Tahoe Science Advisory Council

Tahoe Regional Planning Agency 2023 Threshold Evaluation
Independent Peer Review

Appendix B – Submitted Reviews

Air Quality - Keith Bein

Carbon Monoxide (CO)

- ***Highest 8-hour average concentration of carbon monoxide***
  - *General presentation*
    1. "Key Points" accurately summarizes the most important points, and these are supported by the data and analyses presented: rapidly shifting fire regime may drive up future CO concentrations, potentially offsetting gains made elsewhere, e.g., transportation and recreation.
    2. "Rationale Details" sufficiently addresses how the standard was evaluated and status determined: 8-hour average over the 4-year period 2020-2023; less than half the threshold standard.
    3. "Confidence Details" adequately explains how the confidence level was determined, and this is supported by the information presented: *status* = high (traffic levels have not increased to those observed in 2012 and CO concentrations were consistently below applicable standards), *trend* = low (low coefficient of determination r^2 = 0.12 and high p-value = 0.3), *overall* = moderate.
    4. "Delivering and Measuring Success" provides links to relevant projects on standard attainment, as well as the monitoring programs and metrics used to assess progress: *EIP Action Priorities, EIP Indicators, Example EIP Projects, Local and Regional Plans,* and *Monitoring Programs*.
  - *Threshold status determination*
    1. Analytical methods are appropriately applied in determining indicator status, trend, and confidence for the highest 8-hour average CO concentration: gas filter correlation CO analyzer coupled to trend analysis via non-parametric Theil-Sen estimator.
    2. Evaluation methods/metrics for indicator status and trend are sufficient, no further suggestions.
- ***Average daily winter traffic volume, President's Weekend***
  - *General presentation*
    1. "Key Points" accurately summarizes the most important points, and these are supported by the data and analyses presented: evaluated over an 8-hour period (16:00-24:00) on Saturday of President's Day weekend and the standard has been in attainment since 1996 with a 50% drop in AADT in 2022 compared to 2001.
    2. "Rationale Details" sufficiently addresses how the standard was evaluated and status determined: assuming peak annual hourly traffic volume is sustained over an 8-hour period, the standard is still attained, and this is further supported by the

President's Day weekend observations in 2020. There has been little to no change in traffic volume trends since 2005, which are relatively stable at ~15k.

3. "Confidence Details" adequately explains how the confidence level was determined, and this is supported by the information presented: *status* = high (Caltrans counts are considered accurate and declines are large relative to measurement error), *trend* = high, *overall* = high.
4. "Delivering and Measuring Success" provides links to relevant projects on standard attainment, as well as the monitoring programs and metrics used to assess progress: *Local and Regional Plans* and *Monitoring Program* (Caltrans and NDOT).

– *Threshold status determination*

1. Analytical methods are appropriately applied in determining indicator status, trend, and confidence for average daily winter traffic volume on Presidents' weekend: Caltrans vehicle counts.
2. Evaluation methods/metrics for indicator status and trend are sufficient, no further suggestions.

Nitrate Deposition

- ***Reduce generation and transport of nitrate to achieve water quality standards***
  – *General presentation*
    1. "Key Points" accurately summarizes the most important points, and these are supported by the data and analyses presented: NO_x emissions have been steadily decreasing over the years and are projected to continue decreasing due to vehicle emission standards and the transition to EVs. The potential impact of increasing wildfire activity on nitrate deposition, however, is not discussed.
    2. "Rationale Details" sufficiently addresses how the management strategy for reducing nitrogen deposition was formulated and implemented: policies, programs and ordinances for reducing generation of airborne precursors, e.g., alternative transportation and new emission standards, and reducing nitrogen loading in surface runoff and groundwater supplies, e.g. stormwater treatment.
    3. "Confidence Details" were not included for this indicator although data and trendlines are clearly presented. Confidence in status, trends, and overall are not reported.
    4. "Delivering and Measuring Success" provides links to relevant projects on standard attainment, as well as the monitoring programs and metrics used to assess progress: *EIP Action Priorities, EIP Indicators, Example EIP Projects,* and *Monitoring Programs*.
  – *Threshold status determination*
    1. Analytical methods are appropriately applied in determining lake clarity trends: Secchi depth coupled to linear regression model. However, it is unclear how mid-lake DIN is being measured or analyzed and there are no thresholds or standards reported for these indicators.
    2. Accountability research is difficult and costly to conduct so it is not immediately clear how to evaluate the success or efficacy of the policies, programs and

ordinances implemented to reduce generation and transport of nitrogen-containing species in the Tahoe Basin.

Ozone (O_3)

- ***Highest 1-hour average concentration of ozone***
  - *General presentation*
    1. "Key Points" accurately summarizes the most important points, and these are supported by the data and analyses presented: rapidly shifting fire regime may drive up future O_3 concentrations due to increasing precursor emissions from wildfires, potentially offsetting gains made elsewhere, e.g., transportation and emissions control tech, effect of altitude on ozone photochemistry, and ozone exceedance correlated with elevated PM concentrations, suggesting influx of wildfire emissions.
    2. "Rationale Details" sufficiently addresses how the standard was evaluated and status determined: yearly maximum 1-hour O_3 concentration averaged over 5 measurement sites around the basin from 2020-2023 is slightly higher than threshold target. Trends are generally decreasing but with a significant uptick in recent years due to increased wildfire emissions.
    3. "Confidence Details" adequately explains how the confidence level was determined, and this is supported by the information presented: *status* = high (accurate instrumentation and consistent measurement protocols), *trend* = low (low coefficient of determination $r^2 = 0.3$), *overall* = moderate. "Confidence of Trend" could benefit from a rewording, and it is unclear what the p-value is intended to be numerically. Confidence in the trendline is designated as low but then it is stated that that the downward trend is highly significant. This seems contradictory.
    4. "Delivering and Measuring Success" provides links to relevant projects on standard attainment, as well as the monitoring programs and metrics used to assess progress: *EIP Action Priorities, EIP Indicators, Example EIP Projects, Local and Regional Plans,* and *Monitoring Programs*.
  - *Threshold status determination*
    1. Analytical methods are appropriately applied in determining indicator status, trend, and confidence for the highest 1-hour average O_3 concentration: UV photometric O_3 analyzer coupled to trend analysis via non-parametric Theil-Sen estimator.
    2. Evaluation methods/metrics for indicator status and trend are sufficient, no further suggestions.
- ***Oxides of nitrogen emissions***
  - *General presentation*
    1. "Key Points" summarizes important points, and these are supported by the data and analyses presented, but there is no mention of the impact of increasing wildfires on NOx concentrations. It is stated that NO_x emissions are likely to continue declining due to increasingly stringent vehicular emission regulations, but this does not consider increasing wildfires and prescribed burns.
    2. "Rationale Details" sufficiently addresses how the standard was evaluated and status determined: CARB emission inventory estimates for daily NO_x from 2020 are significantly lower than threshold.

3. "Confidence Details" adequately explains how the confidence level was determined, and this is supported by the information presented: *status* = high (based on emissions inventories and calculated by CARB staff), *trend* = high (high coefficient of determination $r^2 = 0.799$ and low p-value < 0.05, statistically significant trendline), *overall* = high.
4. "Delivering and Measuring Success" provides links to relevant projects on standard attainment, as well as the monitoring programs and metrics used to assess progress: *EIP Action Priorities, EIP Indicators, Example EIP Projects, Local and Regional Plans,* and *Monitoring Programs*.

– *Threshold status determination*
1. Modeling approach is appropriately applied in determining indicator status, trend, and confidence for annual NOx emissions: CARB emission inventories and modeling efforts.
2. Evaluation methods/metrics for indicator status and trend are sufficient. It is stated that there is "recently installed monitoring at the TRPA offices in Stateline, Nevada." I think it will be important to bring this instrument online to provide real-time NOx data for future threshold assessments.

Regional Visibility

- ***Regional visibility 50th percentile***
  – *General presentation*
    1. "Key Points" accurately summarizes the most important points, and these are supported by the data and analyses presented: average visibility days shows long term improvement but increasing wildfires have partially offset these gains recently and this may increase in the future.
    2. "Rationale Details" sufficiently addresses how the standard was evaluated and status determined: 3-year running average of IMPROVE light extinction measurements significantly less than threshold and the temporal trend continues decreasing at a moderate rate, meaning visibility is improving.
    3. "Confidence Details" adequately explains how the confidence level was determined, and this is supported by the information presented: *status* = high (based on well-established IMPROVE sampling and measurement protocols), *trend* = high (high coefficient of determination $r^2 = 0.92$ and low p-value << 0.05, statistically significant trendline), *overall* = high.
    4. "Delivering and Measuring Success" provides links to relevant projects on standard attainment, as well as the monitoring programs and metrics used to assess progress: *EIP Action Priorities, EIP Indicators, Example EIP Projects, Local and Regional Plans,* and *Monitoring Programs*.
  – *Threshold status determination*
    1. Analytical methods are appropriately applied in determining indicator status, trend, and confidence for average visibility days: IMPROVE sampling and measurement protocols are well established and analyses based on these data are routinely published in the scientific literature.

2. Evaluation methods/metrics for indicator status and trend are sufficient, no further suggestions.

- ***Regional visibility 90th percentile***
  - *General presentation*
    1. "Key Points" accurately summarizes the most important points, and these are supported by the data and analyses presented: poor visibility days are trending upward due to increasing wildfire activity, as suggested by measurements showing PM OC to be the dominant driving factor. This will likely continue increasing in future years given projections on wildfires and prescribed burns.
    2. "Rationale Details" sufficiently addresses how the standard was evaluated and status determined: 3-year running average of IMPROVE light extinction measurements significantly greater than threshold with increasing trend in light extinction and thus severity of poor visibility days increasing.
    3. "Confidence Details" adequately explains how the confidence level was determined, and this is supported by the information presented: *status* = high (based on well-established IMPROVE sampling and measurement protocols), *trend* = low (low coefficient of determination r^2 = 0.1368 and high p-value = 0.2938, which is largely a result of accelerating upward trends in poor visibility days over recent years 2020-2022 due to wildfire smoke), *overall* = moderate.
    4. "Delivering and Measuring Success" provides links to relevant projects on standard attainment, as well as the monitoring programs and metrics used to assess progress: *EIP Action Priorities, EIP Indicators, Example EIP Projects, Local and Regional Plans,* and *Monitoring Programs*.
  - *Threshold status determination*
    1. Analytical methods are appropriately applied in determining indicator status, trend, and confidence for poor visibility days: IMPROVE sampling and measurement protocols are well established and analyses based on these data are routinely published in the scientific literature.
    2. Evaluation methods/metrics for indicator status and trend are sufficient, no further suggestions.

Respirable and Fine Particulate Matter

- ***Highest 24-hour PM_{10} concentration***
  - *General presentation*
    1. "Key Points" accurately summarizes the most important points, and these are supported by the data and analyses presented: peak annual PM_{10} concentrations have been increasing in recent years due to increasing wildfire activity and these trends will likely continue in future years. This has resulted in annual peak PM_{10} concentrations exceeding threshold values over multiple years.
    2. "Rationale Details" sufficiently addresses how the standard was evaluated and status determined: highest annual 24-hour PM_{10} concentration from all 3 monitoring sites for the most recent year data is available (2023) is lower than the target threshold but these data are generally trending upwards.

3. "Confidence Details" adequately explains how the confidence level was determined, and this is supported by the information presented: <u>*status*</u> = high (based on well-established IMPROVE sampling protocols and gravimetric analysis and CARB beta attenuation monitors), <u>*trend*</u> = moderate (moderate coefficient of determination $r^2 = 0.7$ with low p-value = 0.01 so trend is statistically significant), <u>*overall*</u> = moderate.
4. "Delivering and Measuring Success" provides links to relevant projects on standard attainment, as well as the monitoring programs and metrics used to assess progress: *EIP Action Priorities, EIP Indicators, Example EIP Projects, Local and Regional Plans,* and *Monitoring Programs*.

– *Threshold status determination*
1. Analytical methods are appropriately applied in determining indicator status, trend, and confidence for highest 24-hour PM_{10} concentration: IMPROVE and CARB sampling and measurement protocols are well established, and these data are routinely published.
2. Evaluation methods/metrics for indicator status and trend are sufficient, no further suggestions.

- ***Annual average PM_{10} concentration***
  – *General presentation*
    1. "Key Points" accurately summarizes the most important points, and these are supported by the data and analyses presented: despite increasing peak annual PM_{10} concentrations due to wildfires, average annual PM_{10} concentrations are decreasing and well below air quality standards.
    2. "Rationale Details" sufficiently addresses how the standard was evaluated and status determined: highest annual average PM_{10} concentration from all 3 monitoring sites for the most recent year data is available (2023) is lower than the target threshold and these data are trending downwards.
    3. "Confidence Details" adequately explains how the confidence level was determined, and this is supported by the information presented: <u>*status*</u> = high (based on well-established IMPROVE sampling protocols and gravimetric analysis and CARB beta attenuation monitors), <u>*trend*</u> = moderate (moderate coefficient of determination $r^2 = 0.509$ with low p-value << 0.05 so trend is statistically significant), <u>*overall*</u> = moderate.
    4. "Delivering and Measuring Success" provides links to relevant projects on standard attainment, as well as the monitoring programs and metrics used to assess progress: *EIP Action Priorities, EIP Indicators, Example EIP Projects, Local and Regional Plans,* and *Monitoring Programs*.
  – *Threshold status determination*
    1. Analytical methods are appropriately applied in determining indicator status, trend, and confidence for annual average PM_{10} concentration: IMPROVE and CARB sampling and measurement protocols are well established, and these data are routinely published.
    2. Evaluation methods/metrics for indicator status and trend are sufficient, no further suggestions.

- ***Highest 24-hour $PM_{2.5}$ concentration***
  - *General presentation*
    1. "Key Points" accurately summarizes the most important points, and these are supported by the data and analyses presented: peak annual $PM_{2.5}$ concentrations have been increasing in recent years due to increasing wildfire activity and these trends will likely continue in future years. This has resulted in annual peak $PM_{2.5}$ concentrations consistently exceeding threshold values since 2020.
    2. "Rationale Details" sufficiently addresses how the standard was evaluated and status determined: 3- year running average of the 98th percentile in daily $PM_{2.5}$ concentrations from all 3 monitoring sites for the most recent year data is available (2023) is higher than the target threshold for the site with the highest $PM_{2.5}$ and these data are trending upwards at an accelerated rate due to wildfires.
    3. "Confidence Details" adequately explains how the confidence level was determined, and this is supported by the information presented: *status* = high (based on well-established IMPROVE sampling protocols and gravimetric analysis and CARB beta attenuation monitors), *trend* = low (low coefficient of determination $r^2 = 0.35$ due to rapidly increasing wildfire activity over recent years but the p-value << 0.05 so the trend is statistically significant), *overall* = moderate.
    4. "Delivering and Measuring Success" provides links to relevant projects on standard attainment, as well as the monitoring programs and metrics used to assess progress: *EIP Action Priorities, EIP Indicators, Example EIP Projects, Local and Regional Plans,* and *Monitoring Programs*.
  - *Threshold status determination*
    1. Analytical methods are appropriately applied in determining indicator status, trend, and confidence for highest 24-hour $PM_{2.5}$ concentration: IMPROVE and CARB sampling and measurement protocols are well established, and these data are routinely published.
    2. Evaluation methods/metrics for indicator status and trend are sufficient. It is unclear why the highest 24-hour PM_{10} and $PM_{2.5}$ concentrations are evaluated differently: the former is simply the highest annual value while the latter is the rolling 3-year average in the 98% percentile. It seems these indicators should be evaluated equivalently considering they are directly related.
- ***Annual average $PM_{2.5}$ concentration***
  - *General presentation*
    1. "Key Points" accurately summarizes the most important points, and these are supported by the data and analyses presented: despite increasing peak annual $PM_{2.5}$ concentrations due to wildfires, average annual $PM_{2.5}$ concentrations are decreasing and well below air quality standards.
    2. "Rationale Details" sufficiently addresses how the standard was evaluated and status determined: highest annual average $PM_{2.5}$ concentration from all 3 monitoring sites for the most recent year data is available (2023) is lower than the target threshold and these data are trending downwards.
    3. "Confidence Details" adequately explains how the confidence level was determined, and this is supported by the information presented: *status* = high

(based on well-established IMPROVE sampling protocols and gravimetric analysis and CARB beta attenuation monitors), <u>*trend*</u> = high (high coefficient of determination $r^2 = 0.78$ with very low p-value << 0.05 so trend is statistically significant), <u>*overall*</u> = high.

4. "Delivering and Measuring Success" provides links to relevant projects on standard attainment, as well as the monitoring programs and metrics used to assess progress: *EIP Action Priorities, EIP Indicators, Example EIP Projects, Local and Regional Plans,* and *Monitoring Programs*.

– *Threshold status determination*

1. Analytical methods are appropriately applied in determining indicator status, trend, and confidence for annual average $PM_{2.5}$ concentration: IMPROVE and CARB sampling and measurement protocols are well established, and these data are routinely published.
2. Evaluation methods/metrics for indicator status and trend are sufficient, no further suggestions.

<u>Sub-Regional Variability</u>

- ***Sub-regional visibility 50th percentile***
  – *General presentation*
    1. "Key Points" accurately summarizes the most important points, and these are supported by the data and analyses presented: average sub-regional visibility is declining slightly due to increasing wildfire activity but is still well below threshold and significantly better than the 1990s.
    2. "Rationale Details" sufficiently addresses how the standard was evaluated and status determined: 3-year running average of IMPROVE light extinction measurements significantly less than threshold and the temporal trend is increasing slightly, meaning sub-regional visibility is declining.
    3. "Confidence Details" adequately explains how the confidence level was determined, and this is supported by the information presented: <u>*status*</u> = high (based on well-established IMPROVE sampling and measurement protocols), <u>*trend*</u> = high (high coefficient of determination $r^2 = 0.97$ and very low p-value << 0.05, statistically significant trendline), <u>*overall*</u> = high.
    4. "Delivering and Measuring Success" provides links to relevant projects on standard attainment, as well as the monitoring programs and metrics used to assess progress: *EIP Action Priorities, EIP Indicators, Example EIP Projects, Local and Regional Plans,* and *Monitoring Programs*.
  – *Threshold status determination*
    1. Analytical methods are appropriately applied in determining indicator status, trend, and confidence for average visibility days: IMPROVE sampling and measurement protocols are well established and analyses based on these data are routinely published in the scientific literature.
    2. Evaluation methods/metrics for indicator status and trend are sufficient, no further suggestions.

- ***Sub-regional visibility 90th percentile***
  - *General presentation*
    1. "Key Points" accurately summarizes the most important points, and these are supported by the data and analyses presented: poor visibility days are trending upward due to increasing wildfire activity, as suggested by PM OC measurements, but are still well below threshold. The severity of poor visibility days will likely continue increasing in future years given current wildfire projections.
    2. "Rationale Details" sufficiently addresses how the standard was evaluated and status determined: 3-year running average of IMPROVE light extinction measurements significantly less than threshold but with a rapidly increasing trend in light extinction and thus severity of poor visibility days.
    3. "Confidence Details" adequately explains how the confidence level was determined, and this is supported by the information presented: *status* = high (based on well-established IMPROVE sampling and measurement protocols), *trend* = high (high coefficient of determination $r^2 = 0.92$ and very low p-value << 0.05 so trendline is statistically significant), *overall* = high.
    4. "Delivering and Measuring Success" provides links to relevant projects on standard attainment, as well as the monitoring programs and metrics used to assess progress: *EIP Action Priorities, EIP Indicators, Example EIP Projects, Local and Regional Plans,* and *Monitoring Programs*.
  - *Threshold status determination*
    1. Analytical methods are appropriately applied in determining indicator status, trend, and confidence for poor visibility days: IMPROVE sampling and measurement protocols are well established and analyses based on these data are routinely published in the scientific literature.

Air Quality – Naresh Kumar

Memorandum

To: The Tahoe Regional Planning Agency
From: Naresh Kumar, Ph.D.
Date: 10/11/2024

Comments on Tahoe Regional Planning Agency 2023 Threshold Evaluation

An overarching comment on all Indicators
It is not clear why only one plot is shown when presenting data to determine indicator's status and trend. It becomes especially limiting when the "Key Points" for a particular indicator include information that is not presented in the plot. If more data had been presented, many of my comments would not apply.

Highest 8-hour average concentrations of carbon monoxide

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
    - The key points are mostly supported by the data presented. Few comments:
        - The trend beyond 1996-97 is almost flat, so it may be good to draw three trend lines to emphasize that point instead of showing two trend lines.
        - Reference to "climate change driven warming resulting in more frequent and intense wildfires" is most likely true, but the data has not been presented to demonstrate the cause and effect.
2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
    - Yes
3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
    - Yes
4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
    - Yes, there are lot of relevant projects and programs included with links.

Threshold status determination – for each Indicator:

1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
    a. It is not clear how the two trend lines were selected to look at the trend. From the naked eye, it seems the overall trend has been quite flat since 1997. If the second trend line was selected to begin from 1997, the trend determination may have been different.
2. Would you recommend a different method of evaluating indicator status or trend?
    a. Yes, would recommend reexamining trend from a different starting point.

Average Daily Winter Traffic Volume, President's Weekend

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
    a. Most of the key points are supported by the data. Few comments:
        i. Since the traffic for President's weekend can depend on many factors, it is more insightful to compare an average over the years (Key Point #3) rather than compare one single year against another (Key Point #2).
        ii. Since the annual averages are also presented, it may be good to show those averages too rather than just provide a reference.
2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
    a. Yes. The analysis shows that the standard would always be met even if the peak hourly averaged traffic was sustained for 8 hours.
3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
    a. Yes

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
    a. Yes, but there seems to be no additional projects to measure progress other than the traffic monitoring.

Threshold status determination – for each Indicator:

1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
    a. Yes
2. Would you recommend a different method of evaluating indicator status or trend?
    a. In addition to number of vehicles, if one could also measure average speed of the vehicles, that could provide a better measure of the impact of traffic on CO concentrations. Traffic density is may be a better predictor of CO concentrations.

Reduce Generation and Transport of Nitrate to Achieve Water Quality Standard

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
    a. None of the key points seem to be derived from the data presented. For example:
        i. Reduction in NOx emissions from mobile sources over time is not shown.
        ii. Only references are provided for atmospheric deposition of nitrate and ammonium.
    b. Key points don't mention that the trend in annual dissolved nitrogen has stayed flat.
2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
    a. This section talks about different policies meant to reduce nitrogen load into the lake, but doesn't provide any explanation of why the total nitrogen load hasn't changed despite reductions in emissions of NOx and other policies to reduce nitrogen load that have been implemented.
3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
    a. There is no section on "confidence details".
4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
    a. Yes, there seems to be many projects to measure progress of different policies.

Threshold status determination – for each Indicator:

1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
    a. This indicator uses more of a qualitative approach given the nature of the indicator. It would still be beneficial to know how different policies may (or may not) be helping with reducing the nitrogen load to the lake.
2. Would you recommend a different method of evaluating indicator status or trend?

a. Not necessarily a different method, but maybe changing to an indicator that can be determined quantitatively. For example, why is mid-lake dissolved nitrogen not the right indicator?

