

Lake Tahoe Region Aquatic Invasive Species Action Agenda 2021–2030

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Executive Summary

The Lake Tahoe Region Aquatic Invasive Species (AIS) Management Plan (2014) and Implementation Plan for the Control of Aquatic Invasive Species within Lake Tahoe (2015) document the substantial negative changes occurring to Lake Tahoe as a result of the introduction and expansion of aquatic invasive species (AIS).

To address this issue, the California Tahoe Conservancy initiated an effort in 2018 to support the development of short- and long-term management targets and a set of specific actions to control AIS in the Lake Tahoe Region. The Conservancy contracted with Creative Resource Strategies, LLC to conduct a regional stakeholder survey and interviews, and then work with the Lake Tahoe AIS Coordinating Committee to develop a 10-year Action Agenda and complementary Investment Strategy.

Results of the Lake Tahoe Region stakeholder survey and interviews validated support for a comprehensive and aggressive AIS program, the projection that it will take 5–10 years to achieve AIS goals in the Region, the reality that a full complement of control methods will likely be needed to achieve AIS goals, and recognition that everyone has a role to play in monitoring, detecting, controlling, and funding AIS efforts.

This Action Agenda proposes to implement a well-funded, comprehensive, robust, simultaneous, science-based, and aggressive suite of aquatic invasive species (AIS) actions through the next decade to reduce the economic, environmental, and social effects of AIS in the Lake Tahoe Region.

The Agenda describes a 10-year (2021–2030) two-phased effort. Phase 1 (2021–2025) aggressively treats and controls AIS throughout the Region for five consecutive years while containing AIS and completing environmental documents and AIS control testing specific to the Tahoe Keys. Phase II (2026–2030) focuses efforts on reducing aquatic invasive plants and invasive fish in the Tahoe Keys (implementing the outcomes of the environmental assessment and testing processes occurring through 2025), while continuing to maintain, reduce, or when possible, eradicate AIS in other parts of the Lake Tahoe Region such that they minimize detrimental effects to ecosystem function.

The Action Agenda describes four potential implementation options, with varying levels of pace, scale, and cost, to address AIS in the Region. The recommended Option A proposes a 272% increase in pace and scale relative to current efforts, would cost \$74 million through 10 years, or \$7.4 million annually, and is predicted to achieve the greatest return on investment,

maximize benefits to ecosystem services, and minimize risk and degradation to fish and wildlife habitats in the Region. Implementing Option A would result in a predicted:

- 90% reduction to eradication of AI plants in nearshore and upstream areas and the Tahoe Keys;
- 90% reduction in invasive fish biomass in priority areas;
- Reductions of aquatic invasive invertebrates and amphibians in regions of the lake and upstream areas;
- Support for effective Early Detection Rapid Response actions through the creation of an emergency invasive species fund;
- Newly developed detection and monitoring tools;
- Comprehensive nearshore-wide and in situ diver survey and drone transects;
- Strategic investment in new technologies and methodologies to control aquatic invasive species;
- A bi-annual high-risk invasive species assessment;
- Investment in a marina engagement strategy;
- Expanded administrative staff capacity to implement increased pace and scale activities; and
- Enhanced likelihood of recovering the Endangered Species Act-listed Lahontan Cutthroat Trout.

Lake Tahoe is a designated Outstanding National Resource Water. Extreme climatic and hydrologic events, which are becoming more common in the Lake Tahoe Region, are predicted to enhance the negative effects of invasive species on native species and create new niches for invasive species introductions in and around the lake. Climate change effects, the three million people that visit the Lake Tahoe Region annually, and AIS amplify existing and predicted stressors on Lake Tahoe aquatic ecosystems. Enhancing the resilience of these systems to these and other stressors will mitigate detrimental effects to ecosystems, the local economy, and the public, which benefits from the suite of beneficial services the Region provides.

The time is now to implement this Action Agenda to reduce the distribution and abundance of AIS in the Lake Tahoe Region by aggressively treating established and new AIS populations simultaneously and with unprecedented effort. With adequate resources and continued cooperation, collaboration, and innovation, Lake Tahoe regional entities will be successful in protecting, enhancing, and restoring the full suite of beneficial services the Region provides.

Background and Purpose

The *Lake Tahoe Region Aquatic Invasive Species Management Plan* (2014) and *Implementation Plan for the Control of Aquatic Invasive Species within Lake Tahoe* (Wittman and Chandra 2015) include goals, priority locations, and priority species for management of aquatic invasive species (AIS) in the Lake Tahoe Region. These plans provide a solid platform for developing this Action Agenda—a framework that defines:

1. A suite of outcome-based measurable performance metrics that assess progress in managing AIS through time;
2. Refined strategies and actions to address existing and emerging AIS issues in the Region, particularly in the context of increasing climate change stressors;
3. Research and technology needed to address complex AIS management challenges and the unique life histories of Lake Tahoe Region AIS;
4. Adequate and comprehensive monitoring to accurately assess the distribution and abundance of AIS in the Region;
5. The need to monitor and maintain sites previously treated for AIS in perpetuity to ensure these sites remain free from future AIS invasions;
6. Timelines for implementation;
7. The operational and staffing resources needed to achieve AIS management goals from 2021–2030; and
8. Potential sources of funding to support the Agenda as well as the permits likely needed to fully implement this Agenda.

This Agenda builds on the accomplishments to date in controlling and managing AIS in the Region. It differs from past efforts in that it recommends a significant increase in both pace and scale to address existing and emerging AIS issues.

This Agenda focuses on reducing biomass of AIS in priority locations and suppressing the spread of AIS in the Region by aggressively treating established and new introductions of AIS populations simultaneously and with unprecedented effort. Systematic and strategic control using this approach will best inform the potential for AIS eradication in the Region (Wittman and Chandra 2015).

The Lake Tahoe AIS Coordinating Committee (LTAISCC) was foundational to developing this plan, and will play an instrumental role in its implementation and in protecting and enhancing the biological integrity of Lake Tahoe’s natural resources.

Regional Collaboration

The *Lake Tahoe Region Aquatic Invasive Species Management Plan* (2014) describes the authorities and programs that exist to limit the introduction and spread of AIS in the Region.

The Tahoe Regional Planning Agency (TRPA) is the primary lead for aquatic invasive species efforts. The agency operates under the authority of the states of California and Nevada as well as the federal government via the Bi-State Compact. The TRPA implements Lake Tahoe protection and restoration strategies via the Environmental Improvement Program (EIP) and regulatory program, and serves as the fiscal agent for funds associated with implementing the Management Plan.

The Tahoe Resource Conservation District (RCD) promotes the conservation, stewardship, and knowledge of Lake Tahoe Region's natural resources by providing leadership and innovative environmental services to all stakeholders. Tahoe RCD chairs the Nearshore Aquatic Weed Working Group (NAWWG) of the LTAISCC, which was formed to address the threat of aquatic plant infestations and accompanying degradations in the Lake Tahoe Region.

The Tahoe RCD and TRPA are co-chairs of the LTAISCC. The LTAISCC is a bi-state collaborative that provides direction for implementation of AIS issues in the Region, and is composed of 40 public, private, and other stakeholders. This committee collaborates on prevention, control, and early detection of AIS. The LTAISCC shares resources and information, standardizes methods for treatment and data collection, performs coordinated education and outreach activities, obtains grants, prioritizes projects, and organizes effective control efforts.

LTAISCC organizations play a role in implementing a comprehensive AIS program in the Region, including outreach and education, prevention, monitoring, and control projects. For example, land management agencies, such as the US Forest Service and California Department of Parks and Recreation, have implemented AIS control projects on lands they manage. *Eyes on the Lake*, a volunteer citizen science program that helps to prevent the spread of AIS in Lake Tahoe and surrounding waters, is led by the League to Save Lake Tahoe. Through continued cooperation and collaboration, agencies, nonprofit organizations, and the private sector can leverage resources and mutual interests to protect, enhance, and restore the full suite of ecosystem services the Lake Tahoe Region provides.

Protecting Lake Tahoe

Science advisors to the Region note that although there have been changes to Lake Tahoe’s biological communities through time, the potential exists to restore and enhance the biological integrity¹ of Lake Tahoe by enhancing lake habitat associated with fish and wildlife movement corridors (Environmental Improvement Program Focus Area 01-Watersheds, Habitat, and Water Quality).

Extreme climatic and hydrologic events are predicted to become more common in the Region, and the basin is predicted to become considerably warmer in the future (UC Davis 2018). These types of changes are predicted to enhance the competitive and predatory effects of invasive species on native species (Rahel and Olden 2008).

Failure to implement a well-funded, comprehensive, robust, simultaneous, and aggressive suite of AIS control actions through 2030 will lessen chances of eradicating and controlling AIS populations, significantly increase containment and maintenance control projects, detrimentally impact the ecological function of Lake Tahoe and its associated habitats, interject uncertainties into the Lake Tahoe Region economy, and negatively affect the quality of experiences of residents and visitors that value the suite of ecosystem services the Region provides. In addition, failure to aggressively manage and control AIS will make it more difficult to recover populations of federally listed Lahontan Cutthroat Trout, which are threatened under the Endangered Species Act. Lake Tahoe is essential to the recovery of this species, especially for cold water refugia under climate change conditions. Lastly, failure to make significant investments in assessing, monitoring, and controlling existing AIS as well as planning for potential introductions of new invaders, will significantly increase long-term costs to address AIS in the Region.

1 Biological integrity is the ability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region (SNEP 1996).

Action Agenda Context

This plan serves as the third plan in a trilogy of documents associated with AIS management in the Lake Tahoe Region. The *Lake Tahoe Region Aquatic Invasive Species Management Plan* (2014), the first in the trilogy of documents, articulated a suite of overarching goals that remain valid for this Agenda:

- Prevent new introductions of AIS to the Region.
- Limit the spread of existing AIS populations in the Region by employing strategies that minimize threats to native species, and extirpate existing AIS populations when possible.
- Abate harmful ecological, economic, social, and public health impacts resulting from AIS.

The Management Plan described four objectives the LTAISCC developed to meet these three goals, including oversight and internal coordination; prevention; monitoring, detection, and response; and long-term control. Appendix C in the Management Plan further described a suite of short- and long-term strategies and actions to achieve objectives.

The *Implementation Plan for the Control of Aquatic Invasive Species within Lake Tahoe* (Wittman and Chandra 2015), the second in the trilogy of AIS planning documents, focused on implementing control efforts, specifically targeting species selection, site selection, and prioritization of species.

This Action Agenda, the third AIS document in the trilogy, seeks to expand on the foundations created by the Management and Implementation Plans by describing the increase in pace and scale recommended to implement an all-taxa approach to aquatic invasive species in the region. This Agenda incorporates the target species identified in the Implementation Plan, re-prioritizes treatment sites based on emerging information and control work implemented to date, establishes new performance metrics to assess success (to supplement existing effort-based objectives), and identifies the resources needed, on an annual basis, to achieve a comprehensive, all-taxa approach to addressing AIS in the region, as described in all three documents.

Definition of Success

This Action Agenda is intended to be informed by a survey of, and interviews with, Lake Tahoe stakeholders in 2019 (Appendices A and B), which included questions about how respondents would define success as it relates to AIS control in the Region. Survey recipients described a realistic 5 to 10-year timeline for AIS control in the areas of management, prevention, control, monitoring, funding, permitting, research, and public support/buy-in/outreach (Appendix B). Although this Agenda is focused on control efforts, it is critical to understand that all aspects of a comprehensive AIS program, such as the watercraft inspection and decontamination program, and *Eyes on the Lake*, an intensive volunteer effort to monitor for new or spreading invaders, are interrelated and integral to success.

Stakeholders articulated the following definitions of success as it relates to AIS in the Region:

- **Prevention**

No new introductions or detections of currently established species in new areas (expressed in acres), a strong prevention and detection program, public education and outreach (demonstrate an increase in number of people reached), enhanced collaboration and coordination and new partnerships, enhanced quality control on rental boats and boats in marina slips (e.g., monthly inspections), removal of nutrients from nearshore, and establishment of a permanent lake-wide AIS Action Team comprised of experts in AIS management that implements an integrated program funded by a property tax, sales tax, and rooms tax.

The three prevention-related metrics included in the Lake Tahoe invasive species results chain align with the goals of the *Lake Tahoe Region Aquatic Invasive Species Management Plan* (2014) and *Implementation Plan for the Control of Aquatic Invasive Species within Lake Tahoe* (Wittman and Chandra 2015):

- Prevention of new introductions of invasive species;
- Containment or eradication of new invaders; and
- Control or eradication of established invasive species.

- **Control**

- Tahoe Keys: 80%–100% reduction in invasive plants; improved water clarity
- Reduce (decrease in number of sites needing annual maintenance and trend of decreasing infestation acreage), or completely eradicate priority AIS plant infestations in priority locations.
- Use new and emerging technologies to control AIS.

- Eliminate, decrease, reduce, or contain to specific areas (e.g., eradication of Curly-leaf Pondweed) major plant infestations and invasive fish populations.
 - Decrease AIS along Lake Tahoe’s shoreline.
 - Reduce the density and acreage of AIS infestations; contain existing weed populations.
 - Incorporate climate change considerations in control efforts.
 - Implement an integrated management program that includes all proven methods to achieve goals.
- **Research**
Develop a cost-effective method to reduce Asian clams as well as tools to address infestations (including new strategies and knowledge of species).
 - **Early Detection Rapid Response**
Implement *Eyes on the Lake*.
 - **Funding**
Identify new funding sources for a lake-wide program and dedicated sources of funding for control, monitoring, surveys, and research.
 - **Monitoring**
Conduct lake-wide monitoring to identify new/expanding AIS populations.

Addressing Key Gaps and Challenges

Implementation of this comprehensive regional plan requires the following strategies to address key gaps and challenges:

- **Coordination and Collaboration**
 - Continued coordinated, science-based, inter-jurisdictional efforts by the LTAISCC to address the highest aquatic invasive species priorities in the Region.
 - Collaboration with regional and national entities biannually to conduct a high-risk invasive species risk assessment that identifies potential new introductions of invasive species and their pathways of introduction, monitoring needed to detect these species, and an understanding of their life history and biological controls.
 - Enhancement of a marina partnership strategy with both marinas and the boating industry to improve the ability to both detect and control AIS as well as prevent their spread.

