the value
- **Dark Red** – "Considerably Worse than Target" – the value is greater than 125 percent of the desired standard or target

For the "*maintain within range*" standards, attainment is relatively easy to determine if the current year's value falls within the prescribed range. However, if the value is above or below the prescribed range, one needs to first determine which side of the prescribed range the current year's value falls on, and then needs to calculate the percent to target. If the current year's value is below the lower range of the prescribed target, the percent to target is calculated as follows:

percent to target = most current year's measurement/low range of target*100

If the most current year's value is above the upper range of the prescribed target, percent to target is calculated as follows:

percent to target = most current year's measurement/high range of target*100

For example, a TRPA threshold standard for vegetation requires that the immature red fir forest type be maintained between 15 percent and 25 percent of the upland basin landscape, on an acreage basis. If the measured value of this forest type is below the required lower limit, say 10 percent, the following calculation is used:

10% (measured value)/15% (low range of the target) * 100 = 66%

If the measured value of this forest type is above the range required by the upper limit for immature red fir forest type, for instance, 28 percent, the following calculation is used:

28 (measured value)/25 (upper limit of range) * 100 = 112%

The following color categories are used to determine the level of attainment of the reporting icon:

- **Dark Green** – "Considerably Better than Target" – this color choice is not available to characterize the status of "*maintain within range*" standards because the standard specifies both an upper and lower limit
- **Light Green** – "At or Somewhat Better than Target" – the value must be within the range of values prescribed by the standard
- **Yellow** – "Somewhat Worse than Target" –the value is either a) below the lower limit of the standard, but greater than 75 percent of the lower limit or b) above the high range of the prescribed target, but no greater than 125 percent of upper limit
- **Dark Red** – "Considerably Worse than Target" – the value is either a) less than 75 percent of the lower limit or b) greater than 125 percent of upper limit.

3. **Evaluation of Indicator Trend:** Categories of trend trajectories were developed to improve consistency of trend determinations across indicator evaluations (Table 2-3). The trend arrow in the reporting icon describes the indicator "trend" or change in the indicator value relative to the standard or interim target over time. In general, a trend arrow depicted in the reporting icon represents the trend derived using all available data for an indicator unless otherwise noted in the data evaluation and interpretation narrative. In some cases, with a long-term dataset, the trend arrow depicted in the reporting icon represents examination of the most recent data thereby characterizing the near-term trend. In these cases, the trend determination is based on at least the previous five evaluation periods[2]. In cases where only recent data are available representing at least three evaluation periods, a trend determination is made; however, the level of confidence assigned to the trend determination is low due to the limited amount of data. In other cases, a trend determination is not made due to insufficient data (i.e., less than three evaluation periods) so a "diamond" was used in the reporting icon, indicating that no trend is determined. In all cases, details of the trend determination in the reporting icon are disclosed in the "data evaluation and interpretation" section of each indicator summary.

A simple linear regression is the primary analytical approach used to estimate indicator trends from available data. However, data for several indicators are analyzed using different analytical approaches due to the specific characteristics of the data and knowledge about the responses of the indicator to various environmental factors. Methods for modified analytical approaches are explained in the chapter or individual indicator summaries.

Simple linear regression is a statistical method that provides an equation for a straight line through a set of data points plotted on x (generally time) and y (indicator value) axes of a graph. The resulting line is considered the 'best fit' line given the associated variability in the data set.[3] The slope of the best-fit line represents the modeled change in y (indicator values) over the change in x (time). To test if the slope is significantly different from zero (a slope of

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[2] *Evaluation periods vary among indicators and depend on the frequency of data collection analytic methods used. For example, the evaluation period for annual Secchi disk depth is once per year, although the annual value is an average of measurements taken during each month of the year. In contrast, assessments of major vegetation communities throughout the Tahoe Basin only occur about once every five years.*
[3] *The criterion for 'best fit' generally employed uses the concept of 'least squares.' The least squares criterion considers the vertical deviation of each point from the line, and defines the best fit line as that which results in the smallest value for the sum of the squares of these deviations for all values.*