Highest 1-hour Average Concentration of Ozone

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
    a. Most of the key points are not derived from the data presented. Few comments:
        i. The first key point belongs better in the "Description" section.
        ii. The second key point is an important finding, but it is not shown in the data/analysis presented.
        iii. The third key point is an interesting one. It is true that at higher elevations, one can get higher ozone levels due to regional transport as well as from stratospheric intrusions, but there is no analysis provided for Lake Tahoe to support that point.
        iv. Ozone levels seem to be increasing in the most recent years, but that point is missing in the "Key Points".
2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
    a. The status was determined by averaging ozone concentrations at all locations, which is usually not how ozone standards are evaluated. It is normal to average over a period of three years, but it is not a normal process to average for all locations. By averaging for all locations, the status may seem better than it is. For example, even if one site is showing 100 ppb ozone, it should be highlighted.
3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
    a. If one focuses on average ozone at all locations, then determination is reasonable. However, it may be better to examine different sites separately and make the determination.
4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
    a. Yes, there are many relevant projects that theoretically can contribute to standard attainment. However, an analysis may need to be done to understand why the recent trend is upward (i.e., increasing ozone) rather than downward.

Threshold status determination – for each Indicator:

1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
    a. As mentioned above, it may not be appropriate to average ozone at all locations to determine the indicator's status. For trend determination, a liner trend line may not be appropriate when one is observing a change in slope in the recent years.
2. Would you recommend a different method of evaluating indicator status or trend?
    a. Yes, for determining indicator's status, an alternative method that focuses on individual sites should be considered.
    b. For trend determination, either use two trend lines or use a non-linear trend curve.

Oxides of Nitrogen Emissions

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
    a. The key points are implied from the data presented, but don't directly emerge from those data. Few comments:
        i. Key points discuss mobile source emissions, although the data presented includes all emissions sources combined.
        ii. Since the "one-hour average ozone concentration" indicator discussed potential transport from urban areas, it might be insightful to show NOx emissions from upwind urban sources too.
    b. Wildfires were mentioned as one of the potential causes of higher ozone concentrations in recent years, so it might be instructive to show how emissions from wildfires have been changing over time (CARB does estimate emissions from wildfires too).
2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
    a. Yes.
3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
    a. Yes, the determination is reasonably supported by the information presented.
4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
    a. Yes, there are many relevant projects that theoretically can contribute to standard attainment.

Threshold status determination – for each Indicator:

1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
    a. Yes
2. Would you recommend a different method of evaluating indicator status or trend?
    a. No

Highest 24-hour PM10 Concentration

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
    a. The key points are based on information and sources not presented here. Few comments:
        i. There is lot of focus on impact of wildfires and how they affect non-attainment of the 24-hour PM10 standard, but there is no data presented to support those claims.
        ii. If wildfires are the only cause of non-attainment of the 24-hour PM10 standard, as is implied, then it would be good to include analysis showing the impact of wildfires.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
    a. The 24-hour standard is typically evaluated over a period of three years, whereas this section only focused on 2023 when the standard was met. If it focused on 2021 through 2023, the determination would have been different.
3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
    a. There is confidence in the data, and the status determination seems to be supported by the data presented if one were to only use single year values.
    b. Trend determination uses a liner trend line when the shape of the data is more like a parabola. Using two trend lines would have shown that the trend is declining at a faster rate than currently shown.
4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
    a. Yes, there are many relevant projects that theoretically can contribute to reduction in PM10 concentrations.

Threshold status determination – for each Indicator:

1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
    a. No, using a single year value for status determination doesn't seem appropriate. Similarly, using a single trend line for parabolic data doesn't seem appropriate.
2. Would you recommend a different method of evaluating indicator status or trend?
    a. Yes, I suggest using a three-year average of the highest 24-hour PM10 values to determine the indicator's status. Similarly, I suggest either using two trend lines to evaluate the most recent trend or use a non-linear trend curve.

Highest 24-hour PM25 Concentration

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
    a. Again, many of the key points are based on data not presented here. Few comments:
        i. There is lot of focus on impact of wildfires and how they affect non-attainment of the 24-hour standard, but there is no data presented to support those claims.
2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
    a. Yes. However, the status is determined to be "rapid decline", although it says "moderate decline" at the beginning.
3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
    a. Yes, the determination is reasonably supported by the information presented. It is not clear why the DL Bliss site (a remote location) was used for the trend analysis instead of using an average for all sites.

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
    a. Yes, there are many relevant projects that theoretically can contribute to standard attainment.

Threshold status determination – for each Indicator:

1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
    a. As mentioned above, using only a remote site for trend determination may not be appropriate. The indicator's status determination seems appropriate.
2. Would you recommend a different method of evaluating indicator status or trend?
    a. Yes, for the trend determination, use an average trend line and evaluate using two different trend lines given how the concentrations seems to be rapidly increasing in the most recent years.

<u>Annual Average PM25 Concentration</u>

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
    a. Yes, the key points are supported by the data presented.
2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
    a. Yes.
3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
    a. Yes, the determination is reasonably supported by the information presented.
4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
    a. Yes, there are many relevant projects that theoretically can contribute to standard attainment.

Threshold status determination – for each Indicator:

1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
    a. Yes
2. Would you recommend a different method of evaluating indicator status or trend?
    a. No.

<u>Annual Average PM10 Concentration</u>

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
    a. Not all the key points follow from the data presented. For example:
        i. Reductions in PM10 in the south shore are attributed to few control measures, although no data is presented and there are no references included.

ii. PM10 concentrations at DL Bliss are consistent over the years and a conclusion is drawn that the emissions from regional sources may not be dropping as much as local sources. There is no data presented to support that conclusion.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
    a. Yes.
3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
    a. Yes, the determination is reasonably supported by the information presented.
4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
    a. Yes, there are many relevant projects that theoretically can contribute to standard attainment.

Threshold status determination – for each Indicator:

1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
    a. Yes
2. Would you recommend a different method of evaluating indicator status or trend?
    a. No.

Regional Visibility 50th Percentile

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
    a. Yes, the key points are supported by the data presented.
2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
    a. Yes.
3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
    a. Yes, the determination is reasonably supported by the information presented.
4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
    a. Yes, there are many relevant projects that theoretically can contribute to standard attainment.

Threshold status determination – for each Indicator:

1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
    a. Yes
2. Would you recommend a different method of evaluating indicator status or trend?
    a. No.

Regional Visibility 90th Percentile

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
    a. Some of the key points are supported by the data presented, but others are not. For example:
        i. It is stated that organic mass is the dominant contributor to the reduced visibility, although no data is presented to support that.
2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
    a. Yes, for the status determination. For the trend determination, it is not clear why a single trend line was used when there is a clear change in slope from 2013 onwards.
3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
    a. Yes, the determination is reasonably supported by the information presented. For trend determination, the confidence might have been more if two trend lines were used.
4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
    a. Yes, there are many relevant projects that theoretically can contribute to standard attainment.

Threshold status determination – for each Indicator:

1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
    a. Yes, for the indicator's status, but not necessarily for the trend determination
2. Would you recommend a different method of evaluating indicator status or trend?
    a. Yes, would recommend using two trend lines for the trend determination for the most recent years.

Sub-Regional Visibility 50th Percentile

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
    a. There seems to be some discrepancy in the key points. Visibility has improved on average days, but it says that the visibility is declining. There are some key points that may have been copied from another indicator given the reference to organic fraction on poor visibility days, that was also included for another indicator.
2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
    a. It seems this has been copied from the write-up on DL Bliss site and that may be the reason for the discrepancy. DL Bliss site is a remote site, so is not appropriate for the analysis.
3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
    a. Yes.

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
    a. Yes, there are many relevant projects that theoretically can contribute to standard attainment.

Threshold status determination – for each Indicator:

1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
    a. No, there seems to be some discrepancy in what is presented in the data and the actual determination of the trend.
2. Would you recommend a different method of evaluating indicator status or trend?
    a. Yes, I would recommend redoing the trend analysis using data from the sub-regional sites.

Sub-Regional Visibility 90th Percentile

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
    a. Yes, the key points are mostly supported by the data presented. Few comments:
        i. It is stated that organic mass is the dominant contributor to the reduced visibility, although no data is presented to support that.
2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
    a. They provide good explanations, but the section refers to DL Bliss site, whereas the determination was supposed to be for the sub-regional sites.
3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
    a. It is not clear whether the confidence on trend applies to the data presented in the plot or to the DL Bliss site.
4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
    a. Yes, there are many relevant projects that theoretically can contribute to standard attainment.

Threshold status determination – for each Indicator:

1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
    a. No, there seems to be some discrepancy in what is presented in the data and the actual determination of the trend.
2. Would you recommend a different method of evaluating indicator status or trend?
    a. Yes, I would recommend redoing the trend analysis using data from the sub-regional sites.

Fisheries – John Umek

Evaluation Page for Review For Fisheries

Acres of Prime Fish Habitat

1. Does the “Key Points” section summarize the most important points that emerge from the data presented? Are the “Key Points” supported by the data and analysis presented?
    - Overall yes, the "Key Points" section effectively summarizes the most important findings that emerge from the data presented. It concisely highlights the main conclusions, making it easier for readers to grasp the essential insights without wading through the entire dataset. Each point in this section aligns with the broader analysis, capturing critical trends, patterns, or observations that provide a comprehensive overview of the data. By focusing on the most relevant information, this section serves as a clear and accessible summary of the report's findings, facilitating a quick understanding of the report's overall conclusions.

        - Other comments:
            - You describe population surveys (say see below, create hyperlink or something that points to the link lower on the page can you provide the citation (even if grey literature)
                - Points on the map may also be informative for survey locations.
            - Define suitable habitat for LCT and spawning in the definition section as suitable habitat can vary between fish species and BMIs

2. Does the “Rationale Details” section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

    - Yes, the "Rationale Details" section provides a clear and reasonable explanation of how the standard was evaluated and how the status determination was made. It outlines the criteria and methodology used in assessing the standard, allowing readers to understand the logical steps taken in reaching the final status. By detailing the specific factors and data sources that contributed to the evaluation, this section establishes a transparent and credible basis for the status determination.
        - Other comments:
            - How did you come up with the adopted management number for habitat?

3. Does the “Confidence Details” discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented? Does the “Delivering and Measuring Success” section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

    - Yes, the "Confidence Details" discussion thoroughly explains how the confidence determination was made. It provides a clear and detailed rationale behind the confidence levels assigned, including the methodology and criteria used to assess reliability.
        - Other comments:
            - None

4. Are the analytical methods appropriately applied to determine the indicator’s status, trend, and confidence?

    - Yes, the analytical methods have been appropriately applied to determine the indicators' status, trend, and confidence. The methods used provide a clear and systematic approach, allowing for accurate and consistent measurement of each indicator. The chosen techniques align with best practices, ensuring that the data is analyzed reliably and meaningfully reflects the indicators' current state. The approach ensures that trends over time are identifiable. This thorough application of analytical methods enhances the credibility of the findings, offering a robust basis for interpretation and decision-making.
        - Other comments:
            - None
5. Would you recommend a different method of evaluating indicator status or trend?
    - No

Stream Habitat Condition:

1. Does the “Key Points” section summarize the most important points that emerge from the data presented? Are the “Key Points” supported by the data and analysis presented?
    - The "Key Points" are strongly supported by the data and analysis presented in the report. Each summarized point has a clear basis in the underlying data, with evidence provided through detailed analysis and relevant metrics. The consistency between the key points and the data analysis reinforces the credibility of the findings, ensuring that the summarized insights are well-founded and accurately reflective of the data.
        - Other comments:
            - Define suitable stream habitat – why those factors are good for fish and how certain BMIs, if found, indicate suitable habitat
            - The example of EIP projects is good. I would also recommend a link or highlight areas on the map with a point where work

has been done on streams (allow users to go visit these locations or when out and about see the restoration work).

2. Does the “Rationale Details” section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
    - Yes, the "Rationale Details" section provides a clear and reasonable explanation of how the standard was evaluated and how the status determination was made. It outlines the criteria and methodology used in assessing the standard, allowing readers to understand the logical steps taken in reaching the final status.
        - Other comments:
            - None

3. Does the “Confidence Details” discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented? Does the “Delivering and Measuring Success” section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

    - Yes, the “Delivering and Measuring Success” section effectively links to relevant projects that support standard attainment and outlines the monitoring programs and metrics used to measure progress.
        - Other comments:
            - None

4. Are the analytical methods appropriately applied to determine the indicator’s status, trend, and confidence?
    - Yes, the analytical methods have been appropriately applied to determine the indicators' status, trend, and confidence. The methods used provide a clear and systematic approach, allowing for accurate and consistent measurement of each indicator. The chosen techniques align with best practices, ensuring that the data is analyzed reliably and meaningfully reflects the indicators' current state. The approach ensures that trends over time are identifiable. This thorough application of analytical methods enhances the credibility of the findings, offering a robust basis for interpretation and decision-making.
        - Other comments:
            - None

5. Would you recommend a different method of evaluating indicator status or trend?
    - No

Noise – Jeffery Marion

Monitoring Program: Noise – Highways Component

Background: Highway noise is the largest source of background noise in the Basin and is monitored using a Community Noise Equivalent (CNEL) measure. Data are collected from portable monitoring devices at 30 locations deployed during peak highway use periods every four years with data averaged for 24-hr periods.

Reviewer Comments: The website page provides a good description of the monitoring approach but the two-sentence introduction at the top could be expanded to state why noise was selected, why is this a salient indicator? For example, what are the potential negative consequences to residents, visitors, and wildlife? Some explanation of the overall monitoring program and how it fits into an adaptive management decision-making framework should also be considered. For example, why are you monitoring, how is the data used to inform decision-making, what are the standards and what are the potential remedial actions that could ensue when standards are exceeded?

The map of the monitoring locations lacks a description of the symbol color codes. What do they confer? Clicking on the stations brings up a second page that shows more accurate locations and two graphs of the average and maximum CNEL. There is no explanation of these graphs (there should be) and I found them difficult to interpret. Toward that end I downloaded the source Excel file and discovered that there was data for only two of the nine dates (four years apart). Given this I wondered why the graphing method was used and including zeros for all the years when no data are even collected? Would it not be better to graph only data for the collected years and might you also include the standard (threshold) values for direct comparison along with a percentage value of how much the monitoring values are above or below the standards? The graphs also use a wide range of 15 dBs between ticks so interpreting the actual monitoring values is quite imprecise (for example is the graphed value above or below the standard of 55 or 60dB?

In a lower table showing the monitoring site list with monitoring dates and CNEL noise limits there is no monitoring data but there are noise limits, which I presume are the standards? Again, there is no explanation to the reader and direct comparisons require the reader to switch back and forth between each singly selected monitoring station from the map and this table at the bottom. Not very efficient or user-friendly! Apparently only Hwy 50 has the higher noise limits of 65 dB but these could change over time and it's difficult to see when and by how much the actual conditions compare to the standards.

Nomenclature: the web page calls them CNEL noise limits – are these also the standards or thresholds? Some standardized nomenclature and definitions are recommended.

There is no linkage from this page to the other Noise information provided at this page. At this point I went back to the beginning and the Lake Tahoe Info page. There is no explanation here about the adaptive management program, the use of monitoring and thresholds to inform it, etc. The Explore more option does not include this type of general "overview" information. I next chose the

Monitoring Dashboard and again see no information about why the monitoring program exists, how it is tied to decision-making, mention of thresholds, etc.

Monitoring Program: Noise – Plan Areas

Under this option I now see that noise is also monitored in 140 different planning areas arranged into eight categories from wilderness to industrial areas. There are no descriptions or maps of these eight different categories of plan areas. However, this time I happened to notice that under Images there is a map that shows the CNEL noise limits for five dB levels. I suggest these be renamed "thresholds" and not limits to maintain a consistent nomenclature. I also suggest including a map of the eight plan areas and text be included to direct users to these various maps.

This page contains a link to the TRPA Noise Monitoring Plan, which I downloaded and examined (the other page for Highways should also include a link to this document). This document is helpful but somewhat confusing for a member of the public to read and understand. I suggest it start by providing an overview of your adaptive management decision-making framework and how that requires monitoring and "threshold standards" to track trends in the conditions of various salient indicators and to initiate remedial actions if thresholds are exceeded.

This document includes nine land use categories (but no map is provided). Was the critical wildlife habitat area dropped or added more recently? I checked out the data for a few of these locations and the graphs this time showed years out to 2060 (why?) and with 10-yr date ranges that made it difficult to interpret which year the data is from (though hovering over the data point shows the year and exact value). This is a better form than the line graph but still does not convey the threshold or percentage comparison with it. The dB axis is in 30 dBs, which makes its interpretation even harder.

For the eight land use types the data presentation is improved by including a line for the actual threshold with data points for each four-year monitoring period. I much prefer this method, though including a percentage value that the current condition is above or below the threshold would be an additional aid to interpret the findings. I also like the inclusion of the link for the Threshold Dashboard. At this link the status graph is repeated with some additional information. A lack of consistent nomenclature is again evident, with the graph showing the "threshold" line and on the right the "applicable standard" is described. This also mentions a "target" which I presume should not be the threshold or standard as that is a maximum value to be avoided? Is there a preferred target dB value?

This page also includes a nice map showing all the monitoring stations for each land use type. There is also a link to "View Evaluation" which provides some of the same information and some additional information – a bit disjointed now… A "See how thresholds are evaluated" link takes you to yet additional information with color-codes and symbols. I do like these colors and symbols – very nice.

I was curious about the "**Threshold Dashboard**" page so I opened that next to see how it compared to the Evaluation information presented at this last webpage. This page, for the first time (I think) mentions the "Regional Plan" and provides a link to that. A link to the actual Regional Plan finally includes some of the overview info I had been looking to see. For example, it contains the TRPA

Planning Framework and on page 1 the specific info on how it all works together, though it does not and should describe it all as an "ongoing adaptive management process" based on monitoring indicators w/comparison to threshold standards (I see this is mentioned later on…). Your readers should NOT have to dig this deep to understand the general concepts of adaptive management decision-making based on indicators and thresholds!

When I selected Noise and **Cumulative Noise Events** from the Threshold Dashboard page, I see the colored status symbols for each of the land use categories for three years. This is a nice summary page but again, it seems disjointed from the material I reviewed above from the Monitoring Dashboard pages. I suggest that the website be reorganized to make it less disjointed and repetitive. Why not allow viewers to select an indicator like noise and then select the land use types to see the actual current and past conditions, the actual thresholds, and the status assessment with no repetition of data and the need to back out and visit some other disparate part of the website?

When I chose "Transportation Corridors" it reports no data for this land use type. Is this not the same as the Monitoring Program: Noise – Highways I had reviewed at the top? If not then I am confused and I found no explanations on any web page describing the how they are different or the same. Actually, I wonder why these two are separated (Transportation Corridors vs Highways) and why the differences in nomenclature.

Single Noise Events – I do applaud you for retaining single noise events, such as aircraft, jetboats, snowmobiles, and motorcycles. I can recount many outdoor experiences where isolated (but sometimes reoccurring) noise events from these sources greatly intruded in my recreational experience and reduced my satisfaction. Please do consider and monitor these single or recurring high noise level events – I also note that nearly all of these, however, were not evaluated. Question: the aircraft noise is focused on the airport but are there not sightseeing helicopters that give air tours over the lake or military jets that fly by? On my recent backpacking trip of the remote High Sierra Trail we experienced numerous exceptionally loud military jet overflights *every day* and they were exceedingly disruptive to our wilderness experience.

Evaluation Review Questions:

1) Key Points: I examined the data and these key points for the land use types and they all made good sense to me and were supported by the data.
2) Rationale Details: Again, the viewer needs to wander around between different disparate web pages to find all the relevant material for each single indicator. This should flow downward from a single starting point for each indicator. Secondly, overview info on how the monitoring and thresholds work together to aid managers in achieving their protection of Lake Tahoe resources (i.e., an adaptive management decision-making process), is needed, along with the use of consistent well-defined nomenclature. That said, the Status and Trend Rationale statements (once located) were clear and well-written. Under the Status Rationale I *finally found* a percentage measure for the difference between actual conditions and the thresholds.
3) Confidence Intervals: Yes, these all seem fine to me.

4) Delivering and Measuring Success: Yes, though a linkage to the monitoring protocols document would be nice to include for those who want to access the details.
5) Threshold status determination: Everything I read seem acceptable and reasonable to me. I have no recommendations other than to say that the single noise events, which were predominantly not monitored/assessed, do represent a significant impact to recreational experiences that could exceed (be more salient than) the averaged noise levels that *are* evaluated in the current program. I think both are important.

Recreation, Scenic, and Transportation and Sustainable Communities – Jeffery Marion

Lake Tahoe Regional Planning Agency 2023 Threshold Evaluation, Independent Peer Review

Jeffrey L. Marion, Reviewer

jmarion@vt.edu; 540-230-2138

Sustainable Recreation and Transportation

Background: Tourism is a major driver of the Tahoe Region economy and recreational opportunities are highly valued by visitors and residents. Key elements of the Environmental Improvement Program (EIP) are increasing recreation opportunities through public land acquisitions and adding available access to public land along Lake Tahoe's shoreline and in backcountry areas. The EIP accomplishes its work through collaborative inter-agency and non-governmental partnerships to restore the environmental health of Lake Tahoe. One component of this program is Sustainable Recreation and Transportation.

A core challenge are the potential environmental impacts of more than 20 million annual visitors and managing the transportation system, including roads, parking, and trails, that support intensive visitation while minimizing traffic congestion and overcrowding. Key program goals are to 1) preserve and improve air quality, 2) improve outdoor experiences for visitors and residents while protecting natural resources, and 3) increase the use of alternative modes of transportation and decrease reliance on the private automobile. The Tahoe basin's Sustainable Recreation Working Group develops and implements collaborative projects to ensure the Basin is both a world-class recreation destination and a global leader in environmental stewardship.

Performance measures are tracked by year and reported at this website, including miles of developed and improved trails, length of public shoreline added, educational and interpretive programs added, Facilities improved or created, people served, funds expended, and number of projects created. Access to additional information is also provided for more than a hundred past and current EIP program projects. Two core program areas are briefly reviewed before the recreation monitoring programs are examined:

Improve Public Access

The Lake Tahoe Basin land base consists predominantly of public lands (80%), but private lands are often concentrated along Lake Tahoe's shoreline. This program component seeks to increase recreation

opportunities through public land acquisitions and to increase access to shoreline and backcountry areas. This is accomplished through collaborative projects, which are listed and described at this site.

Improve Public Recreation Facilities

Recreation facilities provide access to and accommodate intensive recreational activities while protecting natural resources. Many existing facilities, such as parking areas, trailheads, boat ramps, and beach facilities require upgrades to meet increasing visitation and/or to improve resource protections. The specific past and current projects focused on these objectives are listed and described at this site.

Additional recreation-related program areas include Build and Enhance Transit Systems, Build and Enhance Trail Networks, Operate and Maintain Transit Systems, and Operate and Maintain Trail Networks.

Recreation Monitoring Program Components

The recreation monitoring program seeks to evaluate program success through monitoring focused within two reporting categories: Fair Share Distribution of Recreation Capacity, and Quality of Recreation Experience and Access to Recreational Opportunities. Selected indicators within each category are monitoring and data are presented and evaluated to gauge the status and trends for each indicator.