- **Prevention**

- Continued education, outreach, and prevention efforts to increase awareness, understanding, and ultimately achieve behavioral change that lessens the introduction and spread of AIS.
- Prevention efforts addressing high-risk pathways of invasive species introduction.

- **Enhanced Monitoring**

- A long-term monitoring program that establishes baseline conditions and monitors changes to Lake Tahoe regional aquatic ecosystems through time.

- **Control**

- An effective Early Detection Rapid Response program that has the capacity and resources to achieve success.
- Identification of the highest priority locations for AIS control activities.

- **Resources**

- Adequately funded programs to control, contain, or eradicate established populations.
- Increased capacity to enhance the pace and scale of regional AIS activities to minimize the effects of AIS on ecosystem function and biological integrity in the Region.
- Creation of an emergency fund to address new introductions of invasive species.
- Outcome-based performance metrics that align with the Environmental Improvement Program Tracker deliverables and Tahoe Regional Planning Agency thresholds.

- **Research**

- Research addressing critical information gaps, such as population levels of aquatic invasive invertebrates and amphibians, their detrimental effects on ecosystem function, life history strategies in the Region, and effective controls.

This Action Agenda is intended to provide a framework for addressing these key gaps and challenges and achieving desired levels of success described by regional stakeholders.

Performance Metrics

Sound performance metrics that align with outcome-based strategies drive improvements, focus strategic investments, and are foundational to adaptive management (Campbell et al. 2001). There are two types of metrics important to evaluating success of any AIS program—programmatic metrics that describe effort, and outcome-based metrics that link directly to goals and desired outcomes.

Results chains describe how strategies lead to conservation success by documenting assumptions, focusing on achieving results (versus executing activities), and articulating how managers believe strategies will contribute to threat reductions, or target restorations. Results chains incorporate the use of measurable objectives, which illustrate desired future conditions resulting from strategy implementation (Foundations of Success 2007). Results chains are commonly used to refine theories of change, measure effectiveness, and develop a framework for assessing strategy effectiveness. Results chains map causal statements that link short-term, intermediate, and long-term results by defining strategies as well as objectives and goals that inform expected outcomes, and desired impacts.

A key purpose in using results chains is to focus on desired results versus widget counting. Results chains describe process (i.e., staff, funding, and resources as well as strategies that are implemented), and results (i.e., immediate products of actions (outputs), the interim results achieved by the outputs (outcomes), and the desired end goals (impacts)). The development of results chains can inform performance metrics that are directly linked to desired end goals (e.g., % of priority acres restored or rehabilitated to desired conditions such that there is no longer ecosystem impairment caused by AI plants) versus actions and process (e.g., # of acres treated).

An assessment was conducted of existing metrics in the Environmental Improvement Program (EIP) Tracker and Tahoe Regional Planning Agency Thresholds (Appendix D) used to evaluate AIS success. The assessment demonstrated consistency among the goals and strategies of the Action Agenda, Management Plan, Implementation Plan, and TRPA thresholds, however, key gaps were identified in the outcomes/performance metrics category. The majority of the EIP Tracker metrics describe effort associated with invasive control strategies, such as acres treated, acres inventoried, funds expended, and number of projects completed. Describing effort is a fundamental programmatic part of cost:benefit analysis for any entity.

Programmatic metrics can be used to describe where investments were made and cost per unit effort for year-end reports and funder needs.

This Action Agenda promotes additional metrics that evaluate success based on outcomes in addition to effort (Figure 1). Outcome-based metrics incorporated into the EIP Tracker will help evaluate success in achieving AIS goals. Both types of metrics complement one another and create a robust picture of outcomes associated with strategic investments in AIS in the Region.

Figure 2 describes the suite of metrics that could be used to assess programmatic cost:benefit and effort as well as evaluate progress of regional entities in controlling AIS through time. The proposed metrics are structured in four categories:

- Plants;
- Invasive fish¹;
- Aquatic invasive invertebrates; and
- Invasive amphibians.

These categories correlate to the core categories of AIS currently found in the Region. Continuing the use of effort-based metrics supplemented with outcome-based metrics will result in the ability of the Region to articulate both effort and progress made.

1 Definition: It is non-native to the ecosystem, and its introduction causes, or is likely to cause, environmental harm. Non-native fish regulated by state fish and wildlife agencies as a game or sport fish in Lake Tahoe per each year's fishing regulations are exempted. However, this exemption does not preclude state and federal agencies implementing management plans or actions outside the scope of this document for the benefit of native fish.



AIS CONTROL RESULTS CHAIN

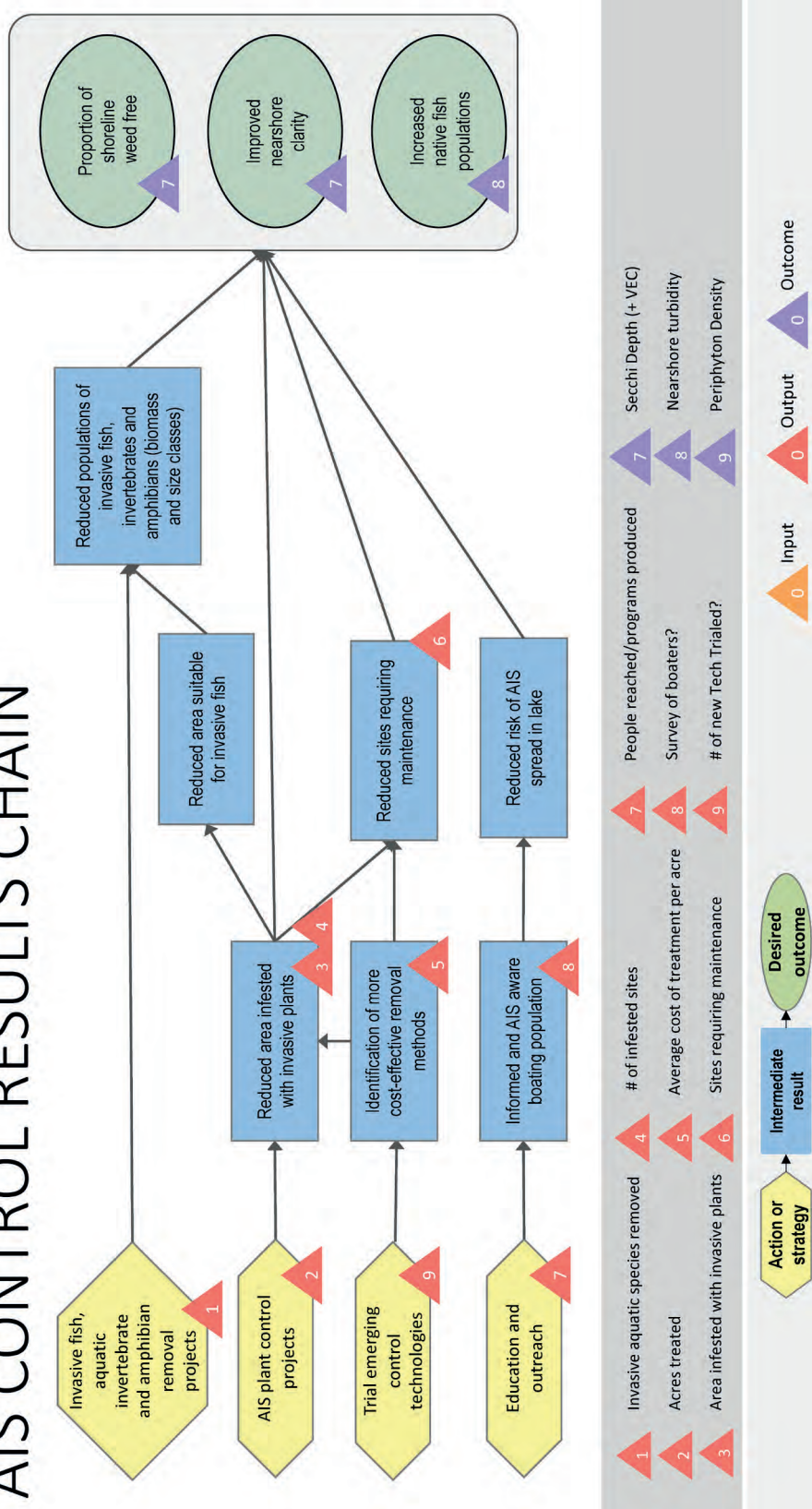
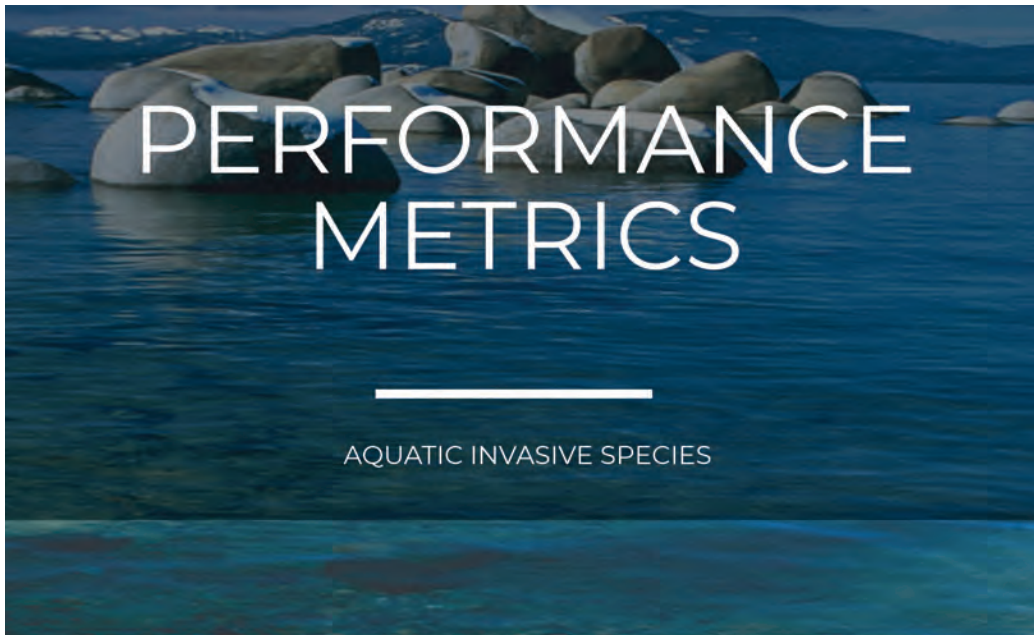


Figure 1. Aquatic Invasive Species Control Results Chain depicting the actions/strategies (yellow), the intermediate results expected from implementing the actions/strategies (blue), and the desired outcomes (green).



EFFORT AND OUTCOME-BASED AQUATIC INVASIVE SPECIES PERFORMANCE METRICS

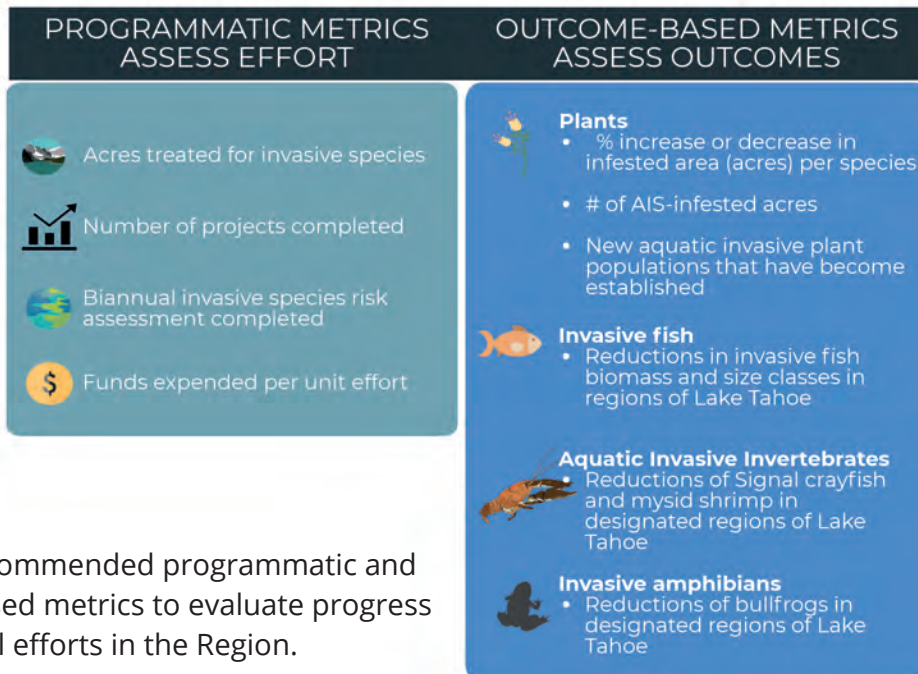


Figure 2. Recommended programmatic and outcome-based metrics to evaluate progress of AIS control efforts in the Region.

Return on Investment

Asset Management

The cost of AIS to Lake Tahoe’s regional economy and environment as well as human health and well-being are well documented (Wittmann and Chandra 2015). Through time, AIS can affect water quality, recreation, tourism, industry, communities, and ecological function, to name a few. The result of an effective AIS program is the implementation of strategic investments through time such that the asset, which in this case is Lake Tahoe and its associated habitats (e.g., lake, streams, and marshes), is maintained at some desired future condition in which AIS minimizes detrimental effects on ecosystem function.

Asset management is an approach that includes inventorying an existing asset(s), determining the current state and value of the asset, evaluating the risks by analyzing the likelihood and consequences of failure of those asset(s), and developing and implementing plans to maintain or enhance the asset(s) to ensure sustainable service delivery (Brooke et al. 2017). In the case of Lake Tahoe, service delivery includes all of the beneficial uses described in Appendix D, including, for example, municipal and domestic water supply, habitat for threatened and endangered species, scenic and cultural values, and recreation.

Asset management is more of an art than a science (Asset Management Council 2017). This is particularly true for green assets that support community well-being and delivery of beneficial services, which are core to sustainability and livability (SEQC 2017). Using an asset management approach allows natural resource assets to be viewed through a similar lens as grey infrastructure assets, which is critical to the delivery of beneficial uses in the Region.