zero indicates no change in trend), data is plotted to determine if a linear relationship was apparent. The coefficient of determination is then evaluated to provide a measure of how well future outcomes are likely to be predicted by the regression model. The coefficient of determination (r^2) estimates the proportion of the variation in the y-values that is explained by the fitted line. The coefficient of determination may be thought of as a measure of the strength of the straight-line relationship, with values ranging from zero (no strength) to one (maximum strength). It is important to note that this method does not take into account nonlinear trajectories (e.g., polynomial models) or complex interactions that can lead to trajectories exhibiting step-functions, or changing cyclical patterns common in wildlife populations. Other statistical approaches are more appropriate in these cases. It also is important to note that a linear regression (and other regression analyses) tests how well two variables are correlated with one another and assumes that the y-value (the indicator) is functionally dependent on the x-value (time). However, it is recognized that a significant linear regression does not establish a cause-effect relationship. Finally, a statistical t-test to evaluate if the slope of the regression line differed significantly from zero was conducted resulting in a p-value. A p-value indicates how likely the observed results are purely the results of chance. A small p-value (typically less than or equal to 0.05) indicates strong evidence against the null hypothesis (indicating that the observations are unlikely to be result of chance).

Determination of trend significance is made using the methods described in the "confidence in status and trend determination" section below.

Table 2-3: Indicator trend categories and associated definitions used to classify trends relative to standards in the reporting icon.

INDICATOR TREND CATEGORY		DEFINITION[4]
Rapid Improvement	⇧	The slope of the indicator trend is in the improving direction and the absolute percent change per year (or evaluation period) relative to the target is better than or equal to 2.5 percent.
Moderate Improvement	⬈	The trend slope is in the improving direction and the absolute percent change per year (or evaluation period) relative to the target is between 2.4 percent and 0.5 percent.
Little or No Change	⇔	The trend slope is flat (horizontal) or marginally improving or declining relative to the target and the absolute percent change per year (or evaluation period) relative to the target is between zero percent and +/- 0.5 percent.
Moderate Decline	⬋	The slope is in the declining direction relative to the target and the absolute percent change per year (or evaluation period) is between 0.5 percent and 2.5 percent.
Rapid Decline	⇩	The slope is in the declining direction and the absolute percent change per year relative to the target is greater than 2.5 percent.
Insufficient Data to Determine Trend	◇	Trend could not be determined due to insufficient data (less than three evaluation periods), highly variable data, or due to differences in analytical approach used across years.

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[4] *To determine % change relative to the target the following equation is used:*
  Percent change = linear regression slope (Beta)/interim target or standard

<u>Estimating Interim Targets:</u>
The approach used to estimate an interim target in all cases is documented in the indicator summary. Generally, interim targets are estimated using one of the following approaches:

- Based on the adopted state or federal goals, such as annual average lake transparency.
- For indicators with a trend line trajectory moving towards attainment and moderate to high confidence, the trend lines are extended out four years (the next threshold evaluation report) and a horizontal line is constructed from the endpoint of the extended trend line to the y-axis. The intersection of the horizontal line with the y-axis is used to estimate an interim target for that indicator.
- For indicators with a trend line trajectory moving away from attainment and moderate to high confidence, the interim target is to slow the rate of change away from attainment or begin progress towards attainment.
- If the indicator is currently in attainment no interim target is listed.

<u>Estimating Threshold Standard Attainment Dates:</u>
The approach used to estimate an attainment date in all cases is documented in the indicator summary. Generally, threshold standard attainment dates are estimated using one of the following approaches:

- For indicators with a trend line trajectory moving towards the threshold standard and "moderate" to "high" confidence, trend lines are extended until they intersected with a horizontal line representing the standard. A vertical line is constructed from the intersection of the extended trend line and the line representing the threshold standard to the x-axis. The intersection of the vertical line with the x-axis is used to estimate an attainment for that indicator.
- In limited cases, best available scientific findings are used to estimate attainment dates.
- No attainment date is estimated for indicators with a trend line trajectory moving away from attainment or where there is low confidence in the trend.
- No attainment date is estimated if the threshold standard is determined to be in attainment.

4. **Confidence in Status and Trend Determinations:** The border surrounding the reporting icon describes how much "confidence" there is in the determination of an indicator's status and trend relative to the standard, interim target or numeric management target. A confidence rating is assigned to the combined status and trend determination in order to provide the reader with a sense of the relative strength or weakness in the available data and the associated analysis, and to aid in identifying areas for monitoring program improvement. Confidence rating categories used for reporting icon included "high," "moderate" and "low." The following steps and criteria are used to assign a confidence rating to status and trend determinations.