Fair Share Distribution of Recreation Capacity

The Lake Tahoe Regional Plan provides for the development, utilization, and management of the recreational resources of the Tahoe Basin. Its goals and policies provide that recreational opportunities keep pace with public demand, recreational facilities remain high on the development priority list, and the quality of the outdoor recreational experience will be maintained. A key element is the number of recreation facilities improved or created, with status illustrated through a bar chart by year with "created" and "improved" subcomponents. Improvements require actions other than routine maintenance that enhance an existing recreation facility. The applicable standard is that "It shall be the policy of the TRPA Governing Body in development of the Regional Plan to establish and ensure a fair share of the total Basin capacity for outdoor recreation is available to the general public." For indicators adopted as recommended policies which lack specific targets the monitoring thresholds are reported as "implemented" and therefore lack status and trend evaluations.

Comment: Background information presented for this component notes that "Factors that influence recreation are the availability of recreational opportunities, the number of visitors using recreation sites, the conditions of the environment and developed recreation facilities, and the ease of accessing recreation sites." I concur and question why some of these attributes are not specifically monitored. For example, as described in some of the collaborative projects, some facilities are improved to increase their recreational capacity, so an easy monitoring indicator is to evaluate changes in recreation facility capacities over time and possibly assessments of actual changes in use by road or trail traffic counters. Finally, facilities generally harden recreation sites through use of pavement to reduce soil erosion and runoff or include borders and fencing to protect vegetation from trampling and loss. It is possible to conduct recreation site monitoring to assess the efficacy of some of these resource protection functions. Relevant indicators could be estimates of aggregate soil and vegetation loss employing both areal (sq ft) and percent (%) measures. These could be assessed for any recreation facility that is created (document baseline conditions) or improved (document before and after changes).

Status and **Key Points** - The website indicates that from 2020-23 28 recreation facilities were created or improved. The aggregate expansion in visitor capacities could be reported here. Also noted is that public lands increased from 70-90% from the 1970's to today, though it would be helpful to present that data by five-year periods.

Threshold Relevance – This statement references the Regional Plan's objectives for recreational opportunities to "keep pace" with public demand. However, measures reflecting changes in recreation capacities or experiential qualities would be beneficial.

Human and Environmental Drivers – This statement emphasizes land uses and amount of private development relative to recreation capacity. However, this is somewhat superficial given that presumably the EIP Basin managers seek to have a balanced recreation program with different zones that prescribe diverse attributes, for example, highly developed areas with concentrated recreational activities (intensive use) and backcountry areas with more dispersed activities and use. While facility development is emphasized in developed zones, more rustic facilities remain appropriate and necessary in backcountry zones and both can be created or improved over time to enhance visitor numbers, experiential qualities, and resource protection.

EIP Action Priorities – This statement also focuses on expanding access through land acquisition and upgrading facilities. As mentioned elsewhere on this webpage, the Basin managers recognize that the number of visitors using recreation sites, their ease of access, and environmental conditions are also influential yet not represented in these priorities.

Rationale Details – Again, the only information provided is that this indicator was implemented, referencing the Regional Plan as a basis for support.

Additional Figures and Resources – This section references the SR 89 and SR 28 corridor plans along with associated planning guidance.

Quality of Recreation Experience and Access to Recreational Opportunities

Once again, the Regional Plan is referenced for recreation-related goals and policies and this indicator is focused on recreation quality and ease of access to recreation facilities. However, the background information does not specifically describe these attributes further. For example, can visitors access desired recreation facility with their personal car or only by bus, are the facilities of the type and condition that visitors desire, is there overcrowding? These topics should be elaborated upon and ideally reflected in the monitoring program.

Status and **Key Points** - The website presents a bar chart indicating results from a recreation survey of visitors for enjoyment. This indicates that about 45% of visitors reported their experiences as extremely enjoyable and 45% as very enjoyable. No accessible information is provided on how the survey was conducted, respondent numbers, or response rates, etc. It is therefore not possible to evaluate the validity of the survey and analysis methods employed. Under key points it does convey that 92% of responses to surveys in 2018 and 2019 were rated in the two top response categories, however, these data are not compared to a standard or threshold (e.g., at least 85% of visitors report extremely or very enjoyable recreation experiences). Once again, this indicator is of the type that only receives an "implemented"

rating with no additional indicators reflecting condition of the recreation facilities or of adjacent natural resources (e.g., soil or vegetation trampling and loss).

Threshold Relevance – This statement references the Regional Plan's objectives for maintaining the quality of outdoor recreational experiences. However, measures reflecting changes in recreation experiential qualities and ease of access would be beneficial.

Human and Environmental Drivers – As previously, this statement is somewhat superficial given that presumably the EIP Basin managers seek to have a balanced recreation program with different high and low use zones that prescribe diverse attributes. Research clearly reveals that the drivers of high-quality recreation experiences are multi-dimensional. For example, to what extent are recreational motives/desires met, were the recreational facilities/settings easily accessed, where the facilities sufficient/appropriate, was the level of use/crowding acceptable, were the natural environmental conditions attractive/protected, etc.

The statement notes that TRPA engaged with the Tahoe Science Advisory Council in 2023 to review best practices in monitoring outdoor recreational access and quality. It also presents room rental information in the Tahoe Region showing depressed rates compared to pre-COVID levels.

EIP Action Priorities – This statement listed indicators of length of public shoreline added and miles of trail developed or improved, along with supporting examples of EIP projects. A linked page indicated an improvement from 2014-16 of 43 lineal feet that was added – but this seems like "old" data... In an associated webpage it is reported that since 1997 EIP partners have added 0.6 miles of shoreline for public access. I will note that it can be potentially confusing to employ multiple web pages that often present some of the same but slightly different information – this is confusing to the public when all such information could be combined and placed on a single more comprehensive page. For miles of trails developed there is an graphic with data through 2023 indicating 11 mi of new trails and 176 mi of improved trails for 2023. Several EIP projects are included as examples of recent work.

Rationale Details – Again, the only information provided is that this indicator was implemented, referencing the Regional Plan as a basis for support.

Additional Figures and Resources – This section includes links to recent monitoring guidelines and recommendations, and some relevant reports on trends, congestion, and visitor surveys.

Finally, I was able to explore other parts of the website to locate three other recreation-related monitoring programs that were not directly linked to the core recreation monitoring component reviewed above. These are the following:

Bicycle and Pedestrian

The description of this effort is: "TRPA and local partners monitor bicycle and pedestrian activity throughout the Region to understand high use areas, mode-split, and support grant applications and reporting. Count information also informs policies and programs targeted to improve and support active transportation." This monitoring began in 2015 and involves permanent counting stations, biennial count locations, and spot counts. A report was prepared and data are accessible online.

Congestion-Travel Time

The description of this effort is: "TRPA monitors congestion on roadways throughout the region to assist with regional transportation planning. A well-executed transportation management system incorporates monitoring data, real-time information, and dynamic operations that respond to seasonal congestion and periodic congestion." This monitoring is restricted to the Tahoe Basin road system and reports median observed travel time in minutes for travel in both directions for numerous road segments. A 2023 report is available online.

Travel Behavior

The description of this effort is: "Since 2006 TRPA has conducted basin-wide travel surveys every two years in order to better understand basic travel characteristics of both residents and visitors. The data collected - which includes data points such as mode share, origin-destinations, and trip purpose - is used for a variety of purposes at TRPA including regional performance metrics, project planning, and travel demand modelling." This monitoring employs an intercept survey at popular sites around the Basin with short surveys of both residents and visitors. Results are presented online along with access to a number of reports from prior years.

Scenic Resources

Background: The Lake Tahoe basin is nationally recognized for its impressive scenery, which can be negatively impacted by developments on private lands, particularly along the Lake Tahoe shoreline. Monitoring of the area's scenic resources occurs at 869 scenic units identified within the Basin. Scenic qualities are protected through EIP projects, scenic shoreland ordinances, and building and design standards for both new and redevelopment projects. Three reporting categories for scenic resources include the Built Environment, Other Areas, and Roadway and Shoreline Units.

Roadway and Shoreline Units

The website describes how this indicator "evaluates and rates scenic conditions of major roadways and views of the shoreline from the lake using two systems: travel route ratings to evaluate the travel experience, and scenic quality ratings which evaluate specific scenic resources (e.g., vistas of the lake, mountain peaks, etc.) seen from the travel unit." Three categories (natural, transitional, and urban) are evaluated along with the Lake Tahoe shoreline, which is separated into 33 units. All are assessed with a monitoring assessment for the quality of the travel experience and the scenic resources viewed.

Scenic Quality Ratings for Roadway Travel Units (Scenic Resources)

Scenic resources are monitored every four years from each roadway travel unit to evaluate changes in land use and development over time; the primary drivers are land use, land and resource management activities, and the visual/aesthetic characteristics of human-made development. TRPA ordinances specify design standards and guidelines for new development and redevelopment projects.

Status and **Key Points** - The website reports that scenic roadway resource ratings are "At or somewhat better than target," with a graph of monitoring data showing an average rating of 9.17 (1982) with slight variations and no change (9.17) in 2023, interpreted as "Little to No Change," and High Confidence. I concur with these interpretations and assessment methods. Key Point information describes how the visual quality of 203 of 208 (98%) of assessments have been maintained or improved, revealing steady but low improvement over time. Roadside parking is cited as a threat to scenic qualities for road corridors with

specific problem areas identified. This is exactly the type of information that monitoring can identify and highlight for managers and collaborators – excellent presentation and interpretation of monitoring data.

Threshold Relevance – This section is adequate, though it could relate scenic quality to recreation quality.

Human and Environmental Drivers – This section is fine.

Delivering/Measuring Success – This section includes example EIP projects. I suggest that information could be presented here that could promote the need to address the roadside parking problems identified by monitoring.

Rationale Details – These statements are accurate and acceptable.

Confidence Details – These statements are accurate, well-supported, and acceptable.

Additional Figures and Resources – A Roadway Scenic Resources document is included with a link. However, this document contains tables of data with no explanations of assessment methods limited comments that interprets the presented data.

Travel Route Ratings for Roadway Travel Units

Scenic resources are monitored every four years along major roadways to evaluate changes in land use and development over time; the primary drivers are land use, land and resource management activities, and the visual/aesthetic characteristics of human-made development. TRPA ordinances specify design standards and guidelines for new development and redevelopment projects. I suggest that additional information is needed to describe how this indicator and its monitoring protocols are different from the preceding and following indicators.

Status and **Key Points** - The website reports that roadway unit ratings are "At or somewhat better than target," with a graph of monitoring data showing improved conditions for the period 2001-23, and High Confidence. I concur with these interpretations and assessment methods. Key Point information describes that 34 units are in attainment in 2023 with data indicating that this level has been largely the same since 2006. However, they do accurately characterize the trends and note that most of the out of attainment units are urban areas that could benefit from further redevelopment. It is important for monitoring data to be fully interpreted in this way, particularly in highlighting current and future needs so that decision-makers can act accordingly. The issue of roadside parking is also recognized here, (excellent), and the associated map clearly identifies the areas of concern.

Threshold Relevance – This section is adequate, though it could relate scenic quality to recreation quality.

Human and Environmental Drivers – This section is fine. I believe for the first time this section recognizes and highlights a concern for the drivers of fire and insects/disease. I suggest that all other monitoring information be reevaluated to include these drivers where appropriate. Fire seasons have lengthened and increased in severity and acres affected and fires also contribute smoke that will deter recreational visitation. Calling additional attention to this issue is both appropriate and necessary.

EIP Indicators – This section includes example EIP projects, particularly the burying of utility lines to improve visual qualities. I suggest that information could be presented here that promotes the need to address the urban redevelopment and roadside parking problems identified by monitoring.

Rationale Details – This statement reports status data but could also state a rationale related to recreation quality. The Trend Rationale statement is excellent.

Confidence Details – These statements are accurate, well-supported, and acceptable.

Additional Figures and Resources – A 2023 Roadway Travel Route Scores document is included with a link, with a 1989 Scenic Quality Improvement Program document.

Scenic Quality Ratings for Shoreline Travel Units (Scenic Resources)

Scenic resources are monitored for shoreline travel units to evaluate changes in land use and development over time; the primary drivers are land use, and the visual exposure and visual/aesthetic characteristics of development visible from Lake Tahoe. TRPA ordinances specify design standards and guidelines for new development and redevelopment projects. Additional information is included to describe Scenic Shoreland Ordinances (2002) and a 2018 Shoreline Plan.

Status and **Key Points** - The website reports that roadway unit ratings are "At or somewhat better than target," with a graph of monitoring data showing incrementally improving conditions over time, interpreted as "Little or No Change," and High Confidence. I concur with these interpretations and assessment methods. Links to a scenic viewpoints ratings table and the code used to create their chart are referenced in the Sources section (great to see this!).

Key Point information describes that 92% (170 or 184 units) have been maintained or improved with no changes in scenic resources scores since 2019.

Threshold Relevance – This section is good.

Human and Environmental Drivers – This section is fine, though it seems that the drivers of fire and insects/disease would also be applicable as discussed above. As a recurring backpacker of the Pacific Crest Trail, I can personally relate how walking through hot sunny burned areas and breathing/seeing constant smoke has very significantly diminished my recreational experiences to the point that my decision-making is markedly affected by these issues (and I have twice visited the Lake Tahoe area before or after my backpacking trips).

Delivering and Measuring Success – This section includes a Scenic Quality Improvement Program link but I suggest that the results/implications from monitoring for TRPA collaborators could also be included here.

Rationale Details – This statement reports status data but could also state a rationale related to recreation quality. The Trend Rationale statement is excellent.

Confidence Details – These statements are accurate, well-supported, and acceptable.

Additional Figures and Resources – A Shoreline Resource Scores document is included with a link. However, this document contains raw data with no explanations of assessment methods or comments to interpret the presented data.

Travel Route Ratings for Shoreline Travel Units

Scenic resources are monitored for scenic conditions looking toward the shore from the surface of Lake Tahoe. The Lake's 72-mile shoreline is separated into 33 individual units, each representing a varying length of the shoreline that exhibits similar visual character. The primary drivers affecting scenic quality in the

shoreline areas of Lake Tahoe are land use, and the visual exposure and visual/aesthetic characteristics of development visible from Lake Tahoe. TRPA ordinances specify design standards and guidelines for new development and redevelopment projects. Additional information is included to describe Scenic Shoreland Ordinances (2002) and a 2018 Shoreline Plan.

Status and **Key Points** - The website reports that 22 of 33 shoreline units are in attainment with a status of "At or somewhat better than target." A graph of monitoring data showing incrementally improving conditions over time since 2001, interpreted as "Little or No Change," and High Confidence. I concur with these interpretations and assessment methods. Links to a scenic viewpoints ratings table and the code used to create their chart are referenced in the Sources section.

Key Point information describes that units not in attainment (11) generally have large lakefront residences with little vegetative screening. Of interest, they also describe earlier deterioration in scenic conditions (1982-2001) and the benefits of TRPA regulations that prompted improvements that are continuing through 2023. Once again, such data are critical to describing trends, correcting deteriorating conditions and demonstrating the value of a collaborate adaptive management decision-making process based on routine monitoring. Key Points also describe specific improvements associated with a redevelopment project and potential threats from kayak rental concessions.

Threshold Relevance – This section is good, though status information is also included (duplicated).

Human and Environmental Drivers – This section is fine, and the drivers of fire and insects/disease are included, though smoke might be specifically cited.

Delivering and Measuring Success – This section includes a Round Hill Pine project, but I suggest that the results/implications from monitoring for TRPA collaborators could also be included here.

Rationale Details – This statement reports status data but could also state a rationale related to recreation quality. The Trend Rationale statement is particularly comprehensive, accurate, and excellent (including comprehensive comparisons).

Confidence Details – These statements are accurate, well-supported, and acceptable.

Additional Figures and Resources – A 2023 Shoreline Travel Route Score document is included with a link. However, this document contains tables of data with limited comments to interpret the presented data.

Transportation and Sustainable Communities

This threshold is designed to reduce reliance on personal vehicles, support greenhouse gas emission reduction goals, and increase mobility. TRPA's planning and community collaborations provide visitors and residents alternative methods of mobility with walkable, bikeable, and transit-friendly communities. The TRPA Governing Board adopted the Transportation and Sustainable Communities threshold category and the VMT per capita threshold standard in April 2021 so this is the first evaluation cycle. The only indicator is Vehicle Miles Traveled per Capita.

Vehicles Miles Traveled per Capita

The TRPA Governing Board adopted the Vehicle Miles Traveled (VMT) per capita threshold standard in April 2021. Therefore it was not evaluated in the 2019 Threshold Evaluation Report. The Applicable

Standard is to "Reduce Annual Daily Average VMT Per Capita by 6.8% from 12.48, the 2018 baseline, to 11.63 in 2045."

Key Points – These describe how the implementation framework is expected to result in nearly zero growth in VMT over the next 25 years. Also that an independent technical group will provide guidance, monitoring, and reporting for this indicator in the future.

Review Comments – I suggest that perhaps some additional text be included to describe how success is expected to be achieved. I presume that additional public transportation will be implemented, a shift from gasoline to electric cars, and increased construction of trails for pedestrian and bicycle use will be promoted. EIP projects to include car recharging stations at hotels and restaurants would be another option. Some U.S. National Parks (e.g., Zion, Grand Canyon, Denali) have closed entire roadways to personal vehicle use (at least seasonally) while providing bus transportation to visitors.

Scenic Quality of Other Areas (Recreation Sites and Bike Trails

This category includes areas such as recreation sites and bike trails with views of the lake and natural landscape, views of natural features, and the visual quality of built facilities. This indicator evaluates how changes in land use and development affects scenic resources over time and how recreation facilities' aesthetics affect visual qualities. Every four years a team examines and evaluates scenic qualities at a sample of public recreation sites and bike trails. EIP projects upgrade existing recreation sites and adds new sites and bike trails.

Status and **Key Points** - The website report a status of "At or somewhat better than target," a trend of "Little or No Change" and "High" confidence. The applicable standard is to "Maintain or improve the numerical rating assigned to each identified scenic resource, including individual subcomponent numerical ratings, for views from bike paths and other recreation areas open to the general public as recorded in the 1993 Lake Tahoe Basin Scenic Resource Evaluation." Key Point text indicates that the scenic resource quality of public recreation sites is nearly the same as in 1993, and that the implemented programs and actions have maintained scenic conditions at or somewhat better than the target, with little to no change. However, no further explanation of these data are provided and no reports are included or referenced for the reader. I suggest that summary information describing this monitoring and citing an accessible report be added.

Threshold Relevance – This section describes what the indicator evaluates and why but the reader still has no background information on how the monitoring is conducted. Additional status information is included here that belongs up in the Status section.

Human and Environmental Drivers – The primary drivers are "land use, land and resource management activities, and the visual/aesthetic characteristics of manmade development." Again, I question the need for another indicator that assesses changes in the aggregate footprint of development over time (i.e., conversion from undeveloped to developed) as this is an unmentioned driver that would be influential to scenic qualities.

EIP Action Priorities – This section highlights Improve Public Recreation Facilities and cites upgrades and maintenance at 36 recreation sites by EIP partners since 2007, while also noting substantial backlogs of remaining improvements and maintenance. An example EIP project is also included. It would be nice to

see actual priorities for groups of projects that would substantially improve scenic qualities as an aid to guide decision-making by collaborative partners.

Rationale Details – The Status section provides information that 97.6% of the locations met the threshold standard and that 2% were somewhat worse than the target. The Trends section notes no clear trend since 1993. Again, referencing a report or short "results" statement that presents additional data and background information would be helpful. The statement could provide additional information on existing or expected future concerns that could help focus partner attention on actions needed to improve this indicator.

Confidence Detail – This is listed as high because a "documented, reviewed, and accepted monitoring protocol was used to guide the collection, analysis, and reporting of the scenic monitoring data." The protocols applied are from a cited 1982 report but there is no link to this report for readers to access (I suggest that there should be). The confidence of trend and overall confidence are rated as high, but again, neither I nor readers can evaluate these without accessing the 1982 monitoring report.

Additional Figures and Resources – Nothing is included here.

Built Environment Community Design)

Scenic qualities related to residential and commercial buildings are guided by a threshold policy standard known as "community design." Design standards and guidelines apply to new, redeveloped, or remodeled buildings which improve scenery over time as older structures are updated or replaced. Design provisions have been incorporated into the Tahoe Regional Planning Agency (TRPA) Design Review Guidelines, Code of Ordinances, and area plans.

As described at this webpage, "The Built Environment (Community Design) indicator calls for the height, bulk, texture, form, materials, colors, lighting, signing, and other design elements of new, remodeled, and redeveloped buildings to be compatible with the natural, scenic, and recreational values of the Tahoe Region. Every four years new and redevelopment projects are evaluated to see if they are consistent with design standards and if the desired community character is being achieved. This indicator is of the type evaluated as "implemented"

Status and **Key Points** - The website reports that scenic evaluation data reveal incremental improvement during the prior four years. However, no further explanation of these data are provided and no reports are included in the Sources location for the Built Environment. I suggest that summary information describing this monitoring and citing an accessible report be added. Key Points text also indicates that project reviews indicated all were consistent with applicable design standards and guidance and policy statements.

For this indicator an evaluation of this type as "implemented" seems to be justified because new and redevelopment projects must be evaluated prior to their approval and building begins. Reviews of efficacy every four years occurring after the construction work is completed would be ineffectual with respect to requiring corrective changes.

Threshold Relevance – This section describes how ongoing new and redevelopment projects are likely to continue enhancing scenic qualities as older structures are upgraded or replaced over time. This seems likely unless there are a substantial or continuing number of new developments over time. I suggest that

an indicator focused on tracking the aggregate footprint of developments within the Basin would also be beneficial (if not already present).

Human and Environmental Drivers – While the primary drivers are the rate and type of development and redevelopment, and efficacy of design standards and guidelines, I wonder if any of those actually consider the replacement of natural undeveloped terrain with developed terrain?

Delivering and Measuring Success – This section includes example EIP projects. Again, success is evaluated merely by the implementation of the various design guidance, ordinances, and area plans.

Rationale Details – Again, the only information provided is that this indicator was implemented, referencing the Regional Plan as a basis for support. Also that a 2020-23 review found that projects were consistent with design standards, guidelines, and policies.

Additional Figures and Resources – A number of community design tables with building photos are included to illustrate designs that comply with relevant guidance.

Transportation and Sustainable Communities – Scott Kelley

Review – VMT Per Capita

Overall, my evaluation is that the indicator is assessed using appropriate methodology using the data that were either made available to or obtained by TRPA. Two key values are of course required to estimate VMT per capita: 1) vehicle miles of travel (VMT) within the TRPA MPO boundary, and 2) the population within that same boundary.

Of these two, the VMT data are the most straightforward to use in this calculation, as these come directly from AVMT data provided by NDOT (it appears these have been converted to DVMT by TRPA in the "VMT" tab of the included VMT per capita calculations spreadsheet) and DMVT data provided by CalTrans in their HPMS reports. Both state DOTs report these data specifically for the part of the TRPA MPO jurisdiction within their respective states, which is great for this purpose. For CalTrans, this is in Table 9 of the HPMS reports for each year, and for NDOT, this is under the "Total AVMT by MPO" table. Each state DOT's VMT data be found using the links provided in the "Sources" tab on the VMT per Capita indicator page. The use of data from the two state DOTs ensures that TRPA uses data that are relatively reliable, consistent, and trustworthy in their calculations. The use of the 3-year averages for VMT is also reasonable for the reasons articulated in the Status Rationale under the Rationale Details section.