Because invasive species negatively affect ecosystem services and trigger economic losses, timely intervention can minimize negative economic and ecological effects (Funk et al. 2014). Investments in invasive species prevention yield the greatest return on investment (Johnstone et al. 2014) (Figure 3). When prevention efforts fail to prevent the introduction and establishment of aquatic invasive species, return on investment (ROI) is an approach to evaluate the conservation benefits of an invasive species control project relative to cost (Murdock et al. 2007). Projects with high cost and low conservation benefit generally have low ROI whereas projects with high cost and high conservation benefit are evaluated in depth before proceeding (Funk et al. 2014). The following equation describes factors that are considered to evaluate ROI (Tear et al. 2014).

$$\text{ROI} = \frac{\text{Conservation Benefit} \times \text{Probability of Success}}{\text{Cost}}$$

Implementing strategies targeted at prevention and eradication efforts yield much greater economic returns on investment than implementation of containment, or asset-based protection strategies (Figure 3).

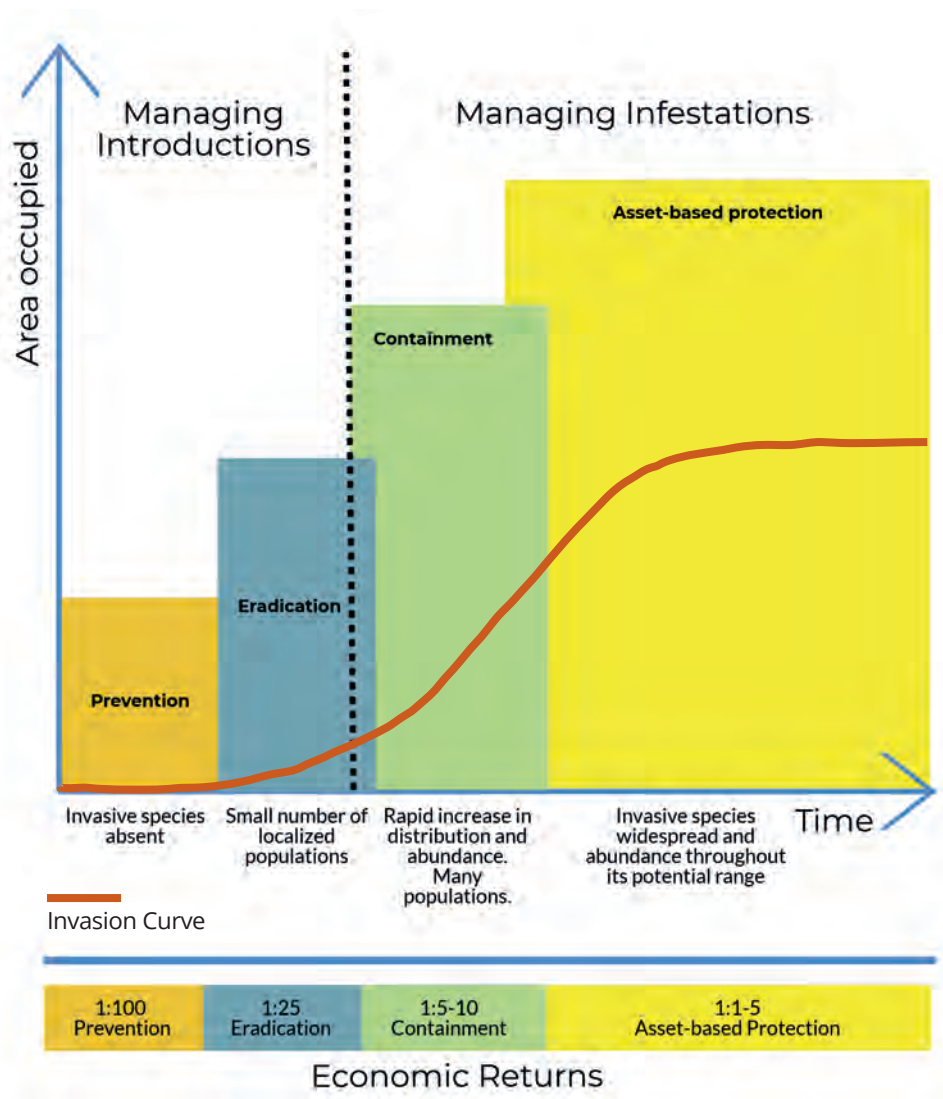


Figure 3. Economic returns on investment relative to invasive species prevention, eradication, containment, and asset-based protection. Through time, the economic returns associated with managing invasive species infestations declines as species become more widespread. The most significant economic returns are associated with prevention and eradication. Adapted from NSW 2016.

Lake Tahoe AIS Action Agenda, 2021-2030

This Action Agenda proposes two five-year phases for implementation:

▶▶▶▶▶ Phase I | 2021–2025

Phase I (2021–2025) aggressively treats and controls aquatic invasive species throughout the Region for five consecutive years while containing AIS and completing environmental documents and AIS control testing specific to the Tahoe Keys. The Phase I goal is to reduce aquatic invasive plants to maintenance levels (or complete eradication) in areas outside of the Tahoe Keys such that aquatic invasive plants and invasive fishes have minimal detrimental effects to ecosystem function while developing the science, technologies, and methodologies to assess population levels of invasive invertebrates and amphibians so that they can be reduced to minimize effects to ecosystem function. Phase I includes continued efforts to seek solutions for treatment methods within Tahoe Keys.

▶▶▶▶▶ Phase II | 2026–2030

Phase II (2026–2030) focuses efforts on reducing aquatic invasive plants and invasive fish in the Tahoe Keys (implementing the outcomes of the environmental assessment and testing processes occurring through 2025), while continuing to maintain, reduce, or when possible, eradicate AIS in other parts of the Lake Tahoe Region such that they minimize detrimental effects to ecosystem function.

Tables 1–4 in this Action Agenda framework include:

1. A suite of measurable objectives and outcomes;
2. Strategies and actions to address existing and emerging AIS issues in the Region;
3. Outcome-based performance metrics to evaluate success;
4. Desired outcomes;
5. Research and technology needed to address AIS challenges;
6. Adequate and comprehensive monitoring to evaluate progress and success;
7. Timelines for implementation, and
8. The resources needed to achieve AIS management goals from 2021–2030.

The framework is organized by the following four groups:

- Aquatic invasive plants
- Invasive fish, aquatic invasive invertebrates, and invasive amphibians
- Research and monitoring
- Administration

All of the proposed strategies align with the goals of the *Lake Tahoe Region Aquatic Invasive Species Management Plan* (2014) as well as the priority species described in the *Implementation Plan for the Control of Aquatic Invasive Species within Lake Tahoe* (2015).

Note: The Tahoe Keys will experience a different timeline and suite of controls based on the current Environmental Impact Statement/Environmental Impact Report (EIS/EIR) and work with local stakeholders to define a control program that addresses aquatic invasive plants and water quality issues. The timeline for the Tahoe Keys has not been fully described while this report was being produced, however, it is estimated that the first EIS/EIR will be completed by 2023, followed testing, and the development of a second EIS/EIR and additional testing. Small-scale herbicide testing following by non-herbicide methods pending approval is slated to occur by 2021. Non-herbicide methods (diver-assisted pulling, broader bottom barrier use, UV light) evaluation is slated to occur through 2020. A long-term integrated management plan is projected to be produced in 2020.



Aquatic Invasive Plants

Aquatic invasive plant strategies (Table 1) are focused on implementing a full suite of control actions, using an integrated management approach, to reduce the abundance and distribution of AIS in regional waters while ensuring that no new AI plant populations become established in the Region, and while establishing a baseline for AI plant infestations in upstream portions of Lake Tahoe.

Phase I: \$22,250,000 | **Phase II:** \$24,700,000

► Table 1. Aquatic invasive plant strategies, performance metrics, desired outcomes, lead, budget, and timeline, 2021–2030.

Strategies	Performance Metrics	Desired Outcomes	Lead	Phase I Costs (2021–2025)	Phase II Costs (2026–2030)
<p>Non-Tahoe Keys locations:</p> <p>1A. Establish the baseline for AI plant infestations in upstream portions of the lake.</p> <p>1B. Implement a full suite of control actions, using an integrated management approach, to reduce the abundance and distribution of AIS in regional waters.</p>	<p>% increase or decrease in infested area (acres) per species</p> <p># of AIS-infested acres</p>	<p>By 2030, reduce by 90%, the acreage of AI plant populations in priority areas (and their upstream components) identified in the Implementation Plan as well as any additional areas that have been identified since plan creation (excluding Tahoe Keys).</p>		<p>\$2.5 million annually = \$12.5 million total</p>	<p>Maintenance of an estimated 25 acres annually x \$50,000/acre = \$1.25 million annually x 5 years = \$6.25 million total</p>
<p>1C. Implement a full suite of control actions, using an integrated management approach, to reduce the abundance and distribution of AIS in the Tahoe Keys.</p>	<p>% increase or decrease in infested area (acres) per species</p> <p># of AIS-infested acres</p>	<p><u>Tahoe Keys*</u> By 2030, reduce from 90% to full eradication, AI plant populations in the Tahoe Keys.**</p>	TRPA	<p>\$1 million annually (2021–2023), then \$4 million*** for 2024–2025 = \$7 million total</p>	<p>Estimated \$100,000/acre x 172 acres = \$17.2 million total</p>
<p>1D. Implement EDRR control actions to ensure no new AI plant populations become established in the Region.</p>	<p>Annually, no new AI plant populations become established in the Region</p>			<p>\$250,000 annually x 5 years = \$1.25 million total</p>	<p>\$250,000 annually x 5 years = \$1.25 million total</p>
<p>1E. Environmental documentation for the Tahoe Keys – 2nd round for stakeholder engagement</p>	<p>Conduct round two of environmental documentation</p>			<p>\$1.5 million in 2023</p>	
TOTALS				\$22,250,000	\$24,700,000

*2021–2025 includes actions to contain AIS in the Tahoe Keys during the development of environmental documents and testing potential controls. Years 2026–2030 include control actions intended to eradicate invasive plants in the Tahoe Keys.

** \$4M includes \$3 million to test the outcomes of the 2nd environmental assessment in 2023 and \$1 million for annual AIS containment measures.

*** An Environmental Impact Statement/Environmental Impact Report (EIS/EIR) will inform an AIS control program in the Tahoe Keys. The first EIS/EIR is estimated to be completed by 2023, followed by the development of a 2nd EIS/EIR.

Table 1A describes the categories and priorities of AIS locations and species for control efforts through 2030.

- **Tier 1 locations**—Tier 1 locations are the highest priority based on their location at the upper portion of the Tahoe watershed, the size of the AIS infestation, their connectivity to one another, the existence of other associated AIS (e.g., invasive fish), the projected extent of ecosystem benefits to be achieved (e.g., multiple benefits), and the perceived high risk to ecological integrity. Tier 1 locations are subdivided into three categories: ranging from A (highest priority) to C (lowest priority).
- **Tier 2 locations**—Tier 2 locations are secondary priorities primarily because of the smaller size of the infestation relative to Tier 1 locations. In addition, these locations are not located on the south shore of Lake Tahoe, and are not as well connected to other infested sites.
- **EDRR locations**—EDRR locations are sites that have either been treated and/or are under surveillance because of past infestation, or because of the likelihood of future infestation given the parameters of the site (high boater recreational use, proximity to infested locations, etc.). Monitoring these sites on an annual basis to assess the status of any AIS infestation is critical. EDRR funds should be dedicated and used on an annual basis to control documented infestations at these locations and any new locations in the Region.

Table 1A describes the location of AIS infestations, habitat type, priority of the infestation in the 2015 Implementation Plan, type of AIS present, status of the infestation, current acreage of the infestation, percent cover, acreage of the infestation prior to treatment, and acreage of the survey area. This table should be updated annually and incorporated into the EIP Tracker to represent an updated comprehensive assessment of existing infestations. Ideally, all existing resources would be allocated to the highest priorities and EDRR sites annually.

The “2015 IP Priority” column in Table 1A acknowledges the existence of 2015 Lake Tahoe AIS Implementation Plan priorities and the designation of AIS priority infestations for the 3–5 year period following adoption of that plan. In some instances, site priorities in the Action Agenda are similar to those proposed in 2015. In other cases, significant differences exist in current Action Agenda priorities and 2015 Lake Tahoe AIS Implementation Plan priorities because of expanded monitoring, opportunistic funding to address AIS at specific locations, and other factors. The three groupings of species listed (EWM = Eurasian watermilfoil, CLP = Curlyleaf pondweed, and IF = Invasive fish) were documented as present in locations with an X, not necessarily locations where controls/treatments are ongoing, or have occurred. For example, at the time of this publication, there is no active invasive fish control at any locations in the region.

Table 1A. Categories and priorities of AIS locations and species for control efforts, 2019–2030. Sites in Tiers 1 and 2 in which no active treatment is occurring are undergoing planning for future treatments as well as containment to avoid spread. The species listed were documented as present, not necessarily locations where controls/treatments are ongoing, or have occurred.