<u>Confidence in Status Determination</u>: Confidence in status is determined based on three factors:
a) *Protocols Used:* For this factor, we evaluated if a well-documented and accepted monitoring protocol was used to guide the collection, analysis and reporting of the indicator.
b) *Data Continuity, Recent Data, and Quality Assurance:* All of the following need to be true for an affirmative evaluation of this factor.
   i. Data were collected consistently for two or more monitoring periods.

ii.   Most recent data are less than two monitoring periods old.

iii.   Data were subject to quality control and assurance requirements.

c) *Spatial and Temporal Representation:* Evaluation of this factor examined if the distribution of the sampling effort was supported by a sampling design analysis, a scientifically supportable qualitative rationale, or criteria established by appropriate authorities (e.g., Environmental Protection Agency criteria for establishing air quality monitoring sites). Either approach infers that the spatial and temporal representativeness of the monitoring effort adequately characterizes regional conditions for the resource or condition considered.

"High" confidence in a status determination requires affirmative fulfillment of all of these factors. "Moderate" confidence in status determination requires fulfillment of two out of the three factors, and "low" confidence is assigned if only one or none of the factors are fulfilled. Where insufficient data exists to reach a status determination or there was no established standard, a low confidence was assigned to the status determination.

<u>Confidence in Trend Determination</u>: Confidence in a directional (improving or declining) trend determination depends on three factors evaluated in sequence:

a) *The duration of trustworthy data*: Trustworthy data must be available for at least as long as needed to observe a material change in the indicator (at least three monitoring periods). Low confidence in the trend is automatically assigned if this factor is not met.

b) *The coefficient of determination (r^2)*: An r^2 value greater than or equal to 0.75 had to exist in order to assign "high" confidence in the trend. An r^2 value between 0.50 and 0.74 had to exist in order to assign "moderate" confidence in the trend. An r^2 value less than or equal to 0.50 resulted in an assignment of "low" confidence in the trend.

c) *A statistical test to evaluate if the slope of the regression line differed significantly from zero (p-value).*

The final confidence determination for trend is determined based on the outcomes of all three factors as described in Table 2-4.

Table 2-4: *Trend confidence determinations based on both the r^2-value and t-test significance. All of these determinations assume that the duration of trustworthy data factor is met. If not, then the final confidence determination for trend is low.*

P-value: t-test significance	r^2-value		
	$r^2>0.75$	$0.75{\geq}r^2{\geq}0.5$	$r^2<0.5$
p<0.1	High	Moderate	Low
0.4>p>0.1	Moderate	Moderate	Low
p>0.4	Low	Low	Low

Where the data collected met the "duration of trustworthy data" criterion, and the test for statistical significance found no significant change, the confidence in the trend is assigned based on the confidence in the data. In instances where a trend determination is made without a statistical analysis (i.e., the data were simply graphed and interpreted) the trend determination is assigned a "low" confidence rating.

Overall Confidence: The overall confidence is determined by comparing the separate status and trend confidence rating determinations. These comparisons assume the separate confidence ratings carry equal weight. The following rules are used to establish an overall confidence rating. In instances where both the status and trend are determined to be unknown, an overall confidence rating of low is assigned.

Table 2-5. Overall confidence determinations based on confidence level determined for both status and trend.

Status & Trend Confidence Rating	Overall Confidence Rating
Same	Use this confidence category
One confidence rating is High, and one is Low	Moderate
One confidence rating is High and other is Moderate, or one is Moderate and other is Low	Use the lower confidence rating

Evaluation of Management Standards and Policy Statements

Management standards and policy statements that do not establish numerical standards (i.e., narrative standards) are evaluated differently from numeric standards. Management standards reference implementation of best practices, regulations, norms or policies thought to be associated with the desired environmental conditions. Policy statements were identified to provide specific direction for development of a Regional Plan. Policy statements are principles intended to guide decisions needed to achieve a desired outcome or value The summary write-ups are formatted similarly to numerical indicator summaries but differ in that they do not include an assessment of trend or confidence.

To evaluate qualitative or narrative management standards and policy statements, the following questions were addressed:

- *Has TRPA (and/or other authorities) included provisions and requirements in permit processes that adhere to the management standard or policy statement adopted in Resolution 82-11?*
- *Has TRPA (and/or other authorities) adopted programs that satisfy the intent of the management standard or policy statement?*
- *Is there evidence to suggest these actions are effective in achieving the intent of the management standard or policy statement?*

There are many instances in Resolution 82-11 where management standards provide management directives and numerical targets together. In these instances, the numerical elements of the management standards were evaluated in a manner similar to a numerical standard if data were available and of sufficient quality (see above).

Sources of Status and Trend Data and Information

Multiple agencies, research institutions and consultants contributed to collecting or funding the data presented in this report. Below is a summary of the major data and information sources, organized by threshold category.