As a bit of a "sanity check", I looked up the VMT values for 2020 through 2022 for each state within the TRPA MPO using the links provided, and verified that the numbers included in the VMT per capita calculations file (in the VMT tab of the spreadsheet that is provided under the "Additional Figures and Resources") are consistent. I have two minor comments regarding information in the "Status" section of the Indicator Page:

1. If possible, I might suggest mentioning which table each of these VMT values are sourced from in the two HPMS reports that are included in the "Sources" tab on the Indicator page,

in case someone would like to more quickly find these same TRPA MPO values, as I had to search for them myself.

2. Might a short definition of "VMT" be helpful under the "Definitions" tab? It is described briefly in the Indicator Description at the top of the page, so that may be sufficient, but this tab seems like a good place to include this definition. However, a definition of what TRPA means by "Population" might be helpful in this Definitions tab. I would recommend including the same definition of "Population" that is included in the TEPM output, as we see later in the Status Rationale section that the "…VMT per capita is an estimate of the total population of the Region, including residents, visitors, seasonal residents, day visitors, and workers on an average day." Making that clear right away would help with interpretation.

For reasons that are articulated in the Rationale Details section in particular, the data on the effective population – required to produce a VMT per capita value – include more uncertainty and limitations. This population value is reported in the Tahoe Effective Population Model (TEPM) tool that includes a variety of data sources, and is available to review under the "Sources" table under the "Status" section, in case anyone is curious. The uncertainty about Tahoe's population at any given time is sometimes surprising to people unfamiliar with trying to find data on this topic. Obtaining good, reliable, and timely data on exactly how many people are at Tahoe (and what kind of resident or visitor they are) at any given point in time is a considerable challenge, and I encourage TRPA to continue pursuing as many data sources and types as possible to help better gain an understanding of this topic in the future, which will carry implications for reporting on this indicator. As a way to directly address the uncertainty in the population value, I appreciated the analysis that considered different sources when estimating the VMT per capita estimates as a range of values that is provided at the end of the Status Rationale section under Rationale Details.

I offer specific feedback on the specific elements requested in the Review Charge below.

*Does the "**Key Points**" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?*

Overall, I would say that yes, the key points summarize the most important points that emerge from the data presented. I do have two minor comments about these:

1. While the COVID-19 pandemic almost certainly played a role in declining VMT in the short-term, the analysis here does not address that (and cannot with the data shown), so I might rephrase to "…and travel patterns that very likely led to…", or something similar. The wording in the Trend Rationale in Rationale Details is more reflective of this uncertainty, and I would recommend phrasing the corresponding key point accordingly.
2. For the first the that rely on the population, if population is clearly defined earlier as including residents (year-round and seasonal/second home owners), visitors (day and overnight), and commuters, as is done in the TEPM tool, then that will add some clarity to these claims. However, the third point seems to reflect the findings of analysis of census data (end of second paragraph in the Status Rationale narrative), so I might make this more explicit.

*Does the "**Rationale Details**" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?*

This section (understandably) devotes most of its narrative to describing how to effectively count and track population, and the uncertainties inherent in some of the existing methods. I do appreciate the detailed discussion about some of the data sources and the ranges of values they report. A few things to consider for this section:

1. I do not see much discussion about how vehicle miles of travel are measured, aside from referencing the CalTrans and NDOT sources. Understood that they are reporting data from a secondary source, but perhaps the addition of a brief explanation (maybe a sentence or two) about how VMT is tracked might help a reader of this section better understand how that first component of VMT per capita is compiled. Related to this: in the "Confidence Details" section, we see that data to assess VMT are drawn from the HPMS reports, which are presumably the ones listed under the "Sources" tab under "Status." I'm not sure where the best place to put such a thing would be, but I might suggest including a note in the description of the "VMT per capita calculations" file that these are VMT values in the "effectivepop_inputs.xlsx" file. Then someone who download the file would see where the values on the VMT tab (Columns C & D used to compute Column E) came from, which are then used in the VMTCAP tab in Column C/Rows 21-25.
2. I know from past work with that the TEPM model carries with it several elements of uncertainty, and works with several different datasets at various spatial and temporal scales, so I appreciate the acknowledgment of both the complexity and the uncertainty in this model. There are uncertainties with StreetLight data that make it difficult to assess vehicle counts, trips, and VMT in the Tahoe Basin, and some of these are articulated here. I suspect that is why there is a statement about engaging with them to acquire more recent estimates to recalculate the effective population. At the end of the second full paragraph in this section, we see the list of data that were used in the TEPM, including census data, traffic counts, tax returns, and survey data. Then the narrative quickly transitions to StreetLight. I think a short description of what StreetLight adds that these other sources do not would be helpful in understanding the context of the discussion of StreetLight data. Then, perhaps a brief explanation of why other sources beyond StreetLight were considered due to those aforementioned limitations might help, too.
3. The Trend Rationale discussion is reasonable, and agreed that the pandemic is likely a source of decline on the California side (see my comment above on the Key Points section). In terms of why the Nevada side has rebounded and California has not relative to pre-COVID levels, beyond the usual other factors that may be at play, including potentially greater carpooling, use of bikes and scooters on the California side of Lake Tahoe, or correspondence with transit/TART use, I did have a thought.

One possible explanation for why the Nevada side and its VMT has rebounded while California's has not could be that many of those that previously lived and worked in the Tahoe Basin no longer could afford housing there for the well-documented reasons at Tahoe, causing some to relocate to Carson City, Minden/Gardnerville, or even Reno-Sparks on the Nevada side, while continuing to commute to work at Tahoe. Those cities are much closer and more convenient to locations inside the Tahoe Basin than any city in California where such workers may have relocated to. This is just

speculation, but it does warrant further investigation, as this phenomenon would certainly influence VMT on the Nevada side, but not California. In general, workforce housing dynamics might be worth exploring in future transportation-related work at Tahoe.

*Does the "**Confidence Details**" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?*

I agree with the assessment and the rationale, especially when considering information presented in the previous section (Rationale Details). I imagine the confidence is higher in the HPMS data than the population estimate derived from TEPM. I might just more directly state that if so, which is what I also imagine leads to the overall assessment of "Moderate."

*Does the "**Delivering and Measuring Success**" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?*

There are several links provided to EIP Action Priorities, EIP Projects, and Local and Regional Plans that all help in some way to reduce the reliance on vehicles to conduct travel in the Tahoe Basin. There is an argument to be made that "Improve Public Recreation Facilities" page may not necessarily help with VMT target attainment (unless multi-modal transportation improvements are part of these improvements). That said, I suppose such improvements could also include ways to, measure, and monitor visitation at these sites, even if they attract more travel.

Building and maintaining trail networks and better paths and infrastructure for people walking and bicycling around Tahoe helps encourage these modes of travel and reduces reliance on automobile trips once at Tahoe, as does improving public transportation options.

Threshold status determination – for each Indicator:

Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

Given the available data, yes, I would agree that the analytical methods applied appropriately determine the status, trend, and confidence, with some caveats that I raised earlier.

The narrative in the Rationale Details section makes it clear that TRPA is exploring more big data platforms and options to better understand visitation and better estimate an effective population. I would encourage TRPA to continue to explore any and all ways to collect data, including a combination of novel/emerging technologies and more frequently collecting data in more traditional ways, such as travel surveys that can help better calibrate estimates.

Some of the big data platforms may help with more effectively capturing travel to more "dispersed" recreational activities in the Tahoe Basin that draw people from throughout the region differently at different times of year. These kinds of outdoor recreation activities - including hiking, mountain biking, backcountry skiing, and other adventure

sports - may not always necessarily be coupled with official trailheads or facilities where visitor counts are regularly conducted. This type of visitation may challenge many existing data collection

methods. While their numbers may not be as great as those traveling to the tourist-oriented areas near the shore of Lake Tahoe, it is likely not an insignificant group either.

Would you recommend a different method of evaluating indicator status or trend?

Given the current status of the data reviewed, I think this is the most appropriate way forward right now. However, this should be revisited if an alternative big data source or sources can more effectively and reliably capture population totals and VMT.

Soil Conservation – Mariana Dobre

Indicator Evaluation Review for the TRPA 2023 Threshold Evaluation

Mariana Dobre, PhD
Research Assistant Professor
Department of Soil and Water Systems
University of Idaho

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This review aims to determine whether appropriate methods, the best available science, and accepted best practices were used in conducting the current classification of performance relative to target values in the Tahoe Regional Planning Agency (TRPA) 2023 Threshold Evaluation. The "Summary" section contains a general assessment of the indicators, while the "Specific Indicators" section contains specific comments for each indicator.

Summary

Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

Yes, the "Key Points" section summarizes the most important points in each indicator and class, though some areas could benefit from greater clarity. Each section highlights critical data points, such as impervious coverage trends and discrepancies between actual and threshold values. In several cases the "Delivery and Measuring Success" section contained links to reports that confirmed the information presented in the "Key Points" section, but in other cases the information on each class was not specifically mentioned. For example, the acquisition of environmentally sensitive land is mentioned but there is no mention of the specific acreage for each class individually. Overall, the "Key Points" section summarizes the data effectively and aligns with the analysis. However, there is room for improvement in linking statements to verifiable data.

Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

The "Rationale Details" section provides a mostly reasonable and data-supported explanation of how standards were evaluated and statuses determined. However, the current methodology for classifying

performance relative to target values suffers from inconsistency and ambiguity in the qualitative statements used. For example, instances where values are slightly below target are labeled as "considerably better," (e.g. Class 1a, 12%) while other cases where values are significantly higher than target are incorrectly described as only "somewhat worse" (e.g. Class 3, 31%). Additionally, the absence of clear percentage thresholds for statements such as "better" or "worse" leads to subjective interpretations. To maintain consistency, I refined the classification system with six categories: three for performance above target (At or Somewhat Better, Somewhat Better, and Considerably Better) and three for performance below target (At or Somewhat Worse, Somewhat Worse, and Considerably Worse). This new system applies percentage thresholds to each category: 0-10% difference for "At or Somewhat," 10-30% for "Somewhat," and more than 30% for "Considerably". This will ensure consistent, objective, and easy-to-interpret performance assessments across all cases. Following this classification, most classes retain their original labels, but Class 1a and Class 3 have been relabeled (Table 1).

Table 1. Current and proposed classification categories

Class	Difference	Current classification	Proposed classification
Class 1a	12% below	Considerably better than target	**At or somewhat better than target**
Class 1b	499% above	Considerably worse than target	Considerably worse than target
Class 1c	8% below	At or somewhat better than target.	At or somewhat better than target
Class 2	31% above	Somewhat worse than target	**Considerably worse than target**
Class 3	57% below	Considerably better than target	Considerably better than target
Class 4	79% below	Considerably better than target	Considerably better than target
Class 5	63% below	Considerably better than target	Considerably better than target
Class 6	67% below	Considerably better than target	Considerably better than target
Class 7	10% below	At or somewhat better than target	At or somewhat better than target

Categories marked in **bold** are reclassified.

Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

Yes, this section provides a reasonable discussion of how the confidence determinations were made. The overall confidence is deemed "moderate" due to the reliance on the best available data and the long-term restoration goal spanning 20 years, which seems accurate.

Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

This section provides some examples of projects and programs contributing to standard attainment, but there are some areas where more detailed information or clearer links to specific metrics would be useful. For example, none of the information could be verified for the Impervious Cover Classes 5, 6, 7, while for the other classes it could only partially be verified. For Impervious Cover Class 4, it is mentioned that "More than 613 acres of sensitive lands (land capability classes 1-3) were acquired between 2020 and 2023 by Environmental Improvement Program partners". But following the links, the acres are all lumped together for the three classes. The more sensitive classes 1a, 1b, seem to have links to more projects that could be used to verify the information.

Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

The analytical methods are appropriate and applied systematically to determine status, trend, and confidence for each indicator.

Would you recommend a different method of evaluating indicator status or trend?

- **Aligning status labels** with the revised classification or a similar more consistent classification. While the initial analytical approach applies reasonable thresholds (e.g., exceeding or falling below target values), the status labels are sometimes inconsistent. For instance, Class 2 coverage, which exceeds the target by 31%, is initially labeled as "somewhat worse" but should logically align with the revised "considerably worse" category. I suggest using Table 2 or a similar approach to revise the classification for consistency.
- **Reintroducing remote sensing** for unpermitted coverage. The evaluation primarily relies on permitting data and project reports, which can miss unpermitted changes. A remote sensing or GIS analysis (as done in 2018-2019) could be reintroduced to improve the precision of status determinations, especially in high-sensitivity areas, such as Classes 1a, 1b, and 1c.

1. **Specific Indicators**

Impervious Cover

Land Capability Class 1a

Key Points: This section highlights the low impervious coverage within class 1a (211 acres), which is below the threshold standard of 240 acres. I could not verify this information. It also mentions the minimal impervious coverage changes (less than 0.1 acre) from 2020 to 2023. This information is mostly correct based on the provided data in the "Delivering and measuring success" section, which shows 0.0 acres of impervious coverage retired for the same time period. The section also mentions that "more than 613 acres of sensitive lands (land capability classes 1-3) were acquired between 2020 and 2023 by Environmental Improvement Program partners." This information could be accurate, but the attached documents do not specifically refer to class 1a so I could verify the information.

Rationale Details: This section provides an explanation of how the standard was evaluated and the status determined. It references the Bailey 1a threshold standard of 240 acres and compares it to the existing 211 acres of impervious coverage, which translates to a 12% difference, which is described as "considerably better". When compared to the other classes, this statement seems like an overestimation. This class should be reclassified as "at or somewhat better than target" (see Table 1). The section also notes the collection of over $2.37 million in water quality mitigation fees between 2000 and 2023 for the creation of 29 acres of added coverage in all classes, and the removal of 5.3 acres of coverage on 45 parcels through permit conditions and EIP projects. This information could be accurate; however, I could not verify it. For the trend rationale, the section mentions that impervious cover within class 1a was determined to be "little or no change" compared to 2019, with the mention that the impervious coverage in class 1a changed by less than 0.1 acre, or -0.03 percent. This information is accurate since in 2019 there were still 211 acres of land in this category. However, the "Impervious Coverage Retired" link points to a graph that shows 0.0 acres of land retired between 2019 and 2023, rather than 0.1 acre difference.

Confidence Details: This section explains the basis for the "moderate" confidence level. The reliance on permitting data and the potential for unpermitted impervious coverage contribute to this moderate confidence. The explanation for the trend confidence being moderate due to changes in source data is also reasonable.

Delivering and Measuring Success: The section identifies relevant projects contributing to standard attainment. There are two Environmental Improvement Program (EIP) Indicators presented: Acres of Environmentally Sensitive Land Acquired and Impervious Coverage Retired. In the first EIP indicator, it is mentioned that "Since 2007, EIP partners have acquired over 1,642 acres of environmentally sensitive land for protection or restoration". Following the link provided I could not verify if any of the acquired acres are in category 1a. Similarly, for the second EIP indicator, it is mentioned that "Between 2020 and 2023, EIP partners and private partners through projects retired (i.e., permanently remove from future use) 2,744 square feet (0.1 acres) of class 1a coverage". However, the graph that can be accessed by following the "Impervious Coverage Retired" link shows 0 acres acquired for the 1a category. Lastly, the example of an EIP Project, such as the Clancy-Pohl Sensitive Land Acquisition, directly links to the removal of impervious coverage in class 1a, without specifying averages or percentages in this category.

Threshold Status Determination: The analytical methods employed seem suitable for determining status, trend, and confidence. The approach considers permitting data, mitigation fees, and project tracking. The confidence levels are adjusted reasonably based on potential data limitations.

Recommendation for Evaluation: It might be beneficial to explore remote sensing techniques or high-resolution imagery analysis to detect unpermitted impervious coverage, which could improve the accuracy of the assessment and potentially increase the confidence level. It appears that such an analysis was conducted in 2018 and 2019. I assume in the subsequent years such an approach was not adopted due to high costs associated with digitizing aerial images, however, perhaps this could be done more frequently only for the highly sensitive areas, such as 1a, 1b, and 1c.

Land Capability Class 1b

Key Points: This section highlights the reduction of 1.6 acres of impervious coverage from Class 1b lands between 2020 and 2023. It acknowledges the ongoing challenge of achieving the impervious cover standard for Class 1b, noting that 682 acres, approximately 86% of existing impervious cover, would need to be removed or relocated. This would likely involve the removal and buyout of substantial existing private development, which might be infeasible within a reasonable timeframe. This section contains two paragraphs that refer to SEZs rather than impervious cover. I am not certain if these paragraphs belong in this section.

Rationale Details: This section explains the evaluation process and the status determination. It compares the existing 797 acres of impervious coverage in Class 1b to the Bailey 1b threshold standard of 114 acres, highlighting the significant discrepancy of 683 acres and labeling the status as "considerably worse than target". This statement seems accurate (see Table 1). The section also notes the collection of over $2.37 million in water quality mitigation fees between 2000 and 2023 for the creation of 29 acres of added coverage in all classes, and the removal of 5.3 acres of coverage on 45 parcels through permit conditions and EIP projects. This information could be accurate, however, I could not verify it. For the trend rationale, the section mentions that impervious cover within class 1b was determined to be "little or no change" compared to 2019, with the mention that the impervious coverage in class 1b changed by less than 1.6 acre, or -0.2 percent. This information is accurate since in 2019 there were 799 acres of land in this category.

Confidence Details: This section explains the basis for the "moderate" confidence level. The reliance on permitting data and the potential for unpermitted impervious coverage contribute to this moderate confidence. The explanation for the trend confidence being moderate due to changes in source data is also reasonable.

Delivering and Measuring Success: The section identifies relevant projects contributing to standard attainment. It highlights the achievements of EIP partners in acquiring over 1,642 acres of environmentally sensitive land for protection or restoration since 2007. As was the case with class 1a, following the "Acquire Environmentally Sensitive Lands for Restoration and Protection" link I could not verify if any of the acquired acres are in class 1b. The "Impervious Coverage Retired" mentions that "Between 2020 and 2023, EIP partners and private partners through projects retired (i.e., permanently remove from future use) 36,416 square feet (0.84 acres) of Class 1b coverage". This information is accurate and can be verified. Lastly, the example of an EIP Project, such as the Clancy-Pohl Sensitive Land Acquisition, directly links to the removal of impervious coverage in class 1b but without mentioning the exact number of acres in this class.

Threshold Status Determination: The analytical methods employed seem suitable for determining status, trend, and confidence. The approach considers permitting data, mitigation fees, and project tracking. The confidence levels are adjusted reasonably based on potential data limitations.

Recommendation for Evaluation: It might be beneficial to explore remote sensing techniques or high-resolution imagery analysis to detect unpermitted impervious coverage, which could improve the accuracy of the assessment and potentially increase the confidence level. It appears that such an analysis was conducted in 2018 and 2019. I assume in the subsequent years such an approach was not adopted due to high costs associated with digitizing aerial images, however, perhaps this could be done more frequently only for the highly sensitive areas, such as 1a, 1b, and 1c.

Land Capability Class 1c

Key Points: This section highlights the estimated 495 acres of impervious coverage in class 1c, which falls below the threshold standard of 537 acres. I could not verify this information. It also notes the absence of change in estimated coverage between 2020 and 2023, which is accurate. The section also emphasizes the importance of acquiring and restoring sensitive lands through the Environmental Improvement Program, highlighting their positive impacts on watershed protection, habitat provision, and recreational opportunities. The section also mentions that "more than 613 acres of sensitive lands (land capability classes 1-3) were acquired between 2020 and 2023 by Environmental Improvement Program partners." This information could be accurate, but it was not easy to verify it based on the information provided.

Rationale Details: This section explains how the impervious coverage standard for class 1c was evaluated and the status determination was made. It compares the existing 494.5 acres of impervious coverage to the Bailey 1c threshold standard of 537 acres, noting the 42-acre difference (8% less than allowed). This difference leads to the status classification of "at or somewhat better than target. This statement seems accurate (see Table 1). The section also notes the collection of over $2.37 million in water quality mitigation fees between 2000 and 2023 for the creation of 29 acres of added coverage in all classes, and the removal of 5.3 acres of coverage on 45 parcels through permit conditions and EIP projects. This information could be accurate; however, I could not verify it. For the trend rationale, the section mentions that impervious cover within class 1c was determined to be "little or no change" compared to 2019, which is accurate.

Confidence Details: This section explains the basis for the "moderate" confidence level. The reliance on permitting data and the potential for unpermitted impervious coverage contribute to this moderate

confidence. The explanation for the trend confidence being moderate due to changes in source data is also reasonable.

Delivering and Measuring Success: The section highlights the achievements of EIP partners in acquiring over 1,642 acres of environmentally sensitive land for protection or restoration since 2007. As was the case with classes 1a and 1b, following the “Acres of Environmentally Sensitive Land Acquired” link I could not verify if any of the acquired acres are in category 1c.

Threshold Status Determination: The analytical methods employed seem suitable for determining status, trend, and confidence. The approach considers permitting data, mitigation fees, and project tracking. The confidence levels are adjusted reasonably based on potential data limitations.

Recommendation for Evaluation: It might be beneficial to explore remote sensing techniques or high-resolution imagery analysis to detect unpermitted impervious coverage, which could improve the accuracy of the assessment and potentially increase the confidence level. It appears that such an analysis was conducted in 2018 and 2019. I assume in the subsequent years such an approach was not adopted due to high costs associated with digitizing aerial images, however, perhaps this could be done more frequently only for the highly sensitive areas, such as 1a, 1b, and 1c.

Land Capability Class 2

Key Points: This section states that the estimated impervious coverage within Class 2 is 305 acres, surpassing the threshold standard of 232 acres by 73 acres, or 31%. It also states that there was no change in estimated Class 2 impervious coverage between 2020 and 2023. The section also mentions that “more than 613 acres of sensitive lands (land capability classes 1-3) were acquired between 2020 and 2023 by Environmental Improvement Program partners.” This information could be accurate, but it was not easy to verify it based on the information provided.

Rationale Details: This section states that Class 2 land exceeds the threshold by 73 acres or 31% more than are allowed under the Bailey 2 threshold standard of 232 acres, leading to a "somewhat worse than target" status. This class should be reclassified as “considerably worse than target” (see Table 1). The section also notes the collection of over $2.37 million in water quality mitigation fees between 2000 and 2023 for the creation of 29 acres of added coverage in all classes, and the removal of 5.3 acres of coverage on 45 parcels through permit conditions and EIP projects. This information could be accurate; however, I could not verify it. For the trend rationale, the section mentions that impervious cover within class 1c was determined to be "little or no change" compared to 2019, which is accurate.

Confidence Details: This section explains the basis for the "moderate" confidence level. The reliance on permitting data and the potential for unpermitted impervious coverage contribute to this moderate confidence. The explanation for the trend confidence being moderate due to changes in source data is also reasonable.

Delivering and Measuring Success: The section focuses on relevant projects and programs. It highlights the "Acres of Environmentally Sensitive Land Acquired" indicator and the efforts of EIP partners in acquiring land for protection or restoration, however, following the provided link I could not find specific references to the Class 2 category. The example of an EIP Project, such as the Clancy-Pohl Sensitive Land Acquisition, directly links to the removal of impervious coverage in Class 2, but without mentioning the exact number of acres in this class.

Threshold Status Determination: The analytical methods employed seem suitable for determining status, trend, and confidence. The approach considers permitting data, mitigation fees, and project tracking. The confidence levels are adjusted reasonably based on potential data limitations.