Habitat Categories: M = Marsh; MR = Marina; E = Embayment; O = Open Water; T = Tributary; U = Upland Ponds
 Species Categories: EWM = Eurasian Watermilfoil, CLP = Curlyleaf Pondweed, IF = Invasive fishes, AC = Asian Clams

► Table 1A. Aquatic Invasive Plants

Category	Location	Habitat	2015 IP Priority	2019 Action Agenda Category	Species	Status of Infestation	Estimated Acreage of Infestation	% Cover	Acreage of Infestation Prior to Treatment	Area Surveyed (Acres)
Tier 1	Meeks Creek	T	3	A	EWM, IF	Active treatment 2019	3		3	3.5
	Pope Marsh	M		A	EWM	Active treatment 2019	<1		<1	125
	Tahoe Keys Main Lagoon (CA)	MR, E	1,2	A	EWM, CLP, IF	Planning, testing, containment	172		172	172
	Tahoe Keys Channels Complex	O	1,2	A	EWM, CLP, IF	Planning, testing, containment	10		Unknown	175
	Taylor and Tallac Creeks (CA)	M	8	A	EWM, CLP, IF	Planning, containment	8		n/a	10
	Upper Truckee Marsh (CA)	M		A	EWM, IF	Planning, containment	3		3	5
	Upper Truckee River	T	18	A	EWM, CLP, IF	Planning, containment	1.25 (0.25 CLP, 1 EWM)		n/a	11
	Edgewood Creek and Pond Complex (NV)	U		B	EWM, CLP, IF	Planning, containment	10		n/a	20
	Lakeside Beach (CA)	O	12	B	IF	Active treatment 2019	1.5			2
	Lakeside Marina (CA)	MR	6	B	EWM, CLP, IF	Active treatment 2019	1		3	1
	Ski Run Marina (CA)	MR	4	B	EWM, CLP, IF	Planning, containment	0.5		n/a	0.5
	Ski Run Channel (CA)	O	4	B	EWM, CLP, IF	Planning, containment	3.5		n/a	5

► Table 1A. Aquatic Invasive Plants (continued)

Category	Location	Habitat	2015 IP Priority	2019 Action Agenda Category	Species	Status of Infestation	Estimated Acreage of Infestation	% Cover	Acreage of Infestation Prior to Treatment	Area Surveyed (Acres)
Tier 1	Baldwin Beach (offshore)	O		C	EWM, CLP, IF	Active treatment 2019	0.25		0.25	20
	Camp Richardson Pier	O	18	C	EWM, IF	Active treatment 2019	0.25		0.25	6
	Elk Point Marina	MR	15	C	EWM, CLP, IF	Active treatment 2019	0.5		0.5	0.75
	Timber Cove Pier	O	14	C	EWM, CLP, IF	Active treatment 2019	0.25		0.25	1
Tier 2	Burke Creek (NV Beach)	T			EWM	Active treatment 2019	0.1		0.1	0.5
	Elk Point and Round Hill shoreline structures	E			EWM	Active treatment 2019	3		3	18
	General Creek	T			EWM	Active treatment 2019	0.1		0.1	0.25
	Logan Shoals Marina	MR	17		EWM	Planning, containment	1.75		1.75	2
	Lower Truckee River below dam	T			EWM	Active treatment 2019	17		20	25
	Regan Beach	O	7			?—not surveyed in 2018	0.1		0.1	10
	Sand Harbor	E			AC	Active treatment 2019	22		6	25
	Tahoe Beach Club (NV beach)	T			EWM	Active treatment 2019	0.3		0.3	0.5
	Wavoka Estate Marina	MR			EWM	Active treatment 2019	0.1		0.1	0.25

► Table 1A. Aquatic Invasive Plants (continued)

Category	Location	Habitat	2015 IP Priority	2019 Action Agenda Category	Species	Status of Infestation	Estimated Acreage of Infestation	% Cover	Acreage of Infestation Prior to Treatment	Area Surveyed (Acres)
EDRR Sites	Boatworks/Tahoe City Marina	MR	18	All of these sites are priority sites for EDRR.	IF	no plants present 2018	0		unknown	15
	Crystal Shores East (NV)	MR			EWM, IF	surveillance mode	0		0.5	0.5
	Crystal Shores Villas (NV)	MR			EWM, IF	surveillance mode	0		0.5	0.5
	Crystal Shores West (NV)	MR	9		EWM, IF	surveillance mode	0		n/a	0.5
	Emerald Bay, Avalanche Beach, Vikingsholm, and Parson's Rock	O	18		EWM, CLP, IF	surveillance mode	<0.1		6	12
	Fleur du Lac Marina	MR			EWM	surveillance mode	0		0.5	2.5
	Glenbrook	O			EWM	surveillance mode	0		0.1	7
	Nevada Beach	O	16			no plants present 2018	0		unknown	15
	Star Harbor	MR/E				surveillance mode	0		unknown	2
	Sunnyside Marina	MR	18		IF	no plants present 2018	0		unknown	1
	Tahoe City Dam	O/T	5		EWM, IF	surveillance mode	<0.1		0.2	2
	Tahoe Tavern	O	13			no plants present 2018	0		unknown	0.25
	Tahoe Vista boat ramp	MR			EWM	surveillance mode	0		0.2	0.5
	Zephyr Cove	O				surveillance mode	0		unknown	

Table 1B includes more detailed information about the AIS treatments that will be occurring in the two years prior to the launch of the Action Agenda. Note: Sites treated in 2019 either are treated again in 2020, or are designated as EDRR sites if they have received treatments the prior two years.

▶ Table 1B. 2019–2020 AIS Treatments					
Tier	Location	2019 Treatment Acreage	2020 Treatment Acreage	Species	Notes:
1	Pope Marsh	<1	<1	EWM	
	Lakeside Marina	1	1	EWM, CLP	
	Lakeside Beach		1	EWM, CLP	
	Meeks Marina and Creek	3	3	EWM	
	Baldwin Beach	0.25	EDRR	EWM, CLP	
	Camp Richardson Pier	0.25	EDRR	EWM, CLP	
	Elk Point Marina	0.5	0.5	EWM, CLP	
	Timber Cove Pier	0.25	EDRR	EWM, CLP	
	Ski Run Marina		Planning treatment	EWM, CLP, IF	
2	Elk Point and Round Hill rock cribs shoreline	3	EDRR	EWM	
	General Creek	0.1	EDRR	EWM	
	Lower Truckee River below dam	17	17	EWM	Funding to treat after 2020 currently does not exist.
	Sand Harbor			Treatment for Asian Clams	
	Tahoe Beach Club (NV beach)	0.3	EDRR	EWM	
	Burke Creek (NV beach)	0.1	EDRR	EWM	
	Wavoka Estate Marina	0.1	0.1	EWM	

Invasive Fish, Aquatic Invasive Invertebrates, Invasive Amphibians

Taxa other than invasive plants may play a key role in degrading the biological integrity of Lake Tahoe and its associated habitats (e.g., Asian clams, mysid shrimp). In fact, there may be significant changes occurring to benthic ecosystems in Lake Tahoe, but because these changes are not as readily observable as the presence of dense populations of aquatic plants in places where people live and recreate, their threat to the Region may not be perceived as significant compared to aquatic invasive plants. Overlooking what may be happening in benthic areas could marginalize significant alterations of the food web and ecosystem function in the lake and associated stream habitats. As described in the *Implementation Plan for the Control of Aquatic Invasive Species Within Lake Tahoe* (Wittman and Chandra 2015), there is uncertainty relative to the magnitude and dynamics of the impacts Asian clams are having on lake ecosystems, and a need exists to identify those impacts as well as develop cost-effective control strategies (Wittman and Chandra 2015). The Asian clam is one of the most invasive aquatic species in freshwater ecosystems (Sousa et al. 2008), displacing or reducing available habitat for native species (Vaughn and Hakenkamp 2001), affecting recruitment of other species because of suspension and deposit feeding (Yeager et al. 1994, Hakemkamp and Palmer 1999), competing with native species for benthic resources (Sousa et al. 2005), demonstrating high filtration rates that affect planktonic food supply (McMahon 1991, Strayer 1999), serving as a vector of parasites and pathogens, negatively affecting water quality during massive die-offs (Johnson and McMahon 1998, Strayer 1999, Cherry et al. 2005, Cooper et al. 2005, Sousa et al. 2007b, 2008), bioaccumulating and bio-amplifying contaminants (Narbonne et al. 1999, Tran et al. 2001, Cataldo et al. 2001a,b, Achard et al. 2004), and biofouling (Darrigran 2002).

In addition, invasive fish detrimentally affect ecosystem services, including hybridization, competition, and the introduction of pathogens (Walters et al. 2008, Deacon 1988, Holden and Stalnaker 1975, Mettee et al. 1996), causing declines in native fish and water quality degradation (Baxter et al. 2004, Eilers et al. 2007).

Reductions in invasive fish may advance population recovery of Lahontan Cutthroat Trout populations in the Region. Lahontan Cutthroat Trout, although extirpated by the 1940s from the Truckee River watershed, currently experience natural migration and reproduction patterns in the Pyramid to Tahoe Lake portion of the Region. Improving habitat conditions for Lahontan Cutthroat Trout, and other cold-water fish, include reducing numbers of invasive fish and other species that are altering ecosystem function within the Region.

American bullfrogs can significantly affect ecosystem function because:

- They are a voracious predator, consuming anything that will fit into their mouths (Gherardi 2007, Orchard 2010);
- They reduce the survivorship of native species through competition (Kiesecker and Blaustein 1998, Kupferberg 1997);
- They transmit diseases, such as Chytridiomycosis, which is responsible for global amphibian declines (Hanselmann et al. 2004); and
- They alter the biomass, structure, and composition of algal communities (Flecker et al. 1999), significantly affecting nutrient cycling and primary production (Pryor 2003).

The *Implementation Plan for the Control of Aquatic Invasive Species Within Lake Tahoe* (Wittman and Chandra 2015) documented the effects of American bullfrogs on ecosystem services in other systems, but noted that within the Lake Tahoe Region, uncertainty exists relative to the effects bullfrogs may be having on native species, recreational use, or restoration efforts. In addition, uncertainties exist relative to the efficacy of mechanical or chemical methods control (Wittman and Chandra 2015).

The Implementation Plan also documented potential effects of Signal crayfish and mysid shrimp to the Region.

Strategies associated with invasive fish, aquatic invasive invertebrates, and invasive amphibians (Table 2) focus on reducing invasive fish biomass in priority areas of the lake, and depressing aquatic invasive invertebrate and American bullfrog populations to levels that minimize impacts to ecosystem function in designated regions of the lake. However, cost and adequate long-term controls may be limiting factors, which emphasizes the importance of monitoring to determine distribution, abundance, and densities of these taxa within the Region as well as research and testing to develop emerging technology and control methods. It is widely recognized that it is both ecologically impossible and cost prohibitive to eradicate invasive fish, aquatic invasive invertebrates, and invasive amphibians, however, ecosystem function enhancement is likely possible in regions of the lake via targeted depression of localized populations (Wittman and Chandra 2015).

Phase I: \$2,625,000 | **Phase II:** \$1,845,000

► **Table 2. Invasive fish, aquatic invasive invertebrate, and invasive amphibian control strategies, performance metrics, lead, budget, and timeline, 2021–2030.**

Strategies	Performance Metrics	Desired Outcomes	Lead	Phase I Costs (2021–2025)	Phase II Costs (2026–2030)
2A. Mechanically remove invasive fish from regions of the lake.	Reductions in invasive fish biomass and size classes in regions of Lake Tahoe.	By 2030, reduce by 90%, invasive fish biomass (densities measured as Catch Per Unit Effort) and size classes in Tier 1* areas and Tier 2** areas via mechanical removal (electroshocking and targeted invasive fish nest control for invasive fish species; netting or trawling techniques required for cold water species).	TRPA	\$275,000 annually = \$1.375 million total	\$244,000 annually = \$1.22 million total
2B. Mechanically remove aquatic invasive invertebrates from regions of the lake.	Reductions of aquatic invasive invertebrates in designated regions (e.g., Crystal Bay) of Lake Tahoe.	Depress aquatic invasive invertebrates to population levels that minimize impacts to ecosystem function in designated regions of the lake.		\$250,000 annually = \$1.25 million total	\$125,000 annually = \$625,000 total
2C. Mechanically remove bullfrogs from regions of the lake and basin.	Reductions of bullfrogs in designated regions (e.g., Crystal Bay) of Lake Tahoe.	Depress bullfrogs to population levels that minimize impacts to ecosystems function in designated regions of the lake.			
		TOTALS		\$2,625,000	\$1,845,000

*Tahoe Keys Main Lagoon and Channel (West and East), Meeks Bay, Ski Run Marina/Channel, Tahoe City Dam, Lakeside Marina, Taylor Creek, Crystal Bay (1–3), and Timber Cove Pier.

**Elk Point Marina, Baldwin Beach, Emerald Bay, Upper Truckee River, Camp Richardson, Boatworks Marina, and Sunnyside Marina.



Research and Monitoring

Lake Tahoe is an Outstanding National Resource Water under the Federal Clean Water Act, and is currently listed as impaired under Clean Water Act Section 303(d) because of nitrogen, phosphorus, and sediment inputs. Five major threats to Lake Tahoe and the Region include loss and degradation of wetlands, tree mortality caused by fire suppression and drought, loss of biological diversity, wildfire threats, insect infestations, and aquatic and terrestrial invasive species.

Integrated pest management strategies incorporate mechanical, chemical, and/or biocontrol methods targeted at different locations, times, and life-history stages of AIS to minimize risk and cost and maximize return on investment. The designation of Lake Tahoe as an Outstanding National Resource Water will likely significantly limit both the scope and scale of pesticide use for aquatic invasive weeds. In addition, effective control options currently do not exist for several AIS of concern, such as Signal crayfish, Mysis shrimp, Asian clams, and American bullfrogs. Asian clams, in particular, are one of the most invasive species in freshwater aquatic ecosystems (Sousa et al. 2008), affecting biodiversity and ecological processes.

To achieve regional goals associated with water quality and beneficial uses, investments should be made in technology and research to address existing and emerging AIS threats to the Region and to develop cost-effective control methods that minimize risk and harm to people, native fish and wildlife, and the ecological function of Lake Tahoe ecosystems.

Research and monitoring strategies (Table 3) are focused on developing eDNA tools specific to the Region, better understanding the life history and biology of AIS in the Region, conducting experimental studies to regionally depress aquatic invasive invertebrate and amphibian populations, investing in new technologies that support AIS control efforts in the Region, and conducting several different types of monitoring to assess the distribution, abundance, and population size/acreage/biomass of invasive species (and native cold water fish) in the Region.

Phase I: \$4,290,000 | **Phase II:** \$5,235,000

Note: Research and monitoring costs include an estimated 50% indirect costs (university and federal agency average rate).