Water Quality – Lake Tahoe data is provided by U.C. Davis - Tahoe Environmental Research Center (U.C. Davis). Information on tributary water quality is provided by the U.S. Geological Survey – Nevada Water Science Center (USGS) in partnership with U.C. Davis. Other information on water quality is derived from Nevada Division of Environmental Protection and California Water Board - Lahontan Region reports. Collection of water quality data is funded by Lahontan Regional Water Quality Control Board, Nevada Division of State Lands, TRPA, U.C. Davis, U.S. Forest Service – Lake Tahoe Basin Management Unit, and the USGS. Spatial Informatics Group, LLC estimated lakewide aquatic macrophyte distribution using Worldview-2 satellite imagery from 2010 and 2015. Tahoe Resource Conservation District provided information on the aquatic invasive species prevention program and analyzed data on stormwater. The University of Nevada-Reno provided information on the status and distribution of invasive species.

Air Quality – Air pollutant data and published monitoring reports are provided by the California Air Resources Board and the U.S. Environmental Protection Agency (EPA) through their respective web-based data portals. Washoe County Air Management District, Placer County Air Management District and El Dorado County Air Management District provide data to EPA and California Air Resources Board. Desert Research Institute was retained by TRPA to analyze available data. Funding for data collection is provided by the above listed agencies.

Soil Conservation –Natural Resources Conservation Service provides updated information for the Lake Tahoe Basin via personal communication and through recent publications. Watershed Sciences, LLC, provided 2010 airborne LiDAR data. Digital Globe (Worldview-2 satellite) provided 2010 multispectral satellite imagery. Spatial Informatics Group, LLC, and the University of Vermont did a preliminary analysis of impervious cover through a grant provided by Southern Nevada Public Lands Management Act. Data on stream restoration progress are provided by the U.S. Forest Service Lake Tahoe Basin Management Unit, California Tahoe Conservancy, and Nevada Division of State Lands. Information on permitted projects is provided by Douglas County, El Dorado County, Placer County, the City of South Lake Tahoe, and Washoe County.

Wildlife – Data and information on special status wildlife species is provided by the U.S. Forest Service Lake Tahoe Basin Management Unit, in partnership with TRPA, California Department of State Parks, Nevada Division of Wildlife, California Tahoe Conservancy, California Department of Fish and Game, and U.S. Fish and Wildlife Service. Spatial Informatics Group, LLC performed field surveys to assess impacts on identified waterfowl areas in the basin and Dr. Michael Morrison, of Texas A&M University, reviewed the findings of the waterfowl assessment.

Fisheries – Data, analysis, and information presented in this report are provided by the U.S. Forest Service Lake Tahoe Basin Management Unit, U.S. Fish and Wildlife Service, TRPA contractor Spatial Informatics Group, California Department of Fish and Game, Nevada Division of Environmental Protection, Nevada Department of Wildlife, University of Nevada Reno, Humboldt State University, and Lahontan Regional Water Quality Control Board. Much of the funding for fisheries-related research is provided through the Southern Nevada Public Lands Management Act grant program. Spatial Informatics Group, LLC used Worldview-2 satellite imagery from 2010 and 2015 to refine lake fish habitat maps.

Recreation – Data and information are provided by TRPA, the City of South Lake Tahoe, El Dorado County, Tahoe City Public Utility District, the Lake Tahoe Visitors Authority, and the North Lake Tahoe Resort Association. Review of evaluation and constructive input is provided by California State Parks and the U.S. Forest Service Lake Tahoe Basin Management Unit.

Scenic Resources – TRPA worked with Ascent Environmental, and Nevada State Parks, to collect and analyze the scenic quality data presented in this report. TRPA funded data collection, analysis and reporting of scenic quality data.

Vegetation – The U.S. Forest Service Lake Tahoe Basin Management Unit, and the U.S. Forest Service Region 5, played a substantial role in collecting, analyzing, and reporting data on rare plants, uncommon plant communities, and common vegetation. Quercus Consultants, Inc. collected forest inventory data. The U.S. Forest Service Remote 5 sensing lab managed the forest inventory data collection and analyzed the data used to assess the common vegetation standard. TRPA retained Pyramid Botanical Consultants to compile and analyze data on sensitive plants and uncommon plant communities. The University of Nevada, Reno provided information on the status of deep water plant communities.

Noise - The City of South Lake Tahoe Airport provided quarterly reports to TRPA on airport-related noise. TRPA staff and TRPA contractors Bollard Acoustical Services and Ascent Environmental collected and analyzed all noise data for this evaluation.