Recommendation for Evaluation: It might be beneficial to explore remote sensing techniques or high-resolution imagery analysis to detect unpermitted impervious coverage, which could improve the accuracy of the assessment and potentially increase the confidence level.

Land Capability Class 3

Key Points: This section states that impervious coverage within Class 3 lands is estimated to be 382 acres, which is less than the 885-acre threshold standard. It also notes that there was no change in estimated Class 3 impervious coverage between 2020 and 2023. The section highlights the importance of sensitive land acquisition and restoration efforts, specifically mentioning the acquisition of over 613 acres of sensitive lands (Classes 1-3) between 2020 and 2023 by Environmental Improvement Program partners. This information could be accurate, but it was not easy to verify it based on the information provided.

Rationale Details: This section states that Class 3 land has 382 acres of existing impervious coverage, which is 503 acres less than the allowed limit under the Bailey Class 3 threshold standard of 885 acres, leading to a "considerably better than target" status. This statement seems accurate (see Table 1). The section also notes the collection of over $2.37 million in water quality mitigation fees between 2000 and 2023 for the creation of 29 acres of added coverage in all classes, and the removal of 5.3 acres of coverage on 45 parcels through permit conditions and EIP projects. This information could be accurate; however, I could not verify it. For the trend rationale, the section mentions that impervious cover within class 1b was determined to be "little or no change" compared to 2019, which is accurate.

Confidence Details: This section explains the basis for the "moderate" confidence level. The reliance on permitting data and the potential for unpermitted impervious coverage contribute to this moderate confidence. The explanation for the trend confidence being moderate due to changes in source data is also reasonable.

Delivering and Measuring Success: The section highlights the achievements of EIP partners in acquiring over 1,642 acres of environmentally sensitive land for protection or restoration since 2007. As was the case with other classes, following the “Acres of Environmentally Sensitive Land Acquired” link I could not verify if any of the acquired acres are in Class 3.

Threshold Status Determination: The analytical methods employed seem suitable for determining status, trend, and confidence. The approach considers permitting data, mitigation fees, and project tracking. The confidence levels are adjusted reasonably based on potential data limitations.

Recommendation for Evaluation: It might be beneficial to explore remote sensing techniques or high-resolution imagery analysis to detect unpermitted impervious coverage, which could improve the accuracy of the assessment and potentially increase the confidence level.

Land Capability Class 4

Key Points: This section mentions that the impervious coverage within Class 4 is estimated to be 1,323 acres, which is less than the 6,289 acres allowed by the threshold standard. The section also states that Class 4 land accounts for approximately 16% of the land area in the Tahoe Region. The section also mentions that between 2020 and 2023, just over one acre of additional Class 4 coverage was added and only 21% of the

regional allowable coverage in Class 4 has been utilized. I could not verify this information from the data provided.

Rationale Details: This section states that the Class 4 land has 1,323 acres of impervious coverage, which is 4,966 acres less than the threshold standard of 6,289 acres, which leads to a status of "considerably better than target". This statement seems accurate (see Table 1). The section also notes the collection of over $2.37 million in water quality mitigation fees between 2000 and 2023 for the creation of 29 acres of added coverage in all classes, and the removal of 5.3 acres of coverage on 45 parcels through permit conditions and EIP projects. I could not verify this information from the data provided. For the trend rationale, the section mentions that impervious cover within Class 4 was determined to be "little or no change" compared to 2019, which is accurate.

Confidence Details: This section explains the basis for the "moderate" confidence level. The reliance on permitting data and the potential for unpermitted impervious coverage contribute to this moderate confidence. The explanation for the trend confidence being moderate due to changes in source data is also reasonable.

Delivering and Measuring Success: This section states "No related projects or programs defined for this indicator".

Threshold Status Determination: The analytical methods employed seem suitable for determining status, trend, and confidence. The approach considers permitting data, mitigation fees, and project tracking. The confidence levels are adjusted reasonably based on potential data limitations.

Recommendation for Evaluation: It might be beneficial to explore remote sensing techniques or high-resolution imagery analysis to detect unpermitted impervious coverage, which could improve the accuracy of the assessment and potentially increase the confidence level.

Land Capability Class 5

Key Points: This section mentions that the impervious coverage within Class 5 is estimated to be 1,134 acres, which is less than the 3,047 acres allowed by the threshold standard. The section also states that Class 5 land accounts for 6% of the land area in the Tahoe Region. It is also mentioned that between 2020 and 2023, 2.7 acres of impervious coverage in Class 5 were permitted by the TRPA, and 3.3 acres of Class 5 coverage was retired during that period, including 2.7 acres from the former Tahoe Pines Campground in Meyers as part of the Upper Truckee River project. From the information provided I was able to verify that indeed the retired 2.7 acres are included in the “Upper Truckee River - Tahoe Pines Restoration and Public Access Project” report. I could not verify the 2.7 acres permitted by the TRPA and the remaining 0.6 acres (3.3−2.7) retired between 2020 and 2023. This section also accurately mentions that only 37 percent of the regional allowable coverage in Class 5 has been utilized.

Rationale Details: This section states that Class 5 has 1,134 acres of impervious coverage, 1,913 acres less than the 3,047-acre threshold. This leads to a status of "considerably better than target”, which seems accurate. For the trend rationale, the section mentions that for impervious cover within Class 5 was determined to be "little or no change" compared to 2019. This information is accurate. The section also notes the collection of over $2.37 million in water quality mitigation fees between 2000 and 2023 for the creation of 29 acres of added coverage in all classes, and the removal of 5.3 acres of coverage on 45 parcels through permit conditions and EIP projects. I could not verify this information from the data provided.

Confidence Details: This section explains the basis for the "moderate" confidence level. The reliance on permitting data and the potential for unpermitted impervious coverage contribute to this moderate confidence. The explanation for the trend confidence being moderate due to changes in source data is also reasonable.

Delivering and Measuring Success: The section links to only one relevant EIP project, the Upper Truckee River - Tahoe Pines Restoration and Public Access Project, which contributed to the retirement of 2.7 acres from the class 5 coverage. I could not verify the 2.7 acres permitted by the TRPA and the remaining 0.6 acres (3.3−2.7) retired between 2020 and 2023.

Threshold Status Determination: The analytical methods employed seem suitable for determining status, trend, and confidence. The approach considers permitting data, mitigation fees, and project tracking. The confidence levels are adjusted reasonably based on potential data limitations.

Recommendation for Evaluation: It might be beneficial to explore remote sensing techniques or high-resolution imagery analysis to detect unpermitted impervious coverage, which could improve the accuracy of the assessment and potentially increase the confidence level.

Land Capability Class 6

Key Points: This section mentions that the impervious coverage in Class 6 was estimated to be 2,287 acres, less than the 6,960 acres allowed under the threshold standard. The section also accurately states that about one-third of the regional allowable coverage in Class 6 has been used. Also, this section mentions that Class 6 comprises about 11% of the Tahoe Region. Finally, the section notes that between 2020 and 2023, the TRPA permitted about 7 acres of additional Class 6 impervious coverage. I could not verify this statement from the information provided.

Rationale Details: The section reports that Class 6 land has 2,287 acres of existing impervious coverage. That is 4,673 acres less than the threshold standard of 6,960 acres, which means the status is "considerably better than target". This statement seems accurate (Table 1). For the trend rationale, the section mentions that for impervious cover within class 6 was determined to be "little or no change" compared to 2019, which is accurate. The section also notes the collection of over $2.37 million in water quality mitigation fees between 2000 and 2023 for the creation of 29 acres of added coverage in all classes, and the removal of 5.3 acres of coverage on 45 parcels through permit conditions and EIP projects. I could not verify this information from the data provided.

Confidence Details: This section explains the basis for the "moderate" confidence level. The reliance on permitting data and the potential for unpermitted impervious coverage contribute to this moderate confidence. The explanation for the trend confidence being moderate due to changes in source data is also reasonable.

Delivering and Measuring Success: The section does not provide any links to relevant projects.

Threshold Status Determination: The analytical methods employed seem suitable for determining status, trend, and confidence. The approach considers permitting data, mitigation fees, and project tracking. The confidence levels are adjusted reasonably based on potential data limitations.

Recommendation for Evaluation: It might be beneficial to explore remote sensing techniques or high-resolution imagery analysis to detect unpermitted impervious coverage, which could improve the accuracy of the assessment and potentially increase the confidence level.

Land Capability Class 7

Key Points: This section notes that impervious coverage within Class 7 was estimated at 1,352 acres, below the threshold standard of 1,505 acres. This is 153 acres or 10% less than the allowed threshold. The section also mentions that Class 7 covers merely 2% of the Tahoe Region and is primarily concentrated in the City of South Lake Tahoe. Finally, the section notes that between 2020 and 2023, the TRPA permitted about 22 acres of additional Class 7 impervious coverage. No resources were provided for this Class so I could not verify any of the information.

Rationale Details: The section reports that Class 7 land has 1,352 acres of impervious coverage, which is 153 acres less than the 1,505-acre threshold. This leads to a status determination of "at or somewhat better than target". This statement seems reasonable. For the trend rationale, the section mentions that for impervious cover within class 7 was determined to be "little or no change" compared to 2019, which is accurate. The section also notes the collection of over $2.37 million in water quality mitigation fees between 2000 and 2023 for the creation of 29 acres of added coverage in all classes, and the removal of 5.3 acres of coverage on 45 parcels through permit conditions and EIP projects. I could not verify this information from the data provided.

Confidence Details: This section explains the basis for the "moderate" confidence level. The reliance on permitting data and the potential for unpermitted impervious coverage contribute to this moderate confidence. The explanation for the trend confidence being moderate due to changes in source data is also reasonable.

Delivering and Measuring Success: The section does not provide any links to relevant projects.

Threshold Status Determination: The analytical methods employed seem suitable for determining status, trend, and confidence. The approach considers permitting data, mitigation fees, and project tracking. The confidence levels are adjusted reasonably based on potential data limitations.

Recommendation for Evaluation: It might be beneficial to explore remote sensing techniques or high-resolution imagery analysis to detect unpermitted impervious coverage, which could improve the accuracy of the assessment and potentially increase the confidence level.

Stream Environment Zone

Preserve Stream Environment Zone (SEZ) Function

Key Points: The section highlights the effectiveness of TRPA policies and regulations in preventing further degradation of SEZs. It also mentions the vital roles SEZs play in the Tahoe Region, and the acquisition and protection of over 900 acres of SEZs by public land management agencies like the California Tahoe Conservancy and the USDA Forest Service.

Rationale Details: The section mainly focuses on the success of TRPA code and policies in preventing further SEZ degradation. However, it lacks details about the specific evaluation methods used.

Confidence Details: The sources do not provide information about how the confidence determination was made for the Preserve Stream Environment Zone (SEZ) Function indicator.

Delivering and Measuring Success: This section doesn't provide direct links to projects, monitoring programs, or metrics used to measure progress toward standard attainment.

Threshold Status Determination: The sources don't provide specific details about the analytical methods used to determine the indicator's status, trend, and confidence. However, the effectiveness of TRPA policies and regulations in preventing further SEZ degradation is confirmed.

Recommendation for Evaluation: Few methods that can be used to evaluate ESZs are: field surveys – assess parameters like vegetation composition, bank stability, riparian habitat quality, stream temperature, hydrological modeling – can simulate water flow and assess the effectiveness of SEZs in managing runoff, mitigating floods, and recharging groundwater, and remote sensing/GIS analysis – can help monitor changes in SEZ boundaries, vegetation cover, and land use patterns over time.

Quality and Function of Stream Environment Zone

Key Points: The section that in 2024, the Tahoe Region established a goal of increasing the regional SEZ quality to88%. The average SEZ quality during the assessment period was 76.5%. It mentions the "Lake Tahoe Stream Environment Zone Baseline Condition Assessment" and its role in monitoring. Additionally, it highlights the restoration and enhancement efforts, totaling 37.9 acres and 268 acres respectively, between 2020 and 2023. This information is accurate based on the provided information.

Rationale Details: The Rationale Details section provides a reasonable explanation of the standard's evaluation and the reasoning behind the status designation. It explains the decline in regional SEZ quality from 79% in 2020 to 76% in 2023, which is falling short of the 88% target. The section attributes this status to the SEZ quality being at 86% of the target, categorizing it as “somewhat worse than target”, which is accurate. This section mentions insufficient data to determine a trend. The explanation for why a trend was not established seems reasonable.

Confidence Details: The overall confidence is deemed "moderate" due to the reliance on the best available data and the long-term restoration goal spanning 20 years. This assessment seems accurate.

Delivering and Measuring Success: This section provides links to relevant projects and programs that aim to enhance SEZ quality and function. One of these links accurately points to the restoration and enhancement efforts, totaling 37.9 acres and 268 acres respectively, between 2020 and 2023. This section also provides specific project examples such as the "Incline Lake Property Planning & Implementation," "Post-Caldor Fire Stream Aggradation," and "Upper Truckee River and Marsh Restoration". Lastly, it mentions monitoring programs like the "SEZ Basin-wide Monitoring and Assessment Plan".

Threshold Status Determination: The SEZ Baseline Condition Assessment, completed in December 2020, served as the basis for determining the Threshold Status Determination for the Quality and Function of Stream Environment Zones. The assessment employed ten indicators to evaluate SEZ health. By combining existing data from various sources with targeted data collection conducted in 2019 and 2020, the assessment assigned a health rating to each SEZ in the Tahoe Basin. The assessment results were then translated into a threshold status determination, which indicated that while many SEZs are healthy, a significant portion, particularly meadows and associated stream channels, show signs of degradation. This information is used to track the progress of ongoing monitoring and restoration efforts aimed at achieving the goal of 88% SEZ quality by 2024. This methodology seems appropriate.

Recommendation for Evaluation: The approach seems extensive and detailed.

Vegetation Preservation - Common Vegetation – Thomas Dilts

Overall Comments:
Thanks for providing me with the opportunity to review the thresholds. I have some overall comments that I'd like to share, although I know that many of them are already known by policymakers and scientists in the Lake Tahoe Basin. My first thought is that there are too many indicators and they tend to be assessed mostly by the area of certain vegetation types on maps. Classified vegetation maps tend to be lagging indicators. Field data provide more insights regarding the health of various components of the ecosystem. Not all indicators would need to be assessed through field data. High resolution remote sensing, trends in greenness, and detailed mapping from orthophotos all provide valuable tools upon which assessments could be based.

I would recommend a smaller subset of indicators that with more closely monitored thresholds.

1: Something related to the rate and efficacy of fuels treatments. For example, it could be the area treated measured by polygons on a map every two years and a more detailed LIDAR-based assessment of pre- and post-treatment stand density.

2: Whitebark pine – Whitebark pine is now a federally threatened species (I believe the only federally threatened conifer in the western US). Using field data, high resolution imagery, and moderate-resolution satellite imagery we can see trends in greenness in these communities. These airborne approaches could also be tied to ground repeat photography. For example, the whitebark pine communities in the Mount Rose and Relay Peaks have suffered visible die back that is noticeable in satellite imagery, field data, and from roadsides.

3: Aspen – Aspen should be treated separate from other riparian forest types since it occupies a unique position spanning riparian and upland, is a critical wildlife habitat, is a fire-dependent vegetation type, and is particular susceptible to both conifer encroachment and pest outbreaks. Many of the management actions involve aspen, and it seems fitting that aspen should be elevated to its own indicator. I've been doing work to assess the long-term trends in conifer encroachment in aspen with good success (but not yet published).

4: Meadows – Meadows are critical to carbon storage, water filtration, and ecosystem function. Meadows are particular susceptible to drought and human management leading to a drop in the water table. Overall meadow health can be obtained from NDVI greenness, mapping different types of meadows (wet, dry, shrub) through time using high resolution imagery, and field assessments that catalog species diversity.

5: Riparian zones (not aspen or meadows) – This is included in the thresholds already under the goal of minimizing degradation with SEZs.

6: Sugar pine – Given the massive investment in harvesting and growing sugar pine seedlings it seems like ground-based measures that focus on recruitment would be valuable for this vital species.

7: Old growth – Although old growth is already present as an indicator it is presented in such a manner that it will never be achieved. A more optimistic approach might focus on the conserving the remaining old growth and promoting the health of old growth. A combination of LIDAR and field-based measurements could be used.

8: Invasive species – There is no mention of invasive upland plant species (unlike invasive aquatic species). As the climate becomes warmer and drier new challenges are likely to appear related to invasive species moving in from lower elevations.

9: Conifer mortality – Conifer mortality appears to be on the rise largely due to drought across all conifer types and elevations. More detailed monitoring using state-of-the-art satellite imagery is needed to catalog and map the amount of mortality, relate it to climate and climate lags, and determine the topographic positions most susceptible to conifer mortality.

<u>2023 Indicator Evaluation Page review questions</u>
General presentation for each Indicator Evaluation Page:

5. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
6. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
7. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
   Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Threshold status determination – for each Indicator:

1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
2. Would you recommend a different method of evaluating indicator status or trend?

Common Vegetation
Vegetation Community Richness

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

The key points mentions that the Emerald Fire is the only major disturbance but the Caldor Fire occurred between 2019 and 2023.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

Needs to be updated to reflect the Caldor Fire.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Disturbance polygons could be overlaid on Forest Service vegetation map, but, as the authors acknowledge, this is a lagging indicator.

Relative Abundance of Red Fir Forest In Seral Stages Other Than Mature

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

Authors note that the method for calculating this indicator has changed since the last reporting time making it incomparable to previous time periods.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

Note that the Caldor Fire may affect this indicator in the southern portion of the Lake Tahoe Basin.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
   Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

I agree with the statement that in the absence of disturbance that the vegetation community does not change significantly in four years.

Relative Abundance of Yellow Pine Forest In Seral Stages Other Than Mature

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

Yes. The objective of maintaining a mixture of age classes is clear in this objective.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

Yes.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
   Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

This is reasonable for this objective.

Relative Abundance of Meadows And Wetland Vegetation Types

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

This is an important indicator given the origin of the TRPA and the need to maintain healthy wetlands and meadows for lake clarity.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

This is clear that the basin is somewhat below target for this indicator.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
   Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Meadow greenness can be tracked over time and conifer encroachment can be mapped. I'm not convinced that using an existing vegetation is the best or only way to assess this indicator. Nonetheless within the confines of using the vegetation map to measure this indicator this makes sense.

Relative Abundance of Shrub Vegetation Type

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

This appears good and the rationale of maintaining not more than 25% on the landscape is reasonable.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

The rationale is good. The Emerald Fire is mentioned but the Caldor Fire should also be included.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
   Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

This makes sense and sounds good to me. I agree with this.

Relative Abundance of Deciduous Riparian Vegetation

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

This is an important indicator as riparian deciduous vegetation is vitally important for biodiversity in the Lake Tahoe Basin. How was the 4% target generated? This seems reasonable although knowing how it was derived would help since there is a limited amount of habitat with sufficient water that could support riparian vegetation.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

In the absence of disturbance conifer encroachment can lead to the replacement of aspen over time so this statement is misleading. However, the large number of conifer clearing restoration activities indicates that multiple management agencies are aware of this problem and actively combating it.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
   Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Both Joseph Stewart and myself have generated maps showing changes in aspen vs. conifer cover through time. These products can and should be used for the aspen portion of the riparian cover. If adopted, these products would elevate the confidence from low-moderate to moderate-high, at least for the aspen portion or riparian deciduous.

https://stewartecology.org/TahoeAreaAspenMaps/
https://nevada.app.box.com/s/o5lbh3eh939kb5yn9otaeeetlo3rkd84

Non-Degradation of Stream Environment Zones

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

This is another important indicator that especially makes sense given the mission of the TRPA. It has some overlap with the previous indicator "Relative Abundance of Deciduous Riparian Vegetation" and "Relative Abundance of Meadows And Wetland Vegetation Types". However, the focus of this indicator is more about keeping development away from stream channels and hyporheic zones. Clarification is needed as to what is meant by encroachment. Is this encroachment by human development or conifer encroachment?

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

This is good and makes sense.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

Does the “Delivering and Measuring Success” section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Is this section contained in the link to the SEZ report? I didn’t see it.

Pattern: Limit Size Of New Forest Openings

1. Does the “Key Points” section summarize the most important points that emerge from the data presented? Are the “Key Points” supported by the data and analysis presented?

The 2021 Caldor Fire should be considered. Otherwise these key points are supported by data.

2. Does the “Rationale Details” section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

This makes sense that limiting the size of large anthropogenic (and large wildfire) disturbances should be limited.

3. Does the “Confidence Details” discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
   Does the “Delivering and Measuring Success” section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

There are no standards for measuring success. However, large forest disturbances can be readily mapped and are shown on the accompanying map.

Pattern: Stand Composition And Age

1. Does the “Key Points” section summarize the most important points that emerge from the data presented? Are the “Key Points” supported by the data and analysis presented?

The goal of reducing forest density and ladder fuels is an overarching goal of nearly all coniferous forest management in the Lake Tahoe Basin. This reads clearly to me.

2. Does the “Rationale Details” section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

This is good and is consistent with the numerous transformative fuels projects that most land management agencies have undertaken to reduce fuels.

3. Does the “Confidence Details” discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
   Does the “Delivering and Measuring Success” section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

The data to support this is old and outdated. The link to the EcObject no longer works. It would be far more informative to link to detailed plot data rather than a modeled GIS product and use this to support the assessment.

Consistency with Bailey Land Capability System

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

Yes.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

Yes.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
   Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

The TRPA has its system in place that doesn't permit additional impervious surface. The Bailey, therefore, is more historical and isn't really needed in a practical manner for this particular objective.

Appropriate Management Practices

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

Using low-impact forestry techniques while reducing fuels is critical to minimizing soil erosion and the introduction of invasive species.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

There is a disconnect between the map, which shows the extensive area of treatments, and the objective to minimize forest floor disturbance. I'd say that they don't really support one another even though the map itself is very impressive and represents a significant amount of work that has been done on the ground.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
   Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

The implementation is based on the incorporation of policies into various agency planning documents, but these documents and their agencies are not listed.

Late Seral/Old Growth Ecosystems

Total Old Growth

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

The importance of old growth is clear from the key points and the goal of maintaining what is left makes a lot of sense.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

I find this to be odd given how slow regeneration is, and the authors admit that. There really is no way that more old growth can be obtained in such a short duration. The focus should be on the health of the remaining stands. Are the trees healthy and disease free? Are there ladder fuels that could result in the removal of old growth in the wake of a large fire? Is there competition from an overstocked earlier seral class? Finally, how are old growth-dependent wildlife species, such as the California spotted owl faring?

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
   Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

The use of QMD and LIDAR seems valid.

Sub-Alpine Zone

Same comments as for "total old growth"

Upper Montane Zone

Same comments as for "total old growth"

Montane Zone

Same comments as for "total old growth"

Vegetation Preservation - Sensitive Plants and Uncommon Plant Communities – Robert Shriver

I have reviewed the evaluation pages of Sensitive Plants and Uncommon Plant Communities

One overall observation. Many of the sensitive plant pages lack basic details on monitoring history, protocols, results, or have simply not been monitored. However, often the status and trend determination

and confidence does not seem to reflect this paucity of data, which could lead overconfidence in a species' health. Tahoe Yellowcress is the one exception to this and I think should serve as a model for the information needed on other species.

Below I list responses to the individual questions for each evaluation page.