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► **Table 3. Research and monitoring strategies, desired outcomes, budget, and timeline, 2021–2030.**

Strategies	Desired Outcomes	Phase I Costs (2021–2025)	Phase II Costs (2026–2030)
3A. Develop detection and surveillance monitoring tools, such as eDNA, to enhance detection of organisms and the probability of capturing eDNA.	eDNA detection and surveillance tools are developed to enhance organism detection.	\$600,000 annually for 2 years, then \$200,000 annually for 3 years = \$180,000 total	\$100,000 annually for 5 years = \$500,000 total
3B. Conduct experimental studies to determine the ability to regionally depress Signal crayfish and mysid shrimp populations.	Determine the population levels of Signal crayfish that minimize ecosystem function in regions of Lake Tahoe.		
3C. Conduct a broad spectrum near-shore-wide census every 2 years for six years, and then once every 5 years; conduct in situ diver survey transects and drone surveys at 25 priority locations during intervening years.	Description of AI plant species, abundance, and distribution in the nearshore of Lake Tahoe.		\$375,000 in 2026 and \$400,000 in 2030 = \$775,000 total
	Description of AI plant species, abundance, and distribution in the nearshore, tributary, and marsh areas of Lake Tahoe by monitoring via snorkeling during summer months.	\$244,000 annually for 10 years = \$2.4 million total	
3D. Conduct monitoring to assess the distribution, abundance and population size/biomass of breeding populations of Signal crayfish and mysid shrimp in the Lake Tahoe Region.	Description of invasive fish and AI invertebrate distribution, abundance and population size/biomass via monthly surveys during the summer months.	\$122,000 annually for 10 years = \$1.2 million total	
3E. Conduct monitoring to assess the distribution, abundance and population size/biomass of breeding populations of invasive fish and native fish in Lake Tahoe’s nearshore via 3-4 snorkel surveys in the littoral zone during warm summer months (Chandra et al. 2009).	Evaluate the effect of non-native fish biomass on native fish abundance and distribution.		
3F. Target monitoring: Conduct monitoring to assess the distribution, abundance and population size/biomass of breeding populations of bullfrogs in the Lake Tahoe Region.	Description of bullfrog distribution, abundance and population size/biomass.	\$122,000 annually for 10 years = \$1.22 million total	
3G. Invest in new technologies that support AIS control efforts in the Region.	New technologies are tested that advance AIS control efforts while minimizing negative effects to the Region’s beneficial uses.	\$250,000 annually for 10 years = \$2.5 million total	
3H. Conduct monitoring to assess distribution, abundance, and population size/biomass of cold/deep water invasive fish and native fish in Lake Tahoe’s offshore via hydro-acoustic assessments, trawl and gill netting.	Description of distribution, abundance, and population size/biomass of cold/deep water invasive fish and native fish in offshore regions of Lake Tahoe.	\$150,000 every other year for 10 years = \$750,000 total	
	TOTALS	\$4,290,000	\$5,235,000

Administration

Administering an expanded AIS control program requires increases in staff capacity to administer funds, provide project oversight and reporting, coordinate and collaborate with partners, and perform other important tasks. Ensuring sufficient staffing capacity exists to implement this agenda is critical to success. Currently, a total of four full-time equivalent (FTE) positions (two at TRPA and two at Tahoe RCD) are dedicated to AIS control issues in the Region.

This Action Agenda includes a significant expansion of AIS control activities for all taxa as well as multiple new administrative tasks, including conducting a bi-annual high-risk AIS assessment, implementing an enhanced partnership strategy with marinas, creating and implementing an emergency fund for EDRR, and providing additional support for scientific engagement in AIS control. These new activities will require an estimated six additional FTEs to address existing shortfalls and fully implement the Action Agenda. Two of these strategies are described in more detail below.

Marina Partnership Strategy

Supporting a marina-based strategy to enhance control, prevention, and detection efforts at marinas was a key recommendation made during the 2019 Lake Tahoe AIS Survey and follow-up interviews (Appendix B). Respondents and interviewees expressed the role marinas have the potential to play in introducing and spreading AIS as well as preventing and detecting AIS (e.g., deploying and inspecting settlement plates).

Numerous jurisdictions have created special programs and certifications that promote best management practices at marinas. For example, British Columbia developed the *Invasive-Wise Marina Pilot Program*. Florida launched the *Clean & Resilient Marina Initiative* in 2013, a multi-state program that provides marina operators and owners with strategies and practices to better design, develop and manage their marinas. In addition, the well-recognized *Clean Marina Program* is a voluntary nationwide program that certifies marinas and educates boaters relative to the protection of water resources. California's *Clean Marina Program* for freshwater lakes and rivers includes all of the elements for saltwater marinas plus the ensuring no pollutants are discharged from marinas that may affect sources of drinking water.

TRPA is leading an effort to require marinas to develop AIS Management Plans that address mandatory reporting and compliance requirements. Enhancing these mandatory requirements with an industry-supported infrastructure-focused strategy could engage most, if not all, of the Lake Tahoe marinas in assessing and prioritizing infrastructure investments to reduce the potential for spread of AIS when the public uses marina facilities in the Region.

For example, Lake Tahoe’s Meeks Bay Restoration Project seeks to address the deteriorating condition of the marina and associated water quality, invasive species, and habitat issues by moving the stream channel and wetland such that natural geomorphic and hydrologic processes support ecosystem function while continuing to support recreational activities.¹ In addition, marinas with breakwaters could redesign to include more circulation to prevent AIS growth and establishment.

Partnering with industry to seek innovative solutions and support infrastructure enhancements at Lake Tahoe marinas will advance AIS prevention efforts in the Region. A meeting in the Fall of 2019 with marinas in the Region will advance key next steps.

Lake Tahoe Region AIS Emergency Fund

The ability to access funds to immediately respond to a new introduction of AIS in the Lake Tahoe Region is integral to long-term success and protecting strategic investments to date in control efforts.

Several states have created emergency funds to prepare for invasive species invasions:

- Idaho established The Idaho Invasive Species Act of 2008 (Appendix H) within the State Treasury (22-1911), authorizing the Director of the Idaho Department of Agriculture to determine when funds can be appropriated for control and eradication purposes. When costs of control and eradication exceed money appropriated or otherwise available, the state board of examiners may authorize the issuance of deficiency warrants against the general fund for up to \$5 million dollars in any one year for control and eradication.
- Oregon established the Invasive Species Control Account in 2009 (House Bill 2020) (Appendix H) for the purposes of eradicating, or controlling, new infestations of invasive species in Oregon (ORS 570.810). The fund describes eligible applicants, standards to determine eligibility for release of funds, and the process for delegation and release of funds. Seed funding for the account included a one-time appropriation from the Oregon State Parks and Recreation Department All-Terrain Vehicle Fund. The goal has been to establish a \$5 million fund. The fund is administered by the Oregon Invasive Species Council, a consortium of federal, state, and local government agencies and nonprofit organizations that address statewide invasive species issues.

1 Extracted from “Proposed Action for the Meeks Bay Restoration Project.” US Forest Service Lake Tahoe Basin Management Unit.

- Montana established an Invasive Species Account in the State Revenue Fund, administered by the Department of Fish, Wildlife & Parks, in 2015 (Appendix H). Montana Code 80-7-1004 adopted in 2019, incorporates language that allows money from any source to be deposited into the account for prevention or control of aquatic invasive species, transfers interest, earnings, and unreserved funds in the account to the invasive species trust fund, and prevents Montana Fish, Wildlife & Parks from recovering indirect costs from the account.

The core elements of an invasive species fund document the source of the funds, the location where funds are kept, the purpose and process for which funds are disbursed, statutory protections that prevent the fund from being “swept” if funds are not spent after a period of time, and the desired minimum level of funding in the account (Appendix H). This Action Agenda includes a budget item to develop and maintain a Lake Tahoe AIS Emergency Fund.

Phase I: \$7,220,000 | **Phase II:** \$3,280,000



► **Table 4. Administration strategies, desired outcomes, lead, budget, and timeline, 2021–2030. Note: Costs were based on estimated acreages and control methods (Appendix F).**

Strategies	Desired Outcomes	Lead	Phase I Costs (2021–2025)	Phase II Costs (2026–2030)
4A. Bi-annually document high-risk invasive species that have the potential to cause the greatest ecological, economic and social harm to the Region. Define pathways of introduction.	By December 2020, conduct a high-risk AIS assessment to identify potential high-risk species and pathways of introduction that pose significant environmental, economic, and/or cultural impacts to the Region.	TRPA	\$60,000 in 2022 and 2024 = \$120,000 total	\$60,000 in 2026, 2028, and 2030 = \$180,000 total
4B. Expand the capacity of the LTAISCC to incorporate scientists as LTAISCC members (funds flow through LTAISCC).	Fund, by 2021, a Tahoe Science Advisory Council designee to represent the scientific community at the LTAISCC meeting on a consistent basis.		\$20,000 annually for 10 years = \$200,000 total	
4C. Establish an AIS partnership program at Lake Tahoe with industry, marinas and others to enhance prevention and control efforts.	By 2025, ensure 1 or more Lake Tahoe locations participates in a partnership program to advance infrastructure advancements at marinas and other lake locations.		\$2,000,000	
4D. Establish a \$2 million Emergency Fund for the Lake Tahoe Region to address new invasive species introductions to the Region.	By 2025, a \$2 million Emergency Fund is established.		\$2,000,000	
4E. Add capacity to TRPA and Tahoe RCD to ensure adequate staffing exists to implement this Action Agenda.*	By 2021, staffing capacity has been added to TRPA and Tahoe RCD to administer and implement this Agenda.	TRPA, Tahoe RCD	\$900,000 annually for 10 years = \$9,000,000 total	
TOTALS			\$7,220,000	\$6,280,000

Research and monitoring costs include an estimated 50% indirect costs (university and federal agency average rate)

* Recommended staffing adds capacity for project management and outreach (estimated 6 FTE annually @ \$150K/FTE).

► **Table 5. Total estimated costs (Tables 1–4) for aquatic invasive plant, invasive fish, aquatic invasive invertebrate, and invasive amphibian control, monitoring, and research, and administration, 2021–2030.**

	Phase I	Phase II
Aquatic invasive plants	\$22,250,000	\$24,700,000
Invasive fish, aquatic invasive invertebrates, invasive amphibians	\$2,625,000	\$1,845,000
Research and monitoring	\$4,290,000	\$5,235,000
Administration	\$7,220,000	\$6,280,000
SUBTOTALS	\$36,385,000	\$38,060,000
TOTAL	\$74,445,000	

The following is a summary of four potential options for treating AIS in the Region from 2021–2030, ranging from a comprehensive all-taxa option (Option A) to status quo (Option D). Table 6 highlights specific strategies in Tables 1–4 that would be implemented under each option. Although Option A is the preferred option, the other three options are presented should regional leaders have challenges funding the preferred option.

Option A: All-taxa control throughout Region, including Tahoe Keys

Option A is a 272% increase in pace and scale relative to current efforts, is the most strategic option relative to long-term investment of resources and return on investment, and minimizes long-term maintenance and control costs as well as detrimental effects to ecosystem function. Implementing Option A would result in a predicted 90% reduction to eradication of AI plants in nearshore and upstream areas and the Tahoe Keys, a 90% reduction in invasive fish biomass in Tier 1 and Tier 2 areas, and reductions of aquatic invasive invertebrates and amphibians in regions of the lake and upstream areas. Option A supports EDRR throughout the Region as well as newly developed detection and monitoring tools, and comprehensive nearshore-wide and in situ diver survey and drone transects. Option A supports investment in new technologies and methodologies to control aquatic invasive species, a bi-annual high-risk invasive species assessment, investment in a marina engagement strategy, and the creation of an emergency invasive species fund. This option best supports recovery efforts associated with Lahontan Cutthroat Trout. Six additional FTEs would be hired to provide expanded staff capacity to implement this option.

Risks: This option minimizes short- and long-term economic and environmental risks by taking a comprehensive, aggressive, all-taxa approach aimed at protecting, restoring, and enhancing fish and wildlife habitat and the suite of ecosystem services the Lake Tahoe Region provides.

Option B: Plant-only control throughout Region, including Tahoe Keys

Option B is a 188% increase in pace and scale relative to current efforts, is the second best strategic option relative to long-term investment of resources and return on investment, and ranks second relative to long-term maintenance and control costs as well as detrimental effects to ecosystem function. Option B reduces AI plants in the region (from 90% reduction to eradication), including the Tahoe Keys, and includes expanded support for EDRR, surveys, monitoring, and development of technologies and methodologies for control. Similar to Option A, Option B includes the bi-annual high-risk invasive species assessment, investment in a marina engagement strategy, and the creation of an emergency invasive species fund. Four additional FTEs would be hired to provide expanded capacity to implement this option.

Risks: This option takes an aggressive approach to controlling AI plants in the region, including the Tahoe Keys, but does not address aquatic invasive fishes, invertebrates, and amphibians, which are known to have significant effects on ecosystem function. Failure to address taxa other than plants exposes the region to significant long-term economic and environmental risks.

Option C: Plant-only control throughout the Region, excluding Tahoe Keys

Option C is a 50% increase in pace and scale relative to current efforts, and provides some additional important enhancements over and above status quo. This option would achieve a 90% reduction of aquatic invasive plant control in nearshore areas, excluding the Tahoe Keys, in which containment would be the goal.

Risks:

Long-term maintenance costs under this option would be significant, and return on investment would rank third among the four options. This option does not address invasive taxa other than plants, and does not address invasive plants in areas other than the nearshore and upstream areas. This option is focused on containment, not control or eradication, in the Keys, providing a potential continual source of aquatic invasive species spread, even with significant containment efforts. There would be no attempts at controlling taxa other than invasive plants. No additional science or research would be funded to understand the biology of invasive species in the Tahoe Region, including the development and testing of new technologies or methodologies for control. Only two additional staff would be hired to address aquatic invasive species, leaving the Region understaffed. Compared to Option D, this option better positions the Region for understanding the status of aquatic invasive species through enhanced surveys and a bi-annual high-risk assessment. The implementation of an enhanced marina strategy could lessen the risk of AI plant spread from marinas, and the creation of an emergency fund would position the Region to respond to a significant new invader. However, long-term, significant degradation of Lake Tahoe ecosystems would be expected by implementing Option C.

Option D: Plant-only control in nearshore, excluding Tahoe Keys

Option D represents the status quo, or current levels of investment (\$1.5 to \$2 million annually). This option is the least strategic option relative to long-term investment of resources, has the lowest return on investment, and results in the greatest long-term maintenance costs and most significant costs to ecosystem function in the Region.