Please reach out if you have any additional questions.

Robert K. Shriver
Assistant Professor
Department of Natural Resources and Environmental Science
University of Nevada, Reno
Email: rshriver@unr.edu

Cup Lake Draba

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

It appears that the sub-population numbers have been well above the minimum threshold that has been set, indicating that the status is better than the target. No data on population trends is presented and the text below seems to describe variable trends (both declining in different magnitudes) across sub populations (not stability) and low confidence in the overall trend. Therefore, I believe that based on the information presented saying the species is "stable" not supported by the data and analysis. I believe, the trend should instead be "Moderate Decline" or "Insufficient Data", particularly given the sparse monitoring.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

Yes, for status. For trends it is not clear how potential impacts of the Caldor fire and declining trends (albeit variable) in population was then used to make the determination that the population was stable.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

Yes.

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

No information is provided in this section. I suggest including the USFS monitoring protocols and report generated by monitoring in this section

Threshold status determination – for each Indicator:

5. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

It is challenging to determine this because no information on analytical methods are provided. My interpretation of the information provided is that long-term monitoring is being done in two ways: 1) The number of subpopulations, and 2) population trends in a more limited long-term monitoring site, but no data on the latter are included.

I would like to see more details on how the thresholds were established and details on monitoring and the data from these efforts.

6. Would you recommend a different method of evaluating indicator status or trend?

The data presented only included the sub-population numbers, which is a weaker assessment population health than trends within subpopulations. I would like to see the trend data added.

Galena Rock Cress

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

Yes, but I also think an additional key point should be added stating that no monitoring has been done since 2015

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

Yes, but the evaluation is outdated given that no new data has been collected since 2015.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

Yes. However, "Moderate" confidence in the status is too high given that the populations have not been revisited in nearly 10 years.

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

No information is provided in this section. I suggest including the USFS monitoring protocols and report generated by monitoring in this section

Threshold status determination – for each Indicator:

5. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

Only limited information on methods are provided making it challenging to determine this.

6. Would you recommend a different method of evaluating indicator status or trend?

No, however I would recommend regular resurveys of known populations for status and trends

Long-Petaled Lewisia

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

Yes

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

For the status, yes. Trend rationale mentions population surveys from 2002-2015 but this data is not presented nor are reports linked. This makes it challenging to determine how the determination was made.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

Data on the demographic or population dynamics are lacking, although it mentions survey have been done, making it impossible to determine whether the confidence determination for the trend is supported. Attached report contains data up to 2015 (most haven't been surveyed since 2012), but this quite dated at this point.

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

No information is provided in this section. I suggest including the USFS monitoring protocols and report generated by monitoring in this section

Threshold status determination – for each Indicator:

5. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

Only limited information on methods are provided making it challenging to determine this.

6. Would you recommend a different method of evaluating indicator status or trend?

No, however I would recommend regular resurveys of known populations for status and trends and making such data available.

Tahoe Draba

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

No, the key points mention trends within populations ("stable with variation") but no data on population trends are presented.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

No, the trend rationale is based on data that is nearly 10 years old, and is likely not reflective of the current status. It also does not provide rational for what is considered a stable population. All populations vary through time, so what degree of variation is allowable to be considered stable?

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

The confidence in the current trends cannot be moderate if no data analysis has been done since 2015. The description mentions some post 2015 data that has not been analyzed, but based on my own experience doing research on Tahoe Draba (my lab has monitored populations since 2021), I can say that all of the populations we surveyed experience marked declines between 2015 and 2021. They are beginning to recover, but are still not at pre-2015 levels. Therefore, I have low confidence in the trend determination made here.

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

No information is provided in this section.

Threshold status determination – for each Indicator:

5. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

Only limited information on methods are provided making it challenging to determine this.

6. Would you recommend a different method of evaluating indicator status or trend?

I would recommend regular resurveys of known populations for status and trends and making such data available, and defining what constitutes population stability.

Tahoe Yellow Cress

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

Yes. Data presented here is the most thorough of any of the species.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

Yes, the determined status and trend are justified and supported by the data, but the status and trend determination should be listed before the rationale.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

Yes

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Yes, I would like to see this level of information provided for other species.

Threshold status determination – for each Indicator:

5. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

The status and trend is largely determined by the number of populations, while this likely correlates with population health and viability the addition of monitoring population density and demography into the status and trend determination would be more robust.

6. Would you recommend a different method of evaluating indicator status or trend?

See response to #5.

Deepwater Plants of Lake Tahoe

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

It is not clear if the "recent surveys" referenced in the key points are the 2008-09 data presented in the graph or another source. If it is the 2009 data, I would suggest removing the word recent and replacing with past, as this data is now 15 years old.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

Yes, I think this section presents a reasonable explanation of the data limitations.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

It seems strange to say the status is unknown in the rationale, but then say the confidence in the status is moderate. Shouldn't this be low?

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

No information is presented here.

Threshold status determination – for each Indicator:

5. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

Unknown, no information on approaches or methods are given

6. Would you recommend a different method of evaluating indicator status or trend?

Additional monitoring would be helpful. With just to snapshot surveys (1963 and 2009) it is impossible to determine hoe much of the change is due to interannual variability vs long-term trend vs differences in how groups implement the surveys.

Freel Peak Cushion Plant Community

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

Yes

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

My interpretation based on the Key Points is that the status is carryover from the past since no new data are available. I think this should be more clearly stated right after the status, otherwise it gives the impression that more current data were used to make this determination.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

It seems strange to say the status is unknown in the rationale, but then say the confidence in the status is moderate. Shouldn't this be low?

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

No information is presented here.

Threshold status determination – for each Indicator:

5. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

Yes, with the caveat that no new data are available

6. Would you recommend a different method of evaluating indicator status or trend?

No

Water Quality – Joanna Blaszczak

21 October 2024

To the Tahoe Regional Planning Agency:

Below I provide my evaluation of each 2023 Threshold Assessment page assigned to me.

Overall, the pages are thorough and I mostly have relatively minor comments. That said, because the Tahoe Science Advisory Council recommended removing "Load Reductions: Reduce Loading of Dissolved Phosphorus" and "Load Reductions: Reduce Dissolved Inorganic Nitrogen Loads" from the thresholds, I would recommend removing these pages from the website since they do not contain useful information.

I am happy to answer any questions that may arise from my comments.

Sincerely,

Joanna R. Blaszczak, Ph.D.
Assistant Professor
University of Nevada, Reno

Aquatic Invasive Species: Aquatic Invasive Species Prevention

Note: In the Description section, the last sentence should have "In" removed from the start of the last sentence

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
Overall, yes. One small edit I suggest is to insert "invasive" in front of "aquatic species" in "…the first new detection of an aquatic species in Lake Tahoe since the threshold standard was adopted in 2012" for clarity.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
Yes

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

Yes

4. Does the “Delivering and Measuring Success” section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
Yes

Threshold status determination – for each Indicator:
1. Are the analytical methods appropriately applied to determine the indicator’s status, trend, and confidence?
Yes

2. Would you recommend a different method of evaluating indicator status or trend?
No

Aquatic Invasive Species: No Active Aquatic Invasive Species Infestations

1. Does the “Key Points” section summarize the most important points that emerge from the data presented? Are the “Key Points” supported by the data and analysis presented?
Yes, except I would suggest directing the reader to the About the Threshold section for definitions of Planning/Surveillance/Control. In addition, the statement “Total submerged aquatic vegetation in 2023 was less than half the amount in 2018” could be better supported by either linking to a report or publication, or showing the data.

2. Does the “Rationale Details” section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
Yes

3. Does the “Confidence Details” discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
Yes

4. Does the “Delivering and Measuring Success” section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
Yes, it appears there are several projects aimed at addressing this issue

Threshold status determination – for each Indicator:
1. Are the analytical methods appropriately applied to determine the indicator’s status, trend, and confidence?
Yes

2. Would you recommend a different method of evaluating indicator status or trend?

No except the page on Aquatic Invasive Species Prevention is very focused on the mudsnail, while the infestation page seems primarily focused on plants. In the future, TRPA might consider evaluating invasive plants and animals separately and even consider species-specific trend evaluation comparable to the water chemistry monitoring if the data is available. It is unclear how TRPA weighs how much to invest in managing invasive plants versus animals (even though they of course interact).

Aquatic Invasive Species: Reduce Average Aquatic Invasive Plant Abundance in the Tahoe Keys

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
Yes, the website tahoekeysweeds.org is very helpful.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
Yes

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
Yes

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
Yes

Threshold status determination – for each Indicator:
1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
Yes

2. Would you recommend a different method of evaluating indicator status or trend?
No

Nearshore (Littoral) Lake Tahoe: Nearshore Attached Algae

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
Yes, overall the Key Points section does a good job of summarizing the current state of knowledge, however, it is not supported by the data and analysis presented on the page because the Summary description under "Accomplishments" does not match the figure. See my comments under "Threshold status determination" question 1 below. Additional comments:

1. The wrong Sadro et al. 2018 article is linked in the third to last bullet point. The paper linked only examines variation in lake temperature in response to climate and lake morphometry. The appropriate citation to link is: Sadro, S., J. O. Sickman, J. M. Melack, and K. Skeen. 2018. Effects of climate variability on snowmelt and implications for organic matter in a high-elevation lake. Water Resour. Res. 54: 4563–4578. https://doi.org/10.1029/2017WR022163
2. Under the first bullet point I would edit the text to insert "biomass" after "… no significant change in periphyton" because it is still unclear whether the community has shifted over time beyond the general classifications of filamentous green, cyanobacteria, and stalked diatoms presented in Atkins et al. 2021
3. "Measured periphyton in 2023 was lower than the long-term averages at monitored sites." Consider including 2017 in this statement which was also a high snow year
4. Hackley et al., 2016a is cited in the Summary and Hackley et al. 2016 is cited in the Key Points. Are these the same or different? A link to the document in both instances would be helpful.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
Yes

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
Yes, but note that metaphyton is misspelled in the last sentence.

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
Yes

Threshold status determination – for each Indicator:
1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
In the Summary under Accomplishments, the text ends with "Table adapted from (Hackley et al., 2016a)" but I do not see a table, only a figure (I might be missing something). There are also no trends or summary statistics reported – this summary description should be updated to describe the figure. However, the table described in the Summary also seems relevant and if possible, it would be good to include.

2. Would you recommend a different method of evaluating indicator status or trend?
No, the peer-reviewed approach described in Atkins et al. 2021 is robust. However, I'm not sure about the Hackley publication.

Nearshore (Littoral) Lake Tahoe: Nearshore Turbidity (No Stream Influence)

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
A definition of what is meant by "baseline" would be helpful to include (e.g. during the period of no wave action). There is a disconnect between the statement that the turbidity is "0.1 to 0.3 NTU" in the key points when the annual average NTU in the figure above under Status shows NTU values that are higher and mostly above 0.3 NTU.

The thresholds should be depicted as horizontal lines on the figure rather than independent data points to improve clarity of the figure.

Given the distinction between pages as to Stream or No Stream Influence, even some minor assessment of proximity to the nearest inflowing stream among sites might be beneficial to distinguish among them. Are any truly away from inflowing streams?

Other than that, the key points section does a good job summarizing the most important points.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
Yes

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
Yes

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
Yes

Threshold status determination – for each Indicator:
1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
Given the amount of data that is available, yes

2. Would you recommend a different method of evaluating indicator status or trend?
If monitoring data becomes more reliable and consistent across all sites, investigating trends separately during the summer and winter (as is done with the average Secchi disk data) might be useful.

Nearshore (Littoral) Lake Tahoe: Nearshore Turbidity (Stream Influence)

See comments under "Nearshore Turbidity (No Stream Influence)" as the pages are nearly identical. However, I noticed the additional table summarizing average annual turbidity values is

not linked on this page despite the same text and data being presented and would suggest also uploading to this page.

Nearshore (Littoral) Lake Tahoe: Phytoplankton Primary Productivity (Littoral)

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
I would recommend removing the chlorophyll data for attached algae from this page as it is not only not a measurement of productivity, but also it is not representative of phytoplankton (i.e., algae in the water column unattached to surfaces). Under the Key Points section, I would also clarify the distinction between phytoplankton and periphyton in addition to the existing distinction between productivity and biomass. The density of phytoplankton is likely more related to turbidity estimates from the water column, and so I think it would be fair to state that since turbidity is low across monitored nearshore locations, we expect phytoplankton are as well.

I might also move the following Key Point from the "Phytoplankton Primary Productivity (Pelagic)" page to this one: "Work in the nearshore areas of Tahoe found that primary production increased by 40 percent in 2021 when the lake was blanketed in smoke from the Caldor, Tamarack, and Dixie fires (Smits et al., 2024)." It states that the conclusions are drawn from nearshore areas (i.e., littoral) and therefore are more suitable to this page even though the oxygen method captures both benthic and pelagic productivity.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
The first sentence of the "Status Rationale" stating that there is insufficient data is reasonable, but the second sentence seems to still be in a draft state. "…the rate specified in the standard…" is unclear.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
There is no text which is justifiable given the lack of data.

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
There are no specified projects which is justifiable given the lack of data.

Threshold status determination – for each Indicator:
1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
N/A

2. Would you recommend a different method of evaluating indicator status or trend?
I would recommend applying the same methods used to estimate phytoplankton productivity in the pelagic zone to some nearshore locations and evaluating the differences in time, especially nearshore locations both close and far from stream inlets.

Deep Water (Pelagic) Lake Tahoe: Average Secchi Disk Transparency

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
Under Key Point #1, the statement that "Summer clarity continues to show a statistically significant decline" should either link to a report or publication, or I would recommend showing the winter and summer trends separately in the data figure. Otherwise, the Key Points do a good job summarizing the most important points.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
Yes

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
Yes

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
Yes

Threshold status determination – for each Indicator:
1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
Yes

2. Would you recommend a different method of evaluating indicator status or trend?
No, the results are convincing.

Deep Water (Pelagic) Lake Tahoe: Phytoplankton Primary Productivity (Pelagic)

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
Overall yes, but I would recommend that (1) data or a publication should be linked after the statement describing patterns in the DCM (Key Point 4), and (2) the publication reference regarding

increases in primary production in the nearshore in response to smoke (Smits et al. 2024) be moved to the page on Littoral Phytoplankton Primary Productivity.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
Yes

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
Yes

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
Yes

Threshold status determination – for each Indicator:
1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
The trend is designated as "Rapid Decline" and yet, the data show an increase in primary productivity. While I understand wanting to communicate that there is a rapid decline in mid-lake water quality, the data show a rapid increasing trend.

2. Would you recommend a different method of evaluating indicator status or trend?
No, I think consistency through time in the method is important.

Tributaries: Nitrogen Concentration (Tributaries)

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
Overall, yes and it is good that the Domagalski paper is highlighted from the beginning.

Note: In the description at the top, it states there are 7 regularly monitored streams, but in the summary under the data figure it states there are 5 regularly monitored California streams. Is there a reason why only the California data is being presented?

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
Yes

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

I think a brief description somewhere on the page about the frequency and types of dissolved nitrogen that are being monitored would be helpful (i.e., what does "regularly" mean). Especially in the context of dissolved constituents, it would be good to know if both baseflow and stormflow are sampled to generate the average total N concentrations since much of N export from a catchment can occur during storms.

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
Yes

Threshold status determination – for each Indicator:
1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
Yes

2. Would you recommend a different method of evaluating indicator status or trend?
Overall no, but as far as I'm aware ammonium concentrations are no longer being monitored in the streams despite the Domagalski paper showing an increasing trend in ammonium concentrations since 2000. However, I understand that since TDN concentrations are declining that this might not be a priority.

Tributaries: Suspended Sediment Concentration (Tributaries)

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
Yes, the Key Points do a good job, but the data presented under Status are unclear. First of all, the magnitude of the y-axis appears to be in the millions while the units are in mg/L in the axis title. Also, it would be good to include how many tributaries are being included in these average values. Second, if the USGS has been routinely monitoring suspended sediments since 1969, why does the data only goes back to 2011 in the figure?

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
Yes, except it is unclear where the threshold standard of 60 mg/L originated from.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
Yes

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Yes

Threshold status determination – for each Indicator:
1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
Yes, there are no details on how exactly suspended sediments and fine sediments are analyzed in the laboratory but for these pages that seems alright.

2. Would you recommend a different method of evaluating indicator status or trend?
Yes

Tributaries: Phosphorus Concentration (Tributaries)

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
Overall yes, however, the point regarding suspended sediment concentrations and loads declining should be contextualized. A brief explanation that total phosphorus often has a close relationship with TP would help signify the relevance of including this trend.

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
The status is "At or Somewhat Better Than Target" and yet under Status Rationale, none of the California tributaries are in attainment and only one of the two tributaries in Nevada is in attainment. While the concentrations are not drastically high, they are certainly not "somewhat better than target". Are there a few key times of the year that are increasing the mean annual TP concentrations? Or are the streams always elevated above the state standards? Some additional context might help better justify the Status determination.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
The determination is not supported by the information presented since almost all of the tributaries have annual average concentrations of TP greater than the state standards for CA and NV from 2020-2023, while the Domagalski paper only includes data until 2017.

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
Yes

Threshold status determination – for each Indicator:
1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

The trend evaluation outside of the time period included in the Domgalski paper is unclear. If possible, I would recommend extending the same analysis used in that paper to include newer data to determine whether the same downward trend has held true in the six years since 2017.

2. Would you recommend a different method of evaluating indicator status or trend?
See response to question above.

Load Reductions: Decrease Total Annual Suspended Sediment Load

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
Yes

2. Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
Yes; a minor edit would be to remove "below" from the statement "Use the map and check boxes below to see the achievements relative to targets for each jurisdiction, state, and basinwide." Given the evaluation map is above this section on the page.

3. Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
No because there is no information beyond "Moderate"

4. Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
Yes

Threshold status determination – for each Indicator:
1. Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?
Yes

2. Would you recommend a different method of evaluating indicator status or trend?
No

Load Reductions: Reduce Loading of Dissolved Phosphorus

1. Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?
Yes, as stated, this threshold is no longer being used as a standard.

2. Does the “Rationale Details” section provide a reasonable explanation of how the standard was evaluated and the status determination was made?
NA

3. Does the “Confidence Details” discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?
NA

4. Does the “Delivering and Measuring Success” section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?
NA

Threshold status determination – for each Indicator:
1. Are the analytical methods appropriately applied to determine the indicator’s status, trend, and confidence?
NA

2. Would you recommend a different method of evaluating indicator status or trend?
NA

Load Reductions: Reduce Dissolved Inorganic Nitrogen Loads

The Key Points indicates that this was removed as a threshold standard and thus all answers to the questions are NA.

College of Agriculture, Biotechnology and Natural Resources
University of Nevada, Reno

Department of Natural Resources & Environmental Science
1664 N. Virginia Street, Reno, NV 89557
Mail Stop/0186 Fleischmann Agriculture 217

MEMORANDUM

To: Robert Larson
Tahoe Science Advisory Council Program Officer
From: Perry Williams, PhD
Date: October 6, 2024
Subject: TRPA Wildlife Standard Review

This memorandum addresses the review charge for the 2023 Indicator Evaluation Pages. The objective of this review is to assess the breadth and clarity of the information provided for each threshold standard and to offer recommendations for enhancing the analysis and presentation. Below are my responses to the specific questions outlined in the review charge, along with any additional feedback or suggestions.

This is my first time conducting a review for the Tahoe Regional Planning Agency. As such, I was uncertain about the level of detail that would be most helpful for the review process. I opted to err on the side of providing too much detail rather than too little in my comments. Some of the feedback may come across as pedantic; however, you may consider them as suggestions rather than substantive critiques. Examples include suggested edits to phrasing on 'Key Items'. I will indicate where I believe my comments are substantive and warrant attention.

My most substantive recommendation is to use linear regression for all indicators that have annual count data (e.g., bald eagles, osprey nests, peregrine falcon nests). In the key points section, consider including the slope and intercept of the regression line, as well as the 95% confidence intervals for the slope parameter. I have included R code at the end of this memorandum to complete these analyses, along with the relevant information within my review. I prefer linear regression over the more complex EGPN model due to its simplicity, ease of interpretation, widespread acceptability, and parsimony. Additionally, this approach will provide consistency across the different species. You can then add the simple linear regression trend line to the data to visualize the rate of change.

Thank you for the opportunity to conduct this review.

1 Nesting Bald Eagle Population Sites

1.1 General Presentation for Nesting Bald Eagle Population Sites

1.1.1 Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

The Key Points are:

- Two new bald eagle nests were found in Tahoe since the 2019 Threshold Evaluation.
- Since routine monitoring began, the number of nesting bald eagles has increased from an average of less than one (0.9 eagles) in the first 10 years of monitoring to more than two (2.3 eagles) in the most recent 10-year period.
- Controls are in place for projects like trail construction and forest fuels reduction that minimize disturbance to nesting bald eagles and nesting habitat.

Reviewer Comments:

1. The statement *"Two new bald eagle nests were found in Tahoe since the 2019 Threshold Evaluation"* seems somewhat unclear. It's not immediately obvious how "two new nests" were determined. For instance, in 2019, there was only **one active nest**, whereas in 2023, there are now **four active nests**. This raises the question of why the statement mentions only two new nests. I suspect this discrepancy arises because the 2019 Threshold Evaluation incorporated data from 2017 (when two nests were present). It may be clearer to revise the statement to something like: *"Four nests were found in 2023, the most in nearly 30 years."* This revision highlights the significant recent increase and removes ambiguity about the time frame.

2. Rather than dividing the data into two 10-year periods and calculating averages for each, you might consider using the results from the trend line analysis. Upon re-analyzing the data presented in the graph, it appears the trend line has an intercept of **0.46** and a slope of **0.077**. This means that, through time and on average, there were **0.46 nests in 1996**, and the average number of nests through time has increased by **0.077 nests per year** since then. This approach provides a more continuous and detailed view of the trend over time, rather than summarizing it in broad 10-year blocks. It also gives context to the trend line shown in the plot.

3. Change "Controls" to "Protective measures"?

4. Add as an key point: "The expected number of bald eagle nests in 1997 was 0.46 (intercept of regression line). The expected number of bald eagle nests has increased at a rate of 0.08 nests per year (slope of regression line). The 95% confidence interval on the slope is (0.04–0.12), indicating strong evidence for an increasing number of nests through time."

1.1.2 Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

The Rationale Details are:

- **Status Rationale**: The current status was determined based on the number of active nests in the Tahoe Basin in the most recent monitoring year. In 2023 there were four active nests. The average number of active nests during the evaluation period was 3.25. Therefore, the current status is considerably better than target.
- **Trend Rationale**: The percent change since 1996 is 7%, therefore, there is a trend of rapid improvement.

Reviewer Comments:

1. Small edit; consider changing status rationale to "The status was determined using the number of active nests in the Tahoe Basin in 2023. There were four active nests in 2023. The average number of active nests from 2019–2023 was 3.25. Therefore, the current status is higher than the target."
2. Additionally, if you use the trend line to predict the number of nests in 2023, the expected number of nests is 2.54 nests. The 4 active nests are significantly higher than predicted by the trend. So, good year!
3. "Considerably" doesn't really mean anything here.
4. **Substantive Edit:** Is 7% per year? It must be. We can use the trend line to estimate the percent change from the beginning of data collection until now. We can also estimate since 1996 (first year of data) rather than 1997. Using the trend line, the percent change in bald eagle nests for the duration of the study is

$$y = \text{intercept} + (\text{slope} \times x)$$

Where:

- Intercept = 0.45813
- Slope = 0.07718
- x is the number of years since 1996

Step 1: Calculate the regression line values for 1996 and 2023.
- For 1996 ($x = 0$):

$$y_{1996} = 0.45813 + (0.07718 \times 0) = 0.45813$$

- For 2023 ($x = 27$):

$$y_{2023} = 0.45813 + (0.07718 \times 27) = 0.45813 + 2.08386 = 2.54199$$

Step 2: Calculate the percent change.
The percent change from 1996 to 2023 is given by:

$$\text{Percent Change} = \frac{y_{2023} - y_{1996}}{y_{1996}} \times 100$$

Substitute the values:

$$\text{Percent Change} = \frac{2.54199 - 0.45813}{0.45813} \times 100 = \frac{2.08386}{0.45813} \times 100 \approx 454.76\%$$

Thus, the percent change in the regression line from 1996 to 2023 is approximately **454.76%**. That is much larger than the stated 7% improvement.

1.1.3 Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

The Confidence Details are:

- **Confidence of Status:** High. All potential nesting habitat is surveyed each year using standardized protocols and frequent observations.
- **Confidence of Trend:** Low. Trend confidence is determined by 1) the duration of trustworthy data and 2) the coefficient of determination, and 3) the p-value. There is a long-term trustworthy dataset of nesting bald eagles. Linear regression of the number of active eagle nests and year was performed and the R^2= 0.403, p-value= 0.000284669. The highly significant p-value means that we are highly confident that the number of nesting eagles has increasing. The R^2 value suggests that about 40% of the variation in eagle nests can be explained only by time. This means that there is low confidence in the trend lines' ability to predict future increases in nesting eagles.
- **Overall Confidence:** Moderate. The overall trend is an average of the confidence of status and confidence of trend.

Reviewer Comments:

1. **Substantive Edit:** I am more confident about the trend than is stated here. The 95% confidence intervals for the slope are (0.039–0.115). The 99% confidence intervals for the slope are (0.026–0.128). Thus, even the 99% confidence intervals suggest strong evidence for an increasing slope. This is also equivalently indicated by the p-value = 0.000285. Thus, I think this is strong evidence for an increasing trend. I am less concerned about the $R^2 = 0.403$. That actually seems pretty good to me. I see in the comments that Beth Vollmer provide important details about methodology: "According to Chapter 2- Methodology, the confidence of trend is determined by the duration of trustworthy data (long term dataset) and both the coefficient of determination [and the] t-test significance." The coefficient of determination is the R^2 value, which I think

is pretty good, and the t-test (or equivalently, the confidence intervals on the slope parameter) are definitely significant. For most wildlife data, I think this is strong evidence of an increasing trend.

2. Given the previous statement, I think the overall confidence is high.

1.1.4 Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Reviewer Comments: Yes

1.2 Threshold Status Determination – Nesting Bald Eagle Population Sites

1.2.1 Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

Reviewer Comments: See my specific comments and suggestions, above. I would focus on the statistical interpretation of the trend-line analysis (i.e., simple linear regression of bald eagle nests through time).

1.2.2 Would you recommend a different method of evaluating indicator status or trend?

Reviewer Comments: See my specific comments and suggestions, above. I would focus on the statistical interpretation of the trend-line analysis (i.e., simple linear regression of bald eagle nests through time). If the slope, and 95% confidence intervals of eagle nests through time are all positive, trend is increasing. If the confidence interval for the slope overlaps zero, there is uncertainty in the trend. If the slope, and 95% confidence intervals of eagle nests through time are all negative, trend is decreasing. This all assumes none of the assumptions of simple linear regression are violated.

Additional Comments or Feedback

None

2 Wintering Bald Eagle Population Sites

2.1 General Presentation for Wintering Bald Eagle Population Sites

2.1.1 Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

The Key Points are:

- In 2021, 42 individuals were counted during the annual wintering bald count organized by Tahoe Institute for Natural Sciences.The 42 individuals was the highest number ever recorded in Tahoe.
- The wintering bald eagle population in Lake Tahoe has increased substantially since monitoring began in the 1990s.
- The number of observed individuals is well above the threshold target.
- Actions to protect the main over-wintering areas in the Basin for bald eagles have been taken such as prohibiting snowmobiles in the Taylor-Tallac marsh complex.
- The disturbance zone standard for bald eagle has been implemented by TRPA and other partner agencies.

Reviewer Comments:

1. **Substantive Comment:** How was the trend line developed on the Web-Based Dashboard? Doesn't seem to be simple linear regression; it is not in the right place for that. See Fig. 4 for the simple linear regression trend line.

2. I like the first bullet point. It aligns closely with my suggestion for the first bullet point in the Bald Eagle Nesting Site Threshold, which was: *"Four nests were found in 2023, the most in nearly 30 years."*. Thus, revising the first bullet point under Key Points in the Bald Eagle Nesting Site Threshold to my suggested revision, will also make it more consistent to the first bullet point here.

3. We can be specific about the comment "The wintering bald eagle population in Lake Tahoe has increased substantially since monitoring began in the 1990s." Following my comments from Bald Eagle Nesting, above, you could use the results from the trend line analysis. The trend line has an intercept of **6.49** and a slope of **0.85**. This means that, through time and on average, there were **6.49 wintering eagles observed in 1998**, and the average number of wintering eagles through time has increased by **0.85**

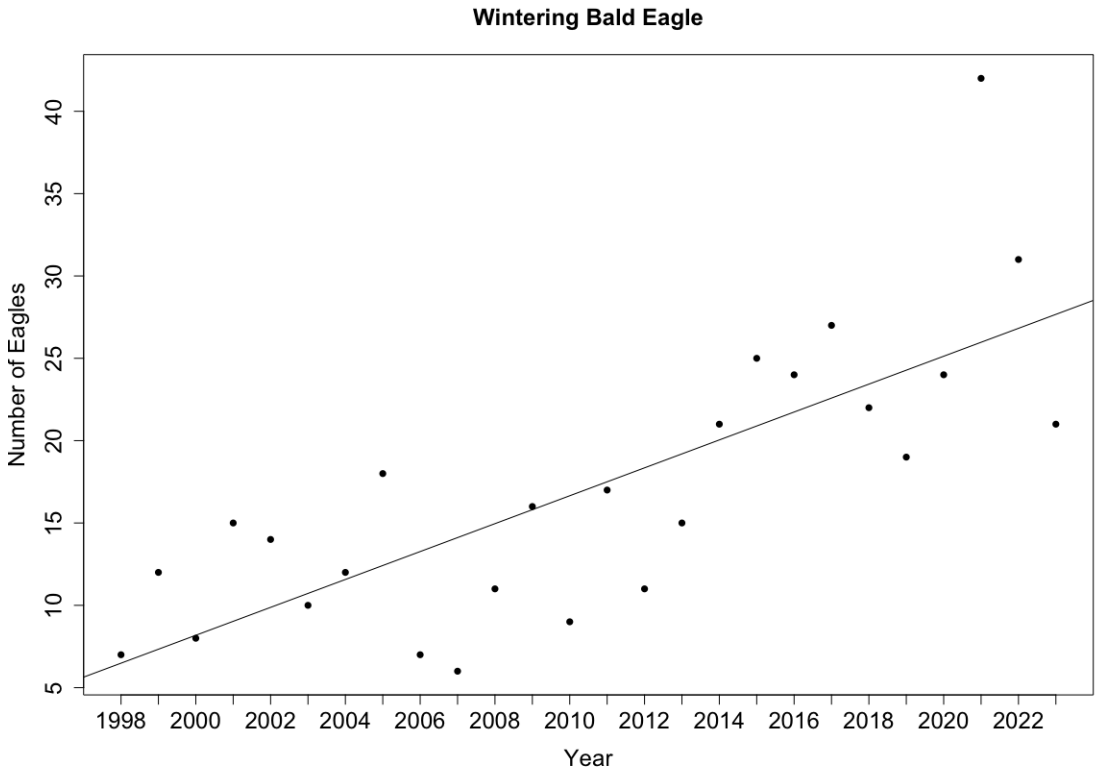

Figure 1: Number of wintering bald eagles through time and trendline for simple linear regression. Note the difference between this trendline and that used in theWeb-Based Dashboard. In the Web-Based Dashboard, the trendline is below the last data point. Here it is above it.

eagles per year since then. This approach provides a continuous and detailed view of the trend over time. It also gives context to the trend line shown in Fig. 4.

4. Be specific and state: "The number of observed individuals is well above the threshold target [of 2 wintering eagles].

5. Minor edit for conciseness: Consider "Protective actions, such as prohibiting snowmobiles in the Taylor-Tallac marsh complex, have been implemented to safeguard key bald eagle overwintering areas in the Basin."

6. I'm not sure what "The disturbance zone standard" is? Concisely describe for a more general audience?

2.1.2 Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

The Rationale Details are:

> - **Status Rationale**: Status was determined based on policies implemented to protect bald eagle winter habitat and the number of bald eagles counted during the annual winter bald eagle count. The number of wintering bald eagles was 21 in 2023. The average number of wintering bald eagles during the period since the last evaluation (2020-2023) was 29.5, considerably better than the target of two.
>
> - **Trend Rationale**: Population trend was estimated using an EGPN (exponential growth process noise) model (Humbert et al. 2009). Process noise refers to differences in observed population abundance that result from environmental variability. From 1997-2023, the annual growth in the wintering bald eagle population is estimated to be 4.4%. Therefore, the trend is determined to be rapid improvement.

Reviewer Comments:

1. **Substantive Comment:** In response to "Population trend was estimated using an EGPN model (Humbert et al. 2009). **I'm not sure why this was used.** I evaluated the assumptions of the simple linear regression model shown in Fig. 4 and the assumptions looked good to me. Using the more complex model adds unnecessary complexity when it probably is not needed. Out of curiosity, I also fit one of the models in Humbert et al. (2009) to this data. The results are shown in Fig. 2. Do the results shown in Fig. 2 justify the added complexity of the model? I'm not sure what the added benefits are. In fact some of the results may not make sense. For example, the second year data were collected, 12 eagles were seen. However the estimate from Humbart's model is less than 10 eagles. I think the estimated number of eagles would be at least as many as how many were seen. The only way the estimate should be lower than the number that were seen is if some eagles were mistakenly counted twice. Is that possible with the way data were collected? To me, the added complexity of

the Humbert et al. (2009) model is not worth the information gained, especially when trying to communicate the results to a general audience. I would error on the side of parsimony and make the model only as complex as necessary. I would use simple linear regression.

2. "From 1997-2023, the annual growth in the wintering bald eagle population is estimated to be 4.4%. Therefore, the trend is determined to be rapid improvement." This must be per year, correct? The total % change in population from the beginning of the study to the end is much higher. Here are the calculations using simple linear regression

$$y = \text{intercept} + (\text{slope} \times x)$$

Where:

- Intercept = 6.4872
- Slope = 0.8472
- x is the number of years since 1998

Step 1: Calculate the regression line values for 1998 and 2023.
- For 1998 ($x = 0$):

$$y_{1998} = 6.4872 + (0.8472 \times 0) = 6.4872$$

- For 2023 ($x = 25$):

$$y_{2023} = 6.4872 + (0.8472 \times 25) = 6.4872 + 21.18 = 27.6672$$

Step 2: Calculate the percent change.
The percent change from 1998 to 2023 is given by:

$$\text{Percent Change} = \frac{y_{2023} - y_{1998}}{y_{1998}} \times 100$$

Substitute the values:

$$\text{Percent Change} = \frac{27.6672 - 6.4872}{6.4872} \times 100 = \frac{21.18}{6.4872} \times 100 \approx 326.49\%$$

Thus, the percent change in the regression line from 1998 to 2023 is approximately **326.49%**.

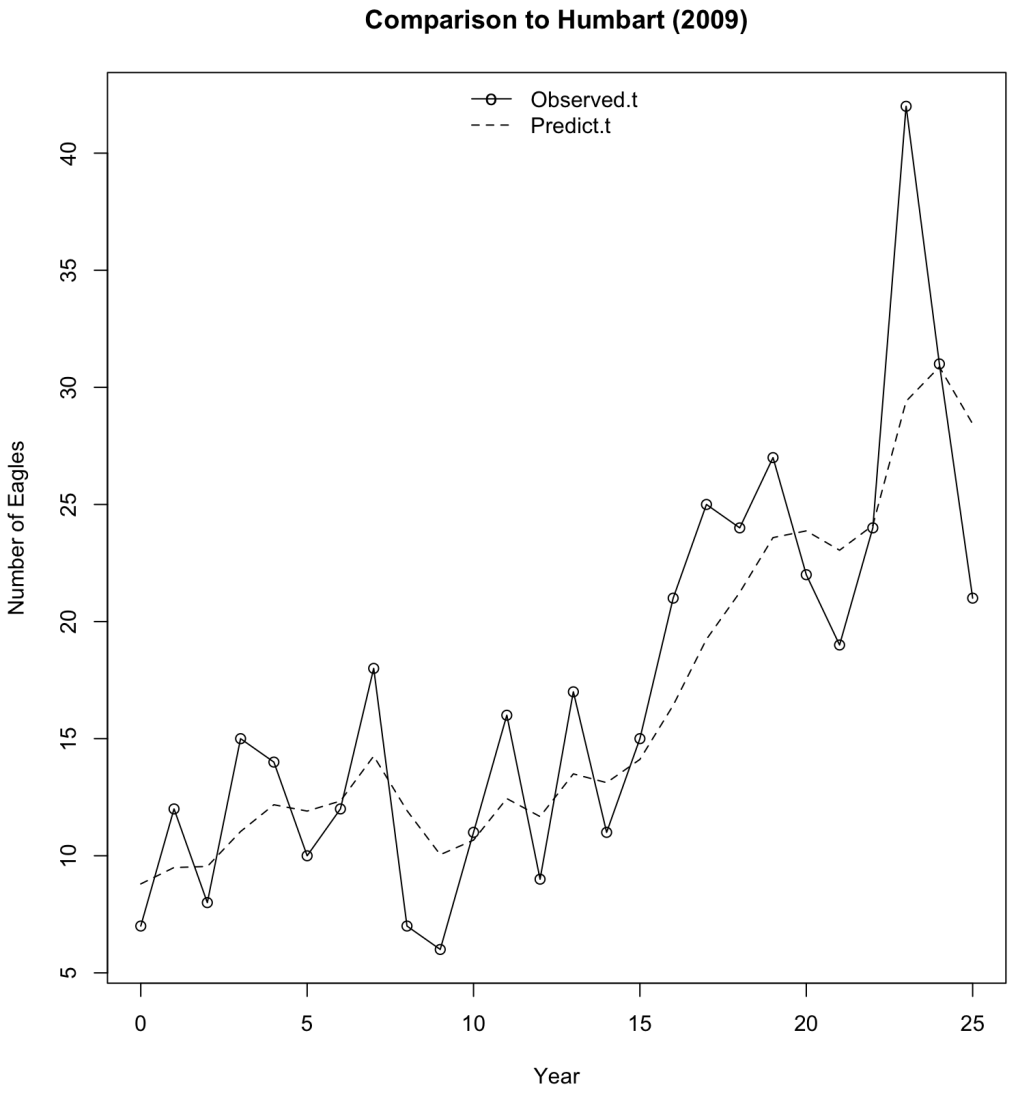

Figure 2: Number of eagles observed near Lake Tahoe from 1998–2023 (solid line) and estimated abundance using Humbert et al. (2009) EGPN model (dashed line). Note often the predicted number of eagles is less than is observed. This can only be true if all eagles living in the area are counted, and some are counted twice.

2.1.3 Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

The Confidence Details are:

- **Confidence of Status:** High. Surveys have been conducted using standardized protocols and a long period of data exists. Policies have been implemented to protect wintering habitat areas.
- **Confidence of Trend:** High. The estimated growth is positive; the 95% confidence interval shows positive population growth. The confidence intervals for the estimated annual rate of change range from an increase of 0.07%/year to an increase of 9.75 %/year.
- **Overall Confidence:** High

Reviewer Comments:

1. I don't really know what this means: "from an increase of 0.07%/year to an increase of 9.75 %/year." I would provide the 95% CI for the slope of the regression line, which is (0.55 – 1.149). The 95% CI does not overlap 0, and therefore, the p-value will be less than 0.05 (in fact it is 0.0000056.)

2.1.4 Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Reviewer Comments: Yes

2.2 Threshold Status Determination – Wintering Bald Eagle Population Sites

2.2.1 Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

Reviewer Comments: See my specific comments and suggestions, above. Like the other Bald Eagle threshold evaluation, I would focus on the statistical interpretation of the trend-line analysis (i.e., simple linear regression of bald eagle nests through time). I would simplify the current method and use simple linear regression, because there was no evidence of lack of fit of that model.

2.2.2 Would you recommend a different method of evaluating indicator status or trend?

Reviewer Comments: See my specific comments and suggestions, above. I would focus on the statistical interpretation of the trend-line analysis (i.e., simple linear regression of winter

bald eagle counts through time). If the slope, and 95% confidence intervals of eagle counts through time are all positive, trend is increasing. If the confidence interval for the slope overlaps zero, there is uncertainty in the trend. If the slope, and 95% confidence intervals of eagle nests through time are all negative, trend is decreasing. This all assumes none of the assumptions of simple linear regression are violated.

Additional Comments or Feedback

None

3 Deer Disturbance-Free Zone

3.1 General Presentation for Deer Distrubance-Free Zone

3.1.1 Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

The Key Points are:

- Disturbance-free zones protect important sites that are used by special interest species by restricting habitat manipulations or other activities that would degrade the condition of habitat within the site.
- The zones are areas where activities that would disturb the species are minimized.
- All of the listed disturbance-free zone standards have been implemented by TRPA and other partner agencies.

Reviewer Comments:

1. **Minor Comment:** Combine the first two key points into the following single key point: "Disturbance-free zones protect important sites for special interest species by minimizing activities that could disrupt the species or degrade habitat quality through habitat alterations or other disturbances."
2. Can you list the total acreage designated as "disturbance free zones"?

3.1.2 Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

The Rationale Details are:

- **Management Status Rationale**: The TRPA Regional Plan, Goals and Policies, sub-section WL-2.1 provides protections for endangered, threatened, rare, and special interest species.
- TRPA Code of Ordinances section 62.3.2.B states that projects and activities in the vicinity of deer migration areas shall be required to mitigate or avoid significant adverse impacts. The location of deer migration areas shall be verified by the appropriate state wildlife or fish and game agencies. And, Code of Ordinance section 62.3.3.B states that no project or activity shall threaten, damage, or destroy nesting habitat of raptors and waterfowl or fawning habitat of deer.

Reviewer Comments:

1. The rationale details for this threshold standard is very different than the eagles. This seems to describe sections of plans, and less about data analysis.

3.1.3 Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

There was no section "Confidence Details"

3.1.4 Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Reviewer Comments: Yes

3.2 Threshold Status Determination – Deer Disturbance-Free Zone

3.2.1 Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

Reviewer Comments: The only analytic method I saw was " Specific influence areas are mapped for wintering bald eagle, **deer**, and waterfowl..." It is not clear how these were mapped.

3.2.2 Would you recommend a different method of evaluating indicator status or trend?

Reviewer Comments:It is really unclear what is happening here. I think this section needs more detail on what the indicator status and trends are.

Additional Comments or Feedback

- This information in the description doesn't mean much to people unfamiliar with the deer herds: "Portions of deer from the Verdi sub-unit of the Loyalton-Truckee herd and the Carson River herd." Is there a better way to describe what you're talking about? A different map?
- On this comment in the description: "While TRPA does not permit projects that would reduce the availability of fawning habitat" How do you know what fawning habitat is?
- You probably need a citation for this statement in the description: "populations are mostly affected by the loss of wintering habitat outside the region." How do you know this is true?
- I'm really not sure how any any of the Disturbance-Free zones were selected and managed.

4 Golden Eagle Population Sites

4.1 General Presentation for Golden Eagle Population Sites

4.1.1 Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

The Key Points are:

- Four disturbance free zones have been identified for golden eagle protection in the Region. The sites were identified based on historic nest locations in the region. TRPA Disturbance Zone Map
- Recent research suggests that the estimated population in coterminous western U.S. is 31,800. That research also suggests that the population has been stable for multiple decades (Millsap et. al 2022). The estimate is consistent with earlier US Fish and Wildlife Service estimates (US FWS 2016).
- Two research grade iNaturalist observations were recorded in the region during the evaluation period, including one in which the notes suggested mating behavior.
  - https://www.inaturalist.org/observations/70463014
  - https://www.inaturalist.org/observations/194697704

Reviewer Comments:

1. As a Key Point, I might note that there aren't currently any surveys targeted at golden eagle monitoring, and thus, there is limited data on the population status.

4.1.2 Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

The Rationale Details are:

- **Status Rationale**– As a result of limited monitored resources, no in-basin population surveys have been conducted [for] golden eagle[s] since 2010.
- **Trend Rationale**– Low. No status determination has been made because of the limited survey data.

Reviewer Comments:

1. It is a reasonable explanation, given that no surveys were conducted. Note the typo in the text.

4.1.3 Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

Yes, there is Low confidence because no surveys were conducted.

4.1.4 Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Reviewer Comments: Yes

4.2 Threshold Status Determination – Golden Eagle Population Sites

4.2.1 Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

Reviewer Comments: N/A

4.2.2 Would you recommend a different method of evaluating indicator status or trend?

Reviewer Comments:N/A

Additional Comments or Feedback

- Consider dropping this as a threshold indicator is there isn't funding to support monitoring?

5 American ~~Northern~~ Goshawk Population Sites

Note: In 2023, the American Ornithological Society reclassified the Northern Goshawk, which was found in both North America and Eurasia, into two distinct species: the American Goshawk and the Eurasian Goshawk. I do not know the full story behind this decision, but found information on it during my review so wanted to point it out.

5.1 General Presentation for American Goshawk Population Sites

5.1.1 Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

The Key Points are:

- The USDA Forest Service conducts project based goshawk monitoring leading up to their fuels reduction projects. This effort does not qualify as a comprehensive population study, so the current population status is unknown.
- Monitoring of northern goshawk populations has varied widely over the years from intensive to minimal due to budget and staffing limits. Therefore, trends in the population are unknown.
- Based on the number of active territories observed in a partial Tahoe Region survey in 2019, it is likely that a full Tahoe Region survey would show more active territories than the TRPA threshold standard.
- More than 30 territories have been mapped throughout the Tahoe Region. The disturbance zone standard for northern goshawk population sites has been implemented by TRPA and other partner agencies.

Reviewer Comments:

1. What does "project-based goshawk monitoring" mean? Maybe something along the lines of "The USDA Forest Service monitors goshawks in advance of their fuels reduction projects. The survey design for American Goshawks is opportunistic and was not developed to assess or estimate population size or status."
2. Consider "Monitoring efforts for northern goshawk populations have fluctuated significantly over time, ranging from intensive to minimal, largely driven by budgetary and staffing constraints. As a result, reliable estimates of population trends are unavailable".
3. Consider "Based on the number of active territories recorded during a partial survey of the Tahoe Region in 2019, a more comprehensive survey might reveal more active territories, meeting or exceeding the the TRPA threshold standard." However, this is speculative. Yes it's possible, but we don't know.