Risks: This option does not address invasive taxa other than plants, and does not address invasive plants in areas other than the nearshore. This option is focused on containment, not control or eradication, in the Keys, which would provide a continual source of AIS spread. This option would not reduce AIS in upstream areas (providing additional sources of spread), and there would be no assessments or surveys of invasive fish, invertebrates, or amphibians in the Region, and no attempts at controlling taxa other than invasive plants. No additional science or research would be funded to understand the biology of invasive species in the Tahoe Region, including new technologies or methodologies for control. No emergency fund would be created to address new priority invaders, and no expanded marina strategy would exist to address infrastructure improvements that lessen the spread of aquatic invasives. No additional staff would be hired to address aquatic invasive species, leaving the Region understaffed. No increase in resources to address invasive species through time, given climate change and other stressors, will increase the vulnerability of the Region to both an expansion of existing aquatic invasive species as well as the introduction and likely establishment of new species to the Region. This option provides the least support for recovery of Lahontan Cutthroat Trout.

► **Table 6. Invasive species strategies from Tables 1-4 that would be implemented under each of three options for the Lake Tahoe Region, 2021–2030, based on available funding.**

Strategies Listed in Tables 1–4	Option A - Fully Implement Action Agenda	Option B	Option C	Option D Status Quo
<p>1A. Establish the baseline for AI plant infestation in all portions of the lake (to complement the lake-wide survey recently completed).</p> <p>1B. Implement a full suite of control actions, using an integrated management approach, to reduce the abundance and distribution of AIS in regional waters (see Table 1A for a prioritized list of locations and actions).</p>	90% reduction to eradication in near-shore and tributaries	90% reduction to eradication in near-shore and tributaries	90% reduction in near-shore	90% reduction of aquatic invasive plants in nearshore
<p>1C. Implement a full suite of control actions, using an integrated management approach, to reduce the abundance and distribution of AIS in the Tahoe Keys.</p>	90% reduction to eradication in Tahoe Keys	90% reduction to eradication in Tahoe Keys	Containment only in Tahoe Keys; no control	Containment only in Tahoe Keys; no control
<p>1D. Implement EDRR control actions to ensure no new AI plant populations become established in the Region.</p>	X	X	X	X
<p>1E. Environmental documentation for the Tahoe Keys – 2nd round for stakeholder engagement.</p>	X	X		
<p>2A. By 2030, reduce by 90%, invasive fish biomass (densities measured as Catch Per Unit Effort) and size classes in Tier 1 areas and Tier 2 areas via mechanical removal (electroshocking and targeted invasive fish nest control).</p>	X			
<p>2B. Depress aquatic invasive invertebrates to population levels that minimize impacts to ecosystem function in designated regions of the lake.</p>	X			
<p>2C. Depress bullfrogs to population levels that minimize impacts to ecosystems function in designated regions of the lake.</p>	X			
<p>3A. Develop detection and surveillance monitoring tools, such as eDNA, to enhance detection of organisms and the probability of capturing eDNA.</p>	X			
<p>3B. Conduct experimental studies to determine the ability to regionally depress Signal crayfish and mysid shrimp populations.</p>	X			
<p>3C. Conduct a broad spectrum nearshore-wide census every 2 years for six years, and then once every 5 years; conduct in situ diver survey transects and drone surveys at 25 priority locations during intervening years.</p>	X	X	X	

▶ Table 6. Invasive species strategies from Tables 1-4 that would be implemented under each of four potential options for the Lake Tahoe Region, 2021–2030, based on available funding.

Strategies Listed in Tables 1–4	Option A Fully Implement Action Agenda	Option B	Option C	Option D Status Quo
3D. Conduct annual monitoring to assess the distribution, abundance and population size/biomass of invasive invertebrates in the Lake Tahoe Region.	X			
3E. Conduct annual monitoring to assess the distribution, abundance and population size/biomass of invasive fish and native fish in Lake Tahoe’s nearshore via 3-4 snorkel surveys in the littoral zone during warm summer months.	X			
3F. Target monitoring: Conduct annual monitoring to assess the distribution, abundance and population size/biomass of bullfrogs in the Lake Tahoe Region.	X			
3G. Invest in new technologies that support AIS control efforts in the Region.	X			
3H. Conduct monitoring to assess distribution, abundance, and population size/biomass of cold/deep water invasive fish and native fish in Lake Tahoe’s offshore via hydroacoustic assessments, trawl netting, and gill netting.	X			
4A. Bi-annually document high-risk invasive species that have the potential to cause the greatest ecological, economic and social harm to the Region. Define pathways of introduction.	X	X	X	
4B. Expand the capacity of the LTAISCC to incorporate scientists as LTAISCC members (funds flow through LTAISCC).	X			
4C. Establish an AIS partnership program at Lake Tahoe with industry, marinas and others to enhance prevention and control efforts.	X	X	X	
4D. Establish a \$2 million Emergency Fund for the Lake Tahoe Region to address new invasive species introductions to the Region.	X	X	X	
4E. Add capacity to TRPA and Tahoe RCD to ensure adequate staffing exists to implement this Action Agenda.	6 additional FTEs	3 additional FTEs	2 additional FTEs	
10-year Action Agenda Totals	\$74.5 M	\$55–60 M	\$28–33 M	\$15–20 M

Figure 4 illustrates the predicted outcomes achieved by implementing Options A–D, highlighting that the greatest gains to biological diversity, the achievement of performance metrics, and the strongest returns on investment are addressed by implementing Option A. Implementing Option A minimizes the detrimental effects to the Lake Tahoe Region while enhancing biological integrity because invasive species populations and distributions are controlled, eradicated, or contained. Implementing Option D (status quo) results in the least protections for biological integrity of the Lake Tahoe Region because of insufficient control and eradication strategies among all invasive species taxa as well as insufficient research, monitoring, and supporting administrative strategies.

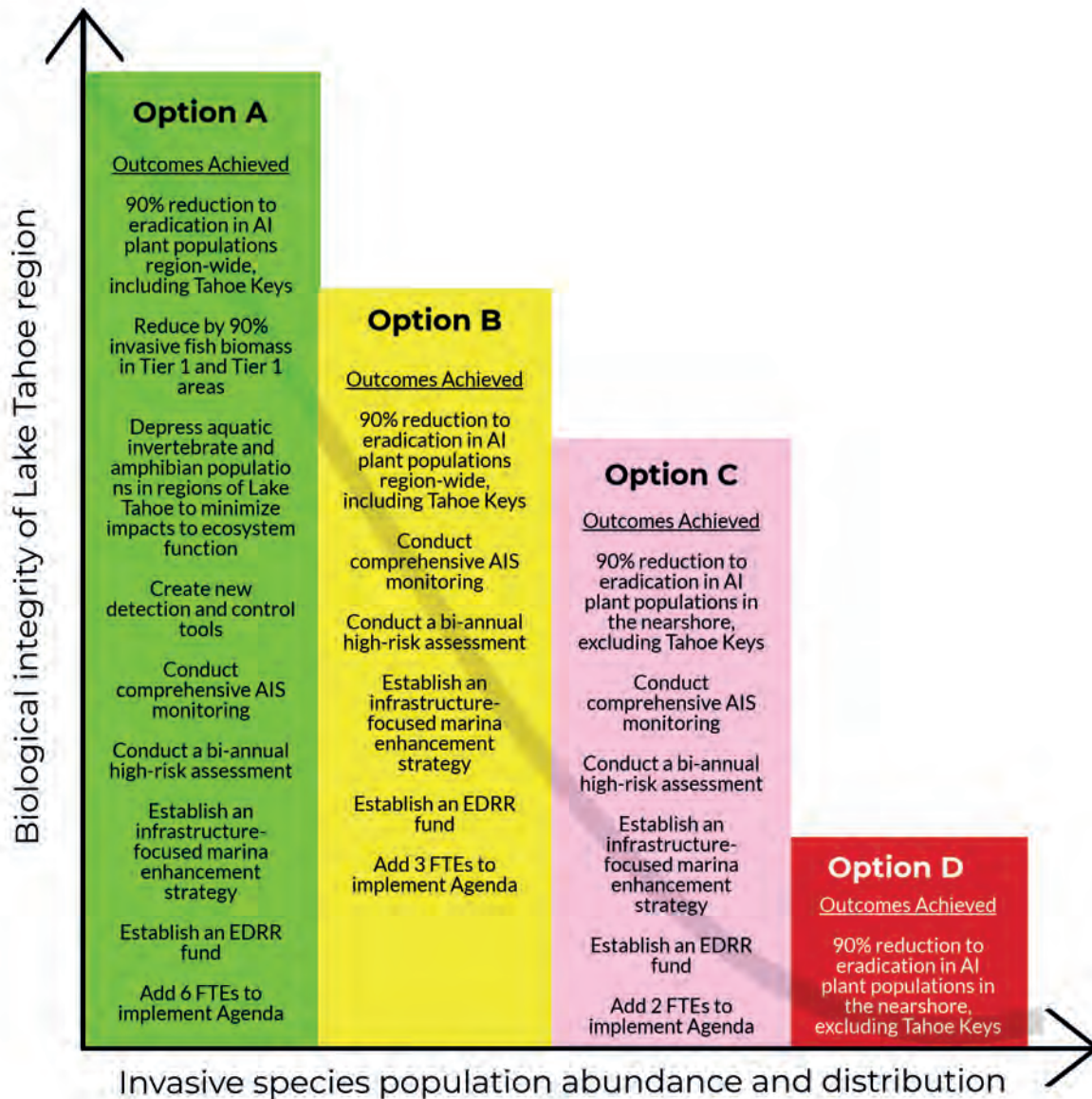


Figure 4. Implementation options A–D.

Strategic Investment Plan

The recommended option that yields the greatest return on investment in aquatic invasive species in the Lake Tahoe Region will cost an estimated \$7.5 million annually from 2021–2023 and represents a 272% increase in pace and scale relative to current AIS control efforts. This level of investment is comparable to other strategic investments made in aquatic invasive species in other regions of the country.

In FY2017, the US government spent an estimated \$3.0 billion across numerous federal agencies and activities to prevent, control, and eradicate invasive species (Congressional Research Service 2018). The most well-known and well-funded regional effort has been the Great Lakes Restoration Initiative, which is supported by annual federal agency appropriation allocations.

Great Lakes Restoration Initiative

One of the Great Lakes Restoration Initiative (GLRI) five focal areas is invasive species. Federal agency allocations from appropriations for invasive species activities have ranged from a low of \$45 million in FY2013 to a high of \$60.2 million in FY2010. The primary source of funds to support the GLRI include seven federal agencies, including the Departments of Homeland Security, Commerce, Defense, Interior, Transportation, Health and Human Services, and Agriculture. In addition, several agencies and entities, including the Environmental Protection Agency, Great Lakes Fishery Commission, International Joint Commission, and miscellaneous individual agencies, contribute toward invasive species activities.

Puget Sound Recovery

Numerous entities provide funding support for recovery and restoration efforts within Puget Sound. The Puget Sound Recovery Caucus documents that every Environmental Protection Agency dollar spent on recovery efforts generates more than \$24 in matching funds from other federal and state agencies, tribes, nonprofit organizations, and other local partners. The highest tier near-term actions in the 2018–2022 Action Agenda for Puget Sound include total \$612,880,033 (Puget Sound Partnership 2018), of which one strategy and two sub-strategies specifically address invasive species:

- Strategy 15: Protect and restore the native diversity and abundance of Puget Sound species, and prevent and respond to the introduction of terrestrial and aquatic invasive species.
 - 15.3: Prevent, and rapidly respond to, the introduction and spread of terrestrial

and aquatic invasive species.

- 15.4: Answer key invasive species research questions and fill information gaps.

The goal of this Strategic Investment Plan (SIP) is to identify traditional and non-traditional sources of funding to achieve the goals and strategies described in this Action Agenda. Elements included in this plan are:

- **A suite of prioritized actions** (Tables 1–4 document the actions that should occur on annual basis from 2021–2030. Tables 1A and 2A prioritize the locations within the Region where these control activities should occur).
- **The types of AIS projects in the basin that have been funded in the past.** Appendix I includes a spreadsheet of AIS control projects that have been funded in the Region in the past, including the sources of those funds.
- **Projected resources likely available for the implementation of future actions, including identification of the gaps.**
 - The Lake Tahoe Restoration Act of 2015, if fully appropriated, would provide between \$6 and \$7 million annually for AIS control efforts, and would provide the majority of funds needed to implement Option A in this Agenda.
 - Senate Bill 630 has a California Tahoe Conservancy allocation of about \$400,000 for invasive species-related work. An estimated 50–75% of these funds would be available for AIS control efforts.
 - An estimated \$150,000 will become available on an annual basis by 2021 from Lake Tahoe boat inspection sticker receipts.
 - Research grants are available on an ongoing basis that could support enhancing the understanding of the life history of priority AIS species as well as the development of innovative technologies and control methods for these species.
 - Implementation of a long-term, 10-year prioritized strategy has the potential to attract large nonprofit foundations that seek to make longer-term, multi-year investments to achieve enhanced ecosystem function.
 - The Forest Resilience Bond model has applicability to the Lake Tahoe Region, especially as it relates to the Tahoe Keys, and could engage a substantial amount of private investors in AIS management efforts in the Region.
 - Annual contributions from California and Nevada state agencies have supported specific projects; it is anticipated contributions from each state will continue.

Ensuring systems are in place to easily receive and disburse funds in a timely and efficient manner is critical to the success of this Agenda. Lake Tahoe Restoration Act of 2015 funds

would be received directly by TRPA, and the creation of an emergency fund, in statute, to be housed within TRPA, would provide a mechanism for housing and disbursing EDRR funds. The proposed increased pace and scale associated with Option A in this Agenda will require enhanced coordination and collaboration among LTAISCC member organizations. Development of multi-agency, multi-partner agreements that solidify commitment and implementation of elements of the Agenda will be an important step in successful implementation of the Agenda.