4. Consider "Over 30 northern goshawk territories have been mapped across the Tahoe Region. The TRPA, in collaboration with partner agencies, has implemented a disturbance zone standard to protect these population sites."

5.1.2 Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

The Rationale Details are:

- **Status Rationale:** Monitoring for the species focuses on preventing project impacts (threshold implementation), rather than determining regional population (threshold assessment). Survey efforts and search geography are highly variable from year to year and driven by the location of proposed forest health treatments. The last regional population survey was completed more than 10 years ago and identified 10 active nests, relative to the threshold standard target of 12. The current status relative to the threshold is unknown.
- **Trend Rationale:** Trend was not analyzed because monitoring effort has been inconsistent through the years and has focused on project-level impacts as opposed to population monitoring.

Reviewer Comments:

1. Consider "Monitoring efforts for the species are primarily aimed at mitigating project impacts (threshold implementation) rather than assessing the overall regional population (threshold assessment). Survey effort and spatial coverage vary considerably from year to year, largely influenced by the geographic location of proposed forest health treatments. The most recent regional population survey, conducted over a decade ago, documented 10 active nests, compared to the threshold standard target of 12. The current population status relative to this threshold remains unknown."

2. Consider "Population trend analysis has not been conducted due to inconsistent monitoring efforts over the years, which have primarily focused on assessing project-level impacts rather than comprehensive population monitoring. This inconsistency in data collection undermines the reliability of population assessments, as it prevents the establishment of a robust dataset necessary for detecting meaningful population trends."

5.1.3 Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

Yes.

5.1.4 Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Reviewer Comments: Yes

5.2 Threshold Status Determination – Golden Eagle Population Sites

5.2.1 Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

Reviewer Comments: No. It is clearly indicated throughout the document that the opportunistic sampling is not suitable for estimating population size, or even an index of population size, given the unequal sampling effort across space and time.

5.2.2 Would you recommend a different method of evaluating indicator status or trend?

Reviewer Comments: There are many different surveys I could recommend if resources and funding was available to implement them.

Additional Comments or Feedback

- Add a citation for the statement: "The species is a top predator, requires large areas of mature to old-growth forest with multiple stories and a high canopy cover, and has low breeding densities."

6 Osprey Population Sites

6.1 General Presentation for Osprey Population Sites

6.1.1 Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

The Key Points are:

- The osprey population has increased substantially since the early 1980's when only a few nests were active in the Tahoe Basin.
- In the last five years, the number of active nests has varied but remains stable.
- The shoreline from Emerald Bay to DL Bliss State Park and the undeveloped portions of the East Shore are the main reproductive areas for osprey.
- The disturbance zone standard for osprey has been implemented by TRPA and other partner agencies.
- Potential disturbances such as new trails and forest fuels reduction projects are adjusted to protect nesting osprey.

Reviewer Comments: Consider the following minor edits to the key points:

- The osprey population in the Tahoe Basin has experienced significant growth since the early 1980s, when only a few nests were active.
- Over the past five years, the number of active nests has fluctuated but has remained stable overall. In 1993 there were 20.17 expected nests. The number of expected nests has increased 0.27 nests per year between 1993 and 2023. The 95% confidence interval for the increased number of nests was (0.08–0.45).
- Key reproductive areas for osprey include the shoreline from Emerald Bay to DL Bliss State Park, as well as the undeveloped sections of the East Shore.
- The TRPA, along with partner agencies, has established a disturbance zone standard to safeguard osprey nesting sites.
- To protect nesting osprey, potential disturbances from new trails and forest fuel reduction projects are carefully managed and adjusted as necessary.

6.1.2 Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

The Rationale Details are:

- **Status Rationale:** Status is based on the number of active nests in the most recent year monitoring was completed. 21 active nests were present in 2023, 525% of the target. Therefore, the current status is considerably better than target.
- **Trend Rationale:** Population trend was estimated using an EGPN (exponential growth process noise) model (Humbert et al. 2009). Process noise refers to differences in observed population abundance that result from environmental variability. From 1997-2023, the annual growth in the osprey population is estimated to be 2.2%.

Reviewer Comments:

1. Similar to my recommendation for Bald Eagles, I would focus on simple linear regression. I fit the simple linear regression model for osprey nest counts from 1997–2023. The results indicate an expected nest count of 20.16 nests in 1997, with an increase of 0.27 nests per year through 2023 (Fig. 3. This indicates a 1.32% increase per year and a 35% increase over the course of the study (1997–2023).

6.1.3 Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

The Confidence details state "Moderate. The estimated growth is likely positive, but the 95% confidence interval includes the possibility of population decline. The confidence intervals for the estimated annual rate of change range from a decline of 2.2%/year to an increase of 6.7 %/year. Therefore, the trend is determined to be moderate improvement."

In my analysis using simple linear regression, the 95% confidence does not overlap 0, indicating higher confidence of the increasing trend. Specifically, the 95% confidence interval of the slope for number of nests is (0.08 – 0.45), which does not include 0. I would state high confidence for the increasing trend.

6.1.4 Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Reviewer Comments: Yes

6.2 Threshold Status Determination – Osprey Population Sites

6.2.1 Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

Reviewer Comments: I would use simple linear regression. It is easy to implement, interpret, understand, and widely acceptable for data like these. I found no egregious violations of the

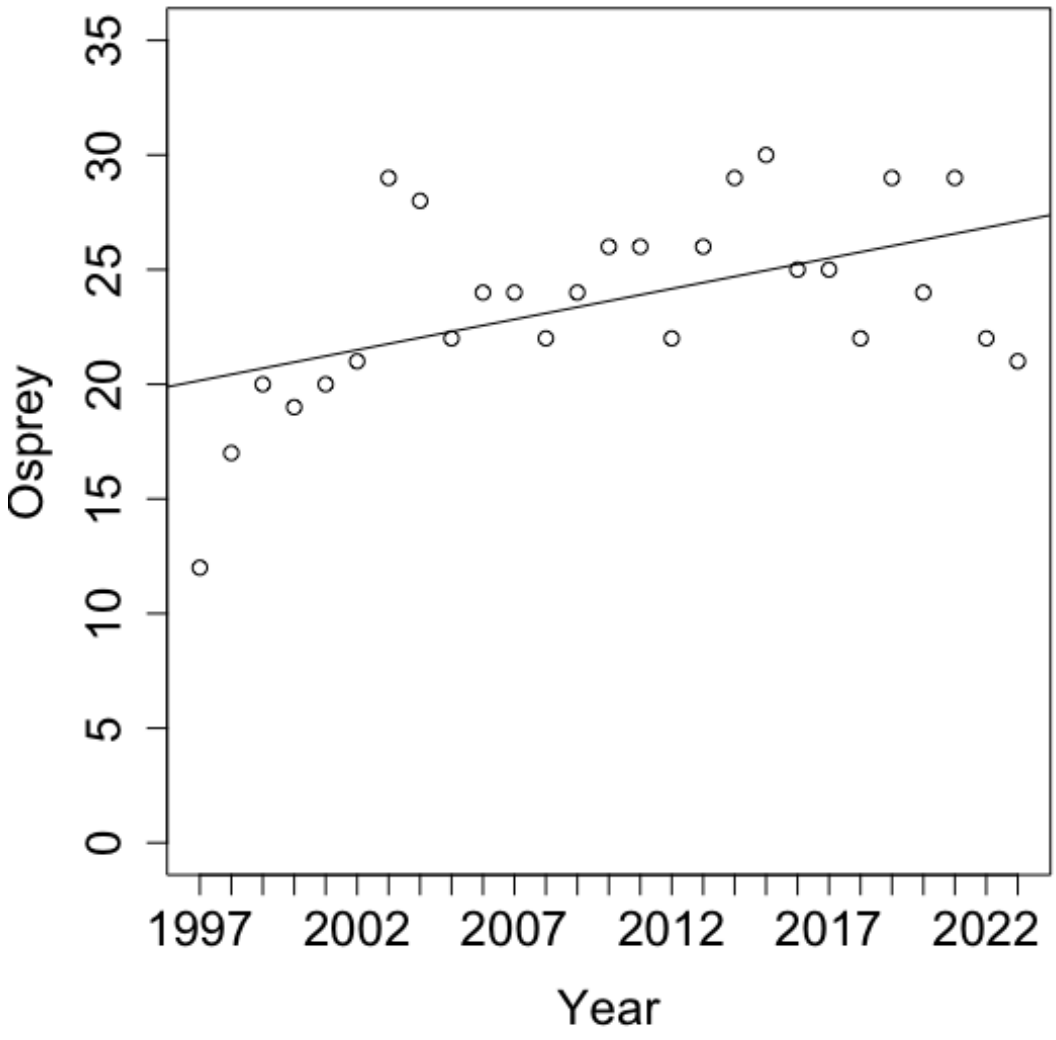

Figure 3: Number of osprey nests counted through time and trendline from simple linear regression.

assumptions when i fit the simple linear regression model.

6.2.2 Would you recommend a different method of evaluating indicator status or trend?

Reviewer Comments: See previous comment. Yes. I would use simple linear regression. I have included code for this analysis.

Additional Comments or Feedback

- Add citations for all the following statements: "Human disturbance near nesting and foraging areas can impact osprey breeding success. Osprey may be able to habituate to human activity depending on the timing, type, and consistency of the activity. Osprey populations could be limited by the number of large nest trees near water and open areas or competition with bald eagles or other species. However, given the limited number of bald eagles present during the breeding season, and the existing protections for large trees, these are not likely to be major limiting factors in the basin. Osprey that breed in the basin likely migrate to Central or South America for the winter. Osprey breeding in the basin may be affected by a variety of factors in their wintering areas or along migration routes, including contamination from organochlorines (e.g. DDT), which is still used in parts of their wintering grounds."
- I think some details about the survey design are warranted, especially because other indicator thresholds go into detail about how appropriate survey designs were not used.

7 Peregrine Falcon Population Sites

7.1 General Presentation for Peregrine Falcon Population Sites

7.1.1 Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

The Key Points are:

- Peregrine falcons have made a remarkable recovery in the Tahoe Region since they first reappeared in 2009.
- Number of active nests varies annually but remains stable.
- Years of monitoring at the Castle Rock nesting site revealed impacts from hikers resulting in nest failures. Multiple Environmental Improvement Program partners worked together to discourage hiking and climbing near the nest site during the nesting period. Due to this effort, the Castle Rock nest has been successful since 2019.
- The disturbance zone standard for Peregrine falcons has been implemented by TRPA and other partner agencies.

Reviewer Comments: Consider the following minor edits to the key points:

- Since their reappearance in 2009, Peregrine falcons have made a remarkable recovery in the Tahoe Region.
- The expected number of peregrine falcon nests in 2009 was 1.4 (intercept of regression line). The expected number of peregrine falcon nests has increased at a rate of 0.29 nests per year (slope of regression line). The 95% confidence interval on the slope is (0.19–0.38), indicating strong evidence for an increasing number of nests through time.
- The number of active nests varies annually but remains relatively stable.
- Monitoring efforts at the Castle Rock nesting site have revealed that hiker disturbances have led to nest failures. In response, multiple partners from the Environmental Improvement Program collaborated to discourage hiking and climbing near the nest site during the nesting season. As a result of these efforts, the Castle Rock nest has successfully fledged young since 2019.
- The TRPA, along with partner agencies, has implemented a disturbance zone standard to protect Peregrine falcon nesting sites.

7.1.2 Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

The Rationale Details are:

- **Status Rationale:** Current status is determined by the number of active nests in the most recent monitoring year. In 2023, there were four active nests, which is 200% of the standard. Therefore, the current status is considerably better than target. **Trend Rationale:** Population trend was estimated using an EGPN (exponential growth process noise) model (Humbert et al. 2009). Process noise refers to differences in observed population abundance that result from environmental variability. From 1997-2023, there has been an annual 10.4% growth in the peregrine falcon population. Therefore, the trend is determined to be rapid improvement.

Reviewer Comments:

1. I would just use simple linear regression. It is not clear what the added benefits of the more complex model are. I found no egregious violation of the assumptions of simple linear regression.

2. If you use simple linear regression, the estimate is 306% larger for the whole study, and 20.4% increase per year.

3. The 95% confidence intervals are 0.19–0.38) and do not overlap 0 indicating strong evidence of a positive increase in nesting by Peregrine Falcons.

7.1.3 Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

I argue that the confidence of trend should be high for the reasons pointed out above (95% CI that does not overlap 0).

7.1.4 Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Reviewer Comments: Yes

7.2 Threshold Status Determination – Peregrine Falcon Population Sites

7.2.1 Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

Reviewer Comments: I would use simple linear regression.

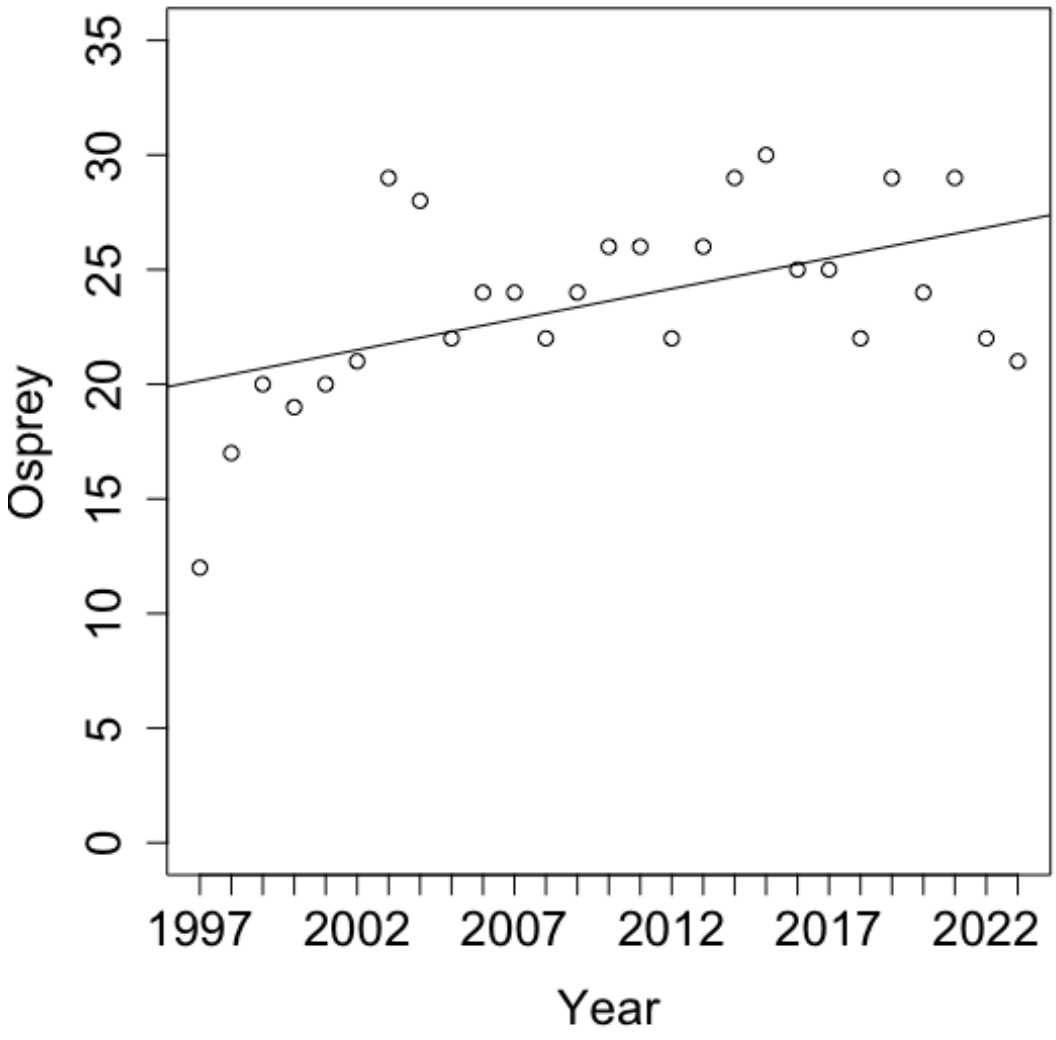

Figure 4: Number of osprey nests counted through time and trendline from simple linear regression.

7.2.2 Would you recommend a different method of evaluating indicator status or trend?

Reviewer Comments: I would use simple linear regression.

Additional Comments or Feedback

- For Peregrine Falcons, care is taken to cite sources in the "About the Threshold" section. The same care should be used for the other species (e.g., osprey and American Goshawk) to match this.

8 Waterfowl Population Sites

8.1 General Presentation for Waterfowl Population Sites

8.1.1 Does the "Key Points" section summarize the most important points that emerge from the data presented? Are the "Key Points" supported by the data and analysis presented?

The Key Points are:

- Eighteen designated waterfowl sites are mapped and none have been altered by development.
- Increases in recreation impacts are leading to greater disturbances at waterfowl sites.
- Several agencies have completed projects to reduce impacts from recreation through fencing and seasonal closures.
- The disturbance zone standard for waterfowl sites has been implemented by TRPA and other partner agencies.

Reviewer Comments: The key points seem fine, given the objectives. I do not think, however, that analyzing whether the site has been developed is a good measure of quality. A lot can go wrong with the site even if it hasn't been developed. I would reconsider this as a threshold indicator.

8.1.2 Does the "Rationale Details" section provide a reasonable explanation of how the standard was evaluated and the status determination was made?

The Rationale Details are:

- **Status Rationale:** The current status of waterfowl population sites was determined by analyzing whether the site has been developed and the current human activity impacts. No waterfowl population sites have been lost. Therefore, the current status is at or somewhat better than target.
- **Trend Rationale** Trend is determined by comparing the number of existing sites through the years and comparing human activity rating scores. Little or no change has been observed.

Reviewer Comments:

1. The descriptions are fine, but I don't think the threshold indicator is a good one. Like I mentioned above, a lot can go wrong with sites even if they haven't been developed.

8.1.3 Does the "Confidence Details" discussion explain how the confidence determination was made? Is the determination reasonably supported by the information presented?

The Confidence details does discuss how the confidence determination was made. It is reasonably supported by the information presented.

8.1.4 Does the "Delivering and Measuring Success" section provide links to relevant projects that would contribute to standard attainment and the monitoring programs and metrics used to measure progress?

Reviewer Comments: Yes

8.2 Threshold Status Determination – Waterfowl Population Sites

8.2.1 Are the analytical methods appropriately applied to determine the indicator's status, trend, and confidence?

Reviewer Comments: There are no analytic methods except whether the site was developed or not.

8.2.2 Would you recommend a different method of evaluating indicator status or trend?

Reviewer Comments: I would assess population size or habitat quality instead of whether the sites were developed or not.

Thank you for the opportunity to review the 2023 Indicator Evaluation Pages. I hope that my feedback contributes to the improvement of TRPA's analysis and presentation of this important information. Please do not hesitate to reach out if further clarification is needed.

Sincerely,
Perry Williams, PhD
Associate Professor
Department of Natural Resources and Environmental Science
University of Nevada, Reno

9 Code Used For Statistical Analysis

```r
# Clear the workspace
rm(list=ls())

### Bald Eagle Nests Analysis ###

# Define the number of bald eagle nests for each year
nests = c(1, 1, 1, 1, 2, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 3, 3,
   2, 1, 2, 1, 1, 3, 3, 3, 4)
# Define the years corresponding to the nests data
year_nests = 1996:2023 - 1996

# Fit a linear model to the data
model_nests = lm(nests ~ year_nests)

# Output the summary and confidence intervals of the model
summary(model_nests)
confint(model_nests)

# Plot the data and regression line
plot(year_nests, nests,
     ylab = "Number of Nests",
     xlab = "Year",
     main = "Bald Eagle Nests Over Time",
     pch = 16,
     cex.axis = 1.5,
     cex.lab = 1.5,
     cex.main = 1.5)

# Add regression line to the plot
abline(model_nests)

### Wintering Bald Eagle Counts Analysis ###

# Define the number of wintering bald eagles for each year
winter_eagles = c(7, 12, 8, 15, 14, 10, 12, 18, 7, 6, 11, 16, 9, 17,
    11, 15, 21, 25, 24, 27, 22, 19, 24, 42, 31, 21)
# Define the years corresponding to the winter eagles data
year_winter = 1998:2023 - 1998

# Fit a linear model to the winter eagle data
model_winter = lm(winter_eagles ~ year_winter)

# Output the summary of the model
summary(model_winter)

```

```r
# Plot the data and regression line
plot(year_winter, winter_eagles,
     ylab = "Number of Eagles",
     xlab = "Year",
     pch = 16,
     main = "Wintering Bald Eagle Counts Over Time",
     cex.axis = 1.5,
     cex.lab = 1.5,
     cex.main = 1.5,
     xaxt = "n")  # Suppress default x-axis

# Add custom x-axis labels from 1998 to 2023
axis(1, at = seq(0, 25, by = 1), labels = seq(1998, 2023, by = 1),
   cex.axis = 1.5)

# Add regression line to the plot
abline(model_winter)

### Osprey Counts Analysis ###

# Define the number of osprey for each year
osprey_counts = c(12, 17, 20, 19, 20, 21, 29, 28, 22, 24, 24, 22,
   24, 26, 26, 22, 26, 29, 30, 25, 25, 22, 29, 24, 29, 22, 21)
# Define the years corresponding to the osprey data
year_osprey = 1997:2023 - 1997

# Fit a linear model to the osprey data
model_osprey = lm(osprey_counts ~ year_osprey)

# Output the summary of the model
summary(model_osprey)

# Plot the data and regression line
plot(year_osprey, osprey_counts, ylim = c(0, 35),
     ylab = "Number of Ospreys",
     xlab = "Year",
     main = "Osprey Counts Over Time",
     cex.axis = 1.5,
     cex.lab = 1.5,
     cex.main = 1.5,
     xaxt = "n")

# Add custom x-axis labels from 1997 to 2023
axis(1, at = seq(0, 26, by = 1), labels = seq(1997, 2023, by = 1),
   cex.axis = 1.5)

# Add regression line to the plot
```

```r
abline(model_osprey)

### Peregrine Falcon Counts Analysis ###

# Define the number of peregrine falcons for each year
peregrine_counts = c(1, 1, 2, 2, 2, 3, 4, 4, 4, 5, 5, 5, 4, 5, 4)
# Define the years corresponding to the peregrine data
year_peregrine = 2009:2023 - 2009

# Fit a linear model to the peregrine data
model_peregrine = lm(peregrine_counts ~ year_peregrine)

# Output the summary and confidence intervals of the model
summary(model_peregrine)
confint(model_peregrine)

# Plot the data and regression line
plot(year_peregrine, peregrine_counts, ylim = c(0, 10),
     ylab = "Number of Peregrine Falcons",
     xlab = "Year",
     main = "Peregrine Falcon Counts Over Time",
     cex.axis = 1.5,
     cex.lab = 1.5,
     cex.main = 1.5,
     xaxt = "n")

# Add custom x-axis labels from 2009 to 2023
axis(1, at = seq(0, length(peregrine_counts) - 1, by = 1), labels =
   seq(2009, 2023, by = 1), cex.axis = 1.5)

# Calculate the percentage increase from the initial to the last
   year
percentage_increase = (coef(model_peregrine)[1] + coef(model_
   peregrine)[2] * length(year_peregrine) - coef(model_peregrine)
   [1]) / coef(model_peregrine)[1] * 100
percentage_increase
```

Listing 1: R Code for Bald Eagle, Osprey, and Peregrine Falcon Analysis