Recommendations

This Action Agenda provides the context for implementing an all-taxa, comprehensive decadal set of strategies aimed at protecting, restoring, and enhancing Lake Tahoe Region ecosystems through the reduction and/or eradication of priority aquatic invasive species. Implementing this Agenda requires:

- Identifying and securing a significant amount of new funding on an annual basis;
- Documenting progress toward achieving new meaningful performance metrics;
- Enhanced staffing and resources to administer projects and administer an expanded AIS program;
- Enhanced outreach and education to increase awareness, understanding, and support for an expanded AIS program;
- Annual review and updating of priority project locations and acreages; and
- Numerous other activities.

In addition to implementing all of the strategies associated with Option A in this Agenda to achieve the highest return on investment, maximize benefits to ecosystem services, and minimize risk and degradation to fish and wildlife habitats in the Region, the following recommendations are made to ensure success:

Funding Committee

Maintain a working AIS Funding Committee to articulate and maintain 5–10 year funding outlooks and develop and implement strategies to obtain those funds well in advance of project implementation.

Performance Metrics

Continue to document programmatic effort-based metrics while adding outcome-based metrics in the categories of plants, invasive fish, aquatic invasive invertebrates, and invasive amphibians to measure progress and success in controlling AIS in the region and to demonstrate the results of strategic resource investments. Incorporate new metrics into the EIP Tracker.

Annual Priorities

Update Table 1A annually to ensure the LTAISCC has a shared understanding of the status of AIS infestations and to ensure existing resources are dedicated to the highest priority locations and EDDR. Incorporate all elements of Table 1A into future iterations of the EIP Tracker to ensure alignment with AIS priorities.

Permits

Work with regulatory agencies to ensure permits needed for AIS control and implementation (Appendix G) are acquired in a timely manner and in advance of all project activities.

Regional Structured Decision Making

Ensure the LTAISCC implements structured decision making, focusing on objectives, incorporating scientific predictions, dealing with uncertainty, and responding to societal values as it determines and implements AIS priorities in the Region. Annually review and assess progress, and make adjustments to annual operations that reflect lessons learned and new information.

Societal Values

Survey regional stakeholders every five years to assess attitudes and beliefs regarding AIS and to inform new and innovative approaches relative to AIS messaging and behavioral change.



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Appendix A

Survey Instrument

Contact Information

- Name, Address, Email, Organization Name, Type of Organization

Defining AIS Success in the Lake Tahoe Region

- What do you believe is a realistic 5-year goal relative to the control of AIS in the Lake Tahoe region?
- Please define how you would describe success relative to control of AIS in the Lake Tahoe region.
- For the definition of success you selected/described above, when do you believe the Lake Tahoe region is capable of achieving that level of success?
 - o One year
 - o Three years
 - o Five years
 - o Within 10 years
 - o Other
- Do you believe the implementation actions described in the Implementation Plan for the Control of Aquatic Invasive Species within Lake Tahoe (2015) will achieve your desired level of success in controlling AIS?
 - o Yes
 - o No
 - o Maybe
 - o I don't know
- If you answered “No” or “Maybe” to the question above, what do you believe needs to occur to achieve the level of success you described (either in addition, or in place of, what was described in the Implementation Plan)?

Aquatic Invasive Species Control Efforts

- Who do you believe should be responsible for controlling AIS in the region? Select all that apply.
 - Government agencies
 - Private landowners
 - Businesses
 - Visitors
 - Environmental groups
 - Other
- How would you rate the control efforts of the following in the Lake Tahoe region? (Ineffective, Somewhat effective, Effective, I don't know)

Overall efforts to date to control and prevent the spread of AIS

Control efforts associated with invasive aquatic plants (e.g., Eurasian watermilfoil, Curlyleaf pondweed)

Control efforts associated with Asian clams

Control efforts associated with invasive warm water fishes

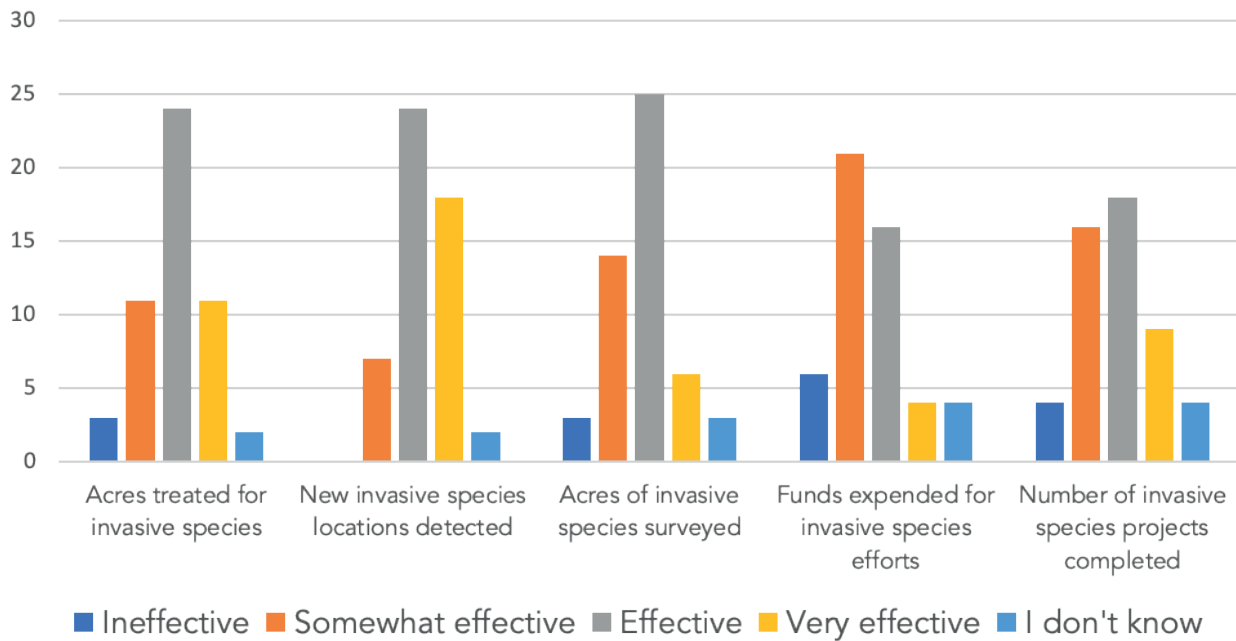
Control efforts associated with signal crayfish

Control efforts associated with bullfrogs

- If you rated the efforts associated with controlling AIS in any category (above) as only somewhat effective, or ineffective, please explain.
- Please order the list below relative to the criteria that should be used to prioritize AIS control efforts. You can move items in the list by clicking, holding, and moving, and the items will renumber accordingly.
 - Multiple invasive species at site
 - Size of AIS infestation
 - Proximity to highly used recreation sites
 - Location of infestation relative to native species and habitats
 - Cost of implementation
 - Ability to achieve goals (e.g., eradication, control, containment)
 - Economic effects on property values and businesses
 - Potential for AIS population to spread
- Is there anything you would like to add relative to AIS control in the region?

Funding Aquatic Invasive Species Control Efforts

The region-wide actions that will be formed will be supported by the development of an investment plan that charts a path forward to implement control actions. The chart below depicts funds expended for AIS efforts in the region since 2010.



- Are you satisfied with the amount of resources that have been expended since 2010 to control AIS in the region?
 - o Yes
 - o No
 - o I don't know
 - o Other
- If you selected “No” to the above question, please state why.
- Do you support a diversity of entities contributing to AIS control efforts in the region?
 - o Yes
 - o No
 - o I don't know
 - o Other

- For each entity below, please designate what percentage of funding you believe the entity should contribute for AIS control in the Lake Tahoe Basin. Note: The total of all entities should add up to 100%.

10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Federal government
State government
Local government
Businesses
Private landowners
Visitors to the region
Non-governmental organizations

- Does your organization/entity financially support AIS control in the Lake Tahoe Region?
 - o Yes
 - o No
 - o I don't know
 - o Other
- Do you support local revenue generation for AIS control in the Lake Tahoe Region? (examples: use permits, tourism fees, dedicated funds, charitable contributions)
 - o Yes
 - o No
 - o I don't know
 - o Other
- What ideas do you have to generate alternative sources of funding to support AIS control in the Lake Tahoe Region?

Metrics to Evaluate Progress and Success

The Lake Tahoe Region Aquatic Invasive Species Management Plan was revised in 2014, and the Control of Aquatic Invasive Species Within Lake Tahoe Implementation Plan was completed in 2015. A key next step to addressing AIS control in the region is to develop short- and long-term management region-wide targets to realize desired AIS outcomes for the Lake Tahoe region, ensuring that actions are in alignment with water quality objectives, management goals, thresholds, and other relevant outcomes that have been described through past planning processes. Note: This survey is not seeking to alter existing thresholds, or indicators for thresholds.

- There are five Environmental Improvement Project performance measures for invasive species in the Lake Tahoe Region. Please rate the effectiveness of each of these relative to their ability to evaluate progress in protecting the biological diversity of the Lake Tahoe Region from AIS.

	Ineffective	Somewhat effective	Effective	Very effective	I don't know
Acres treated for invasive species					
New invasive species locations detected					
Acres of invasive species surveyed					
Funds expended for invasive species efforts					
Number of invasive species projects completed					

- If you rated any of the 5 indicators above as ineffective or somewhat effective, please describe why you believe these are ineffective.
- Please provide any suggestions for performance metrics that you believe would be more effective in evaluating progress in protecting the biological diversity of the Lake Tahoe Region from AIS.
- Please list any datasets you have access to, or that you know are available, that could inform a new performance metric.

Thank you for taking the time out of your busy schedule to complete this survey. We appreciate your input, which will help to inform the development of a region-wide action plan to control AIS in the Lake Tahoe Region.

Appendix B

Survey Results

Executive Summary

In 2018, the California Tahoe Conservancy initiated an effort to develop short and long-term management targets and a set of specific actions to control aquatic invasive species (AIS) in the Lake Tahoe region while ensuring the actions are in alignment with water quality objectives, Environmental Improvement Plan indicators, Tahoe Regional Planning Agency (TRPA) thresholds, and other relevant outcomes that have been described through past planning processes.

A 21-question survey instrument was developed and distributed to 140 individuals in the Lake Tahoe region; a total of 54 individuals representing 34 entities completed the survey. In addition, a series of discussions and follow-up interviews were conducted with several individuals in the region.

There is alignment between the goals and objectives in the AIS management and implementation plans for Lake Tahoe and regional survey respondents and interviews. In general, it is well recognized that preventing new introductions and reducing, and in some cases, eradicating, existing AIS populations will advance social, economic, and environmental goals in the region, particularly as it relates to water quality. Most survey respondents suggest these goals can be achieved in 5–10 years with enhancing funding, capacity, and effort, but that this may not be achieved without being able to use a full complement of control methods, including herbicides.

The majority of respondents concur that government agencies, private landowners, businesses, environmental groups and visitors should be the primary entities responsible for controlling AIS in the region. In addition, respondents expressed that overall efforts to date to control and prevent the spread of AIS have been somewhat effective to effective, however, there was much more uncertainty expressed relative to bullfrogs, Signal crayfish, invasive fishes, and Asian clams compared to aquatic invasive plants. This result is likely indicative of lack of knowledge associated with non-plant taxa, including lack of documented effective controls and population status.

Respondents ranked the top three criteria that should be used to prioritize AIS control efforts

as “potential for AIS population to spread,” “size of AIS infestation,” and “ability to achieve goals.”

There is support for a diversity of entities contributing to AIS control in the region. Satisfaction with the amount of resources expended to date for AIS control was almost evenly split among “Yes” and “No” respondents, and almost 1/5 did not have enough knowledge to assess. Respondents expressed support for federal, state, and local governments bearing the brunt of the costs for AIS control, followed by businesses. Most respondents (89%) support local revenue generation for AIS control, and numerous ideas were suggested for revenue generation, such as additional recreational fees, cost-share programs with marinas, and instituting an occupancy tax dedicated to AIS.

Respondents rated the effectiveness of five Environmental Improvement Project performance measures relative to their ability to evaluate progress in protecting the biological diversity of the region from AIS. In general, EIP measures are effort-based versus outcome-based, with the exception of “new invasive species locations detected,” which received the most “effective and very effective” rating. Numerous suggestions were made to improve indicators by focusing more on desired outcomes versus effort and focusing on priority areas identified by previous planning efforts.

Results of interviews and discussions post-survey implementation provided additional insights into current and potential AIS control efforts. Adopting new performance metrics that reflect outcomes, obtaining adequate resources to significantly accelerate the pace and scale of control efforts, and developing a marina-based strategy to enhance control, prevention, and detection efforts at marinas were key recommendations made during the interviews and discussions.

Results from the five EIP Watersheds, Habitat, and Water Quality indicators were compiled, including acres treated for invasive species, watercraft inspections for invasive species, new invasive species locations detected, acres of invasive species inventoried, funds expended, and number of projects completed. In addition, nine Tahoe Regional Planning Agency (TRPA) thresholds were reviewed. Federal Clean Water Act water quality standards, including beneficial uses, were compiled. EIP indicators, TRPA thresholds and water quality standards were incorporated into a matrix to illustrate the relationship of existing AIS-related metrics to these standards, indicators and thresholds. Several examples of AIS indicators and thresholds from other regions of the country were researched and included.

The results from this report are intended to inform the development of the Lake Tahoe AIS Action Agenda, 2021–2030. Specifically, these results will be used to:

- Suggest a suite of new AIS performance metrics that are outcome-based and align with EIP indicators, TRPA thresholds, and water quality standards. Results chains will be developed to ensure the new metrics focus on outcomes achieved from stated goals.
- Develop a suite of control strategies that accelerates both pace and scale of current control efforts through enhanced and broad-based funding and capacity during the next 10 years.
- Develop AIS control strategies based on the top three criteria regional representatives believe should be used to prioritize AIS control efforts, including potential for the AIS population to spread, size of AIS infestation, and ability to achieve goals.

Background

The introduction and establishment of aquatic invasive species (AIS) have resulted in economic and environmental impacts to the Lake Tahoe Region, including detrimental effects on the region's water quality, aesthetic values, recreation, tourism, and property values (TRPA 2014).

In 2018, the California Tahoe Conservancy initiated an effort to collaborate with key regional representatives to advance the *Lake Tahoe Aquatic Invasive Species Management Plan* (TRPA 2014) and the *Implementation Plan for the Control of Aquatic Invasive Species Within Lake Tahoe* (Wittman and Chandra 2015) to develop short and long-term management targets and a set of specific five-year actions to realize the desired outcomes of these plans while ensuring the actions are in alignment with water quality objectives, Environmental Improvement Plan indicators, Tahoe Regional Planning Agency (TRPA) thresholds, and other relevant outcomes that have been described through past planning processes. The five-year actions are intended to be supported by the development of an investment plan that charts a path forward to obtain the funds, from a variety of sources, to implement the actions.

In advance of the development of the Action Agenda, a survey instrument was developed, deployed, and analyzed to assess the perspectives of individuals associated with AIS control efforts, including entities whose businesses and livelihoods would be affected by the existence of AIS (e.g., marina owners). The survey was followed by a series of in-depth, one-on-one, and focus group interviews with key leaders and policy makers in the region. The content obtained from the survey responses and interviews was used to inform the development of the Action Agenda.

Methodology

A 21-question survey instrument was developed and distributed on February 15, 2019 to 140 individuals representing 69 federal agencies, state agencies, local governments, tribes, academic institutions, non-governmental organizations, businesses and property owner associations in the Lake Tahoe region.

The survey questions focused on defining AIS success, AIS control efforts, funding AIS control, and metrics to evaluate progress and success.

Survey recipients were given a deadline of March 8 to complete the survey.

The Lake Tahoe AIS Coordinating Committee (LTAISCC) proposed a list of individuals to interview after the survey instrument was completed. Individuals included executive staff associated with LTAISCC, key business leaders, water purveyors, marina owners, and others. Interviews were conducted during the month of April 2019. Although there were some general questions that were asked of all interviewees, the interviews were intended to provide an opportunity to share elements of the AIS Action Agenda process and better understand the perspectives of those being interviewed relative to long- and short-term AIS control efforts and outcomes.

Results

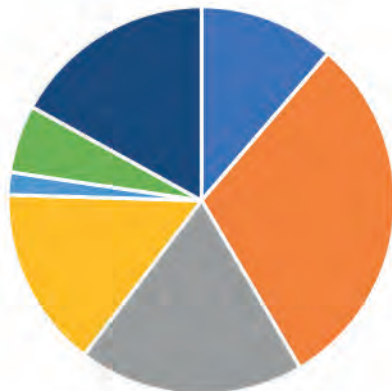
Survey Respondents

A total of 54 individuals representing 34 entities in the region completed the survey (Table 1, Figure 1).

Table 1. Entities that completed the 21-question Lake Tahoe Region AIS Control survey instrument.

Bureau of Reclamation
California Department of Fish and Wildlife
California State Lands Commission
California Tahoe Conservancy
Crystal Shores West HOA
Desert Research Institute
ECHO CHALET, INC
El Dorado County
Homewood High & Dry Marina

Lahontan Regional Water Quality Control Board
Lake Tahoe Visitors Authority
League to Save Lake Tahoe
Meeks Bay Resort/Washoe Tribe of NV & CA
Nevada Division of State Lands
Nevada State Parks
North Tahoe PUD
NV Division of Environmental Protection
Sierra Boat Co.
Sierra Ecosystem Associates
Ski Run Marina
South Tahoe Public Utility District
Sunnyside Marina
Tahoe Fund
Tahoe Keys Marina
Tahoe Keys Property Owners Association
Tahoe Lakefront Owners' Association
Tahoe RCD
Tahoe Regional Planning Agency
Tahoe Resource Conservation District
University of California – Santa Barbara Natural Reserve System
University of Nevada, Global Water Center
U.S. EPA
US Fish and Wildlife Service
US Forest Service
USFS- Lake Tahoe Basin Management Unit
Washoe County Commission
Waterweed Solutions



- Federal government
- State government
- Local/county government
- Business
- Community organization
- Private entity
- Environmental organization

Defining AIS Success in the Lake Tahoe Region

The AIS Action Agenda is intended to achieve the goals stakeholders have for AIS control in the Lake Tahoe region, therefore defining success at the local level is critical to plan development and implementation.

Survey recipients (n=53) described a realistic 5-year goal for AIS control in the areas of management, prevention, control, monitoring, funding, permitting, research, and public support/buy-in/outreach.

- Prevention:
 - Prevent the introduction and establishment of new AIS populations
 - Prevent the spread of existing AIS populations
 - Continued prevention efforts for all other invasive animals
 - Continue the watercraft inspection and decontamination program (expand stations and incorporate Blue Boating stickers)
 - Implement outreach and education associated with the spread of Asian clams (ballast water)
- Control:
 - Reduce and contain existing AIS populations
 - Reduce AIS in the Tahoe Keys and at marinas; implement management plan
 - Control and limit the spread of Asian clams
 - Eradicate small plant infestations
 - Remove all AIS populations outside of the Tahoe Keys
 - Support and implement innovative technologies to address AIS
 - Address effects of cyanobacteria from rapid removal of AIS
 - Implementation of AIS management plans for marinas with past/present AIS
 - Plan:
 - Adopt and implement an integrated weed management plan for Tahoe Keys
 - Rank and prioritize AIS based on potential harm
 - Update the implementation plan
 - Updated spatial maps identifying known AIS locations and high-risk zones
- Monitoring:
 - Create and implement a lake-wide (public/private) monitoring and surveillance plan – conduct annual monitoring
- Funding:
 - Securing funding to address identified priorities, implement EDRR, and monitoring

- o Enhance partnerships with marinas for funding and control of AIS
- Permitting:
 - o CEQA/NEPA completion, and issuance of permits
- Research:
 - o Support Lake Tahoe as a location to pilot AIS technologies and strategies, including control techniques for species that currently do not have well-developed, effective control methods
- Public support/buy-in/outreach:
 - o Achieve levels of support/buy-in/consensus: 90% buy-in and participation by the public and 100% support by the private business sector.

One survey respondent noted, “. . . this window for eliminating species is rapidly diminishing as populations increase in coverage or density in their existing habitats. Simply, with greater densities and coverage, there will be more resources needed for control, which I think will be difficult to obtain in the future at sufficient levels. We need agencies to lead these efforts here, and use science to help evaluate the impacts of control methods at the larger scale of application.”

Survey respondents (n=53) defined success relative to AIS control in the region relative to prevention, control, research, Early Detection Rapid Response, funding, and monitoring.

- Prevention: No new introductions or detections of currently established species in new areas (expressed in acres), a strong prevention and detection program, public education and outreach (document an increase in number of people reached), enhanced collaboration and coordination and new partnerships, enhanced quality control on rental boats and boats in marina slips (e.g., monthly inspections), removal of nutrients from nearshore. Establishment of a permanent lake-wide AIS Action Team comprised of experts in AIS management that implements an integrated program funded by a property mil tax, sales and rooms tax.
- Control
 - o Tahoe Keys: 80%–100% reduction in invasive plants; improved water clarity
 - o A percent reduction (decrease in number of sites needing annual maintenance and trend of decreasing infestation acreage) of existing priority AIS populations to complete removal of major plant infestations in priority locations. Several respondents noted that restoring ecological function should be a key goal. Use of new and emerging technologies to control AIS.

Major plant infestations and invasive fish populations eliminated, decreased, reduced, or contained to specific areas (e.g., eradication of Curlyleaf pondweed)
Decrease of AIS along Lake Tahoe’s shoreline
Reduction in density and acreage of AIS infestations; containment of existing weed populations
Incorporate climate change consideration in control efforts
Implementation of an integrated management program that includes all proven methods to achieve 2, 3 and 5-year goals.

- Research: A cost-effective method to reduce Asian clams, tools to address infestations (including new strategies and knowledge of species)
- Early Detection Rapid Response: Implement Eyes on the Lake
- Funding: Identification of new funding sources for lake-wide program and dedicated sources of funding for control, monitoring, surveys, and research
- Monitoring: Lake-wide monitoring to identify new/expanding AIS populations

For the definition of success that each respondent described, respondents provided the time frame they believed was feasible to achieve that level of success. The majority of respondents (50%) provided a 10-year time frame.

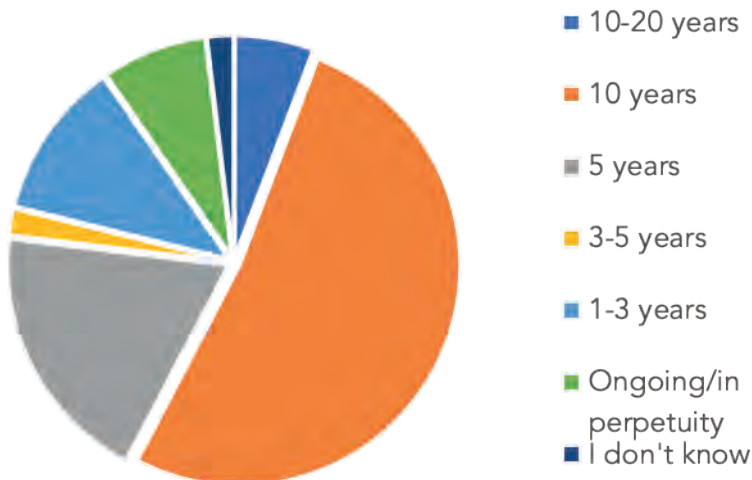


Figure 2. Time frame to achieve success for AIS efforts in the Lake Tahoe region ranged from one year to 10–20 years (n=52).

Respondents were asked if they believe the actions described in the Implementation Plan for the Control of Aquatic Invasive Species Within Lake Tahoe (2015) will achieve their desired level of success controlling AIS. The majority of respondents (51%) stated “Maybe”, followed by and percentage of “Yes” and “I don’t know” (17% each), and “No” (15%) responses.

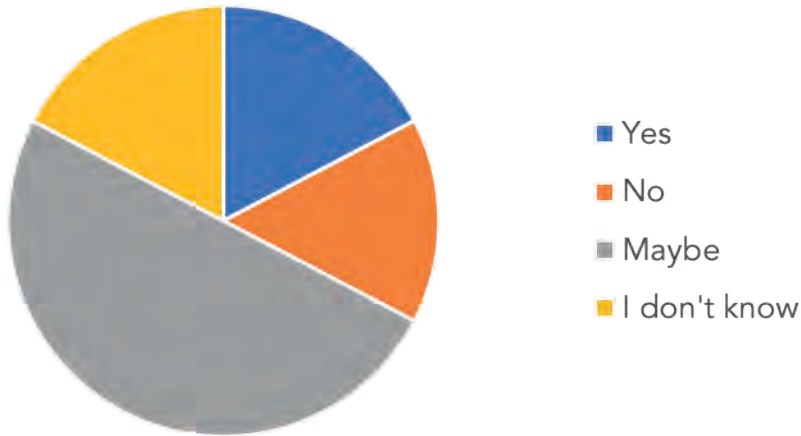


Figure 3. Percentage of respondents that believe the actions described in the Implementation Plan for the Control of Aquatic Species Within Lake Tahoe (2015) will achieve their desired level of success (n=52).

Respondents that answered “No” or “Maybe” to previous survey question were given an opportunity to describe what needs to occur to achieve the level of success they described. A total of 29 respondents provided input.

- Make all tools available for control, pursue control aggressively and simultaneously, and unify efforts across agencies and groups to control priority species in priority locations.
- Update the Implementation Plan for the Control of Aquatic Species Within Lake Tahoe (2015) to address emerging Ultraviolet Light technology, emerging strategies addressing invasive fish populations, Signal Crayfish, and Asian clams, and additional and anticipated AIS introductions and the potential response to those introductions.
- The implementation plan does not identify specific treatments and locations for target invasive species.
- Support the use of herbicides as well as more aggressive, systematic approaches to treating AIS in the region with committed funding and resources.
- Local agencies should be less risk-averse and more proactive in treating AIS.
- Improved understanding of climate change effects on Lake Tahoe and AIS populations would improve the ability to address AIS.
- Adopt an integrated management plan for the Tahoe Keys.
- Increase resources and capacity for prevention efforts.
- Improve monitoring to detect the spread of existing populations and introductions of new AIS.

- More research on control techniques available, and approval of existing techniques.
- Consistent and dedicated participation by all partners in the region, including marinas for funding and control.

Respondents were asked who they believe should be responsible for controlling AIS in the region. All respondents stated that government agencies should be responsible, followed by private landowners (81%), businesses and visitors (74% each), and environmental groups (68%). The remaining four categories included scientists, schools, community groups, marinas, residents, and boaters.

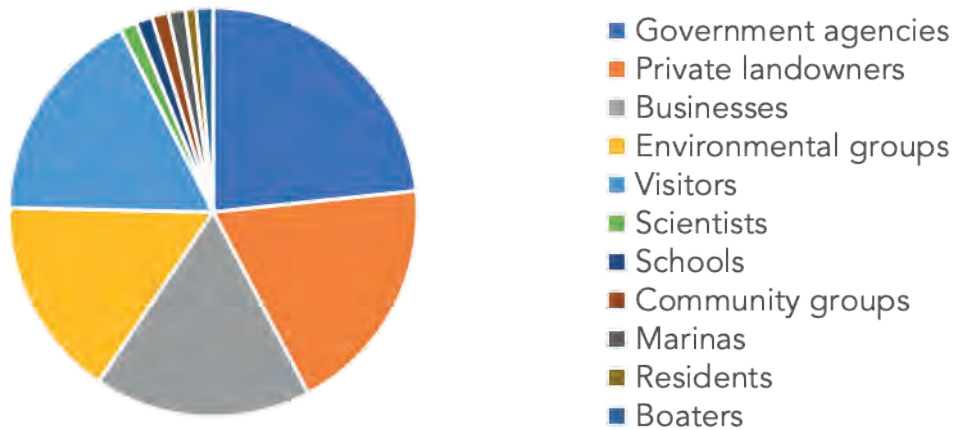


Figure 4. Entities that should be responsible for controlling AIS in the Lake Tahoe region (n=53).

Aquatic Invasive Species Control Efforts

Respondents were asked to rate a variety of efforts associated with control of AIS in the region. All respondents (n=53) answered the question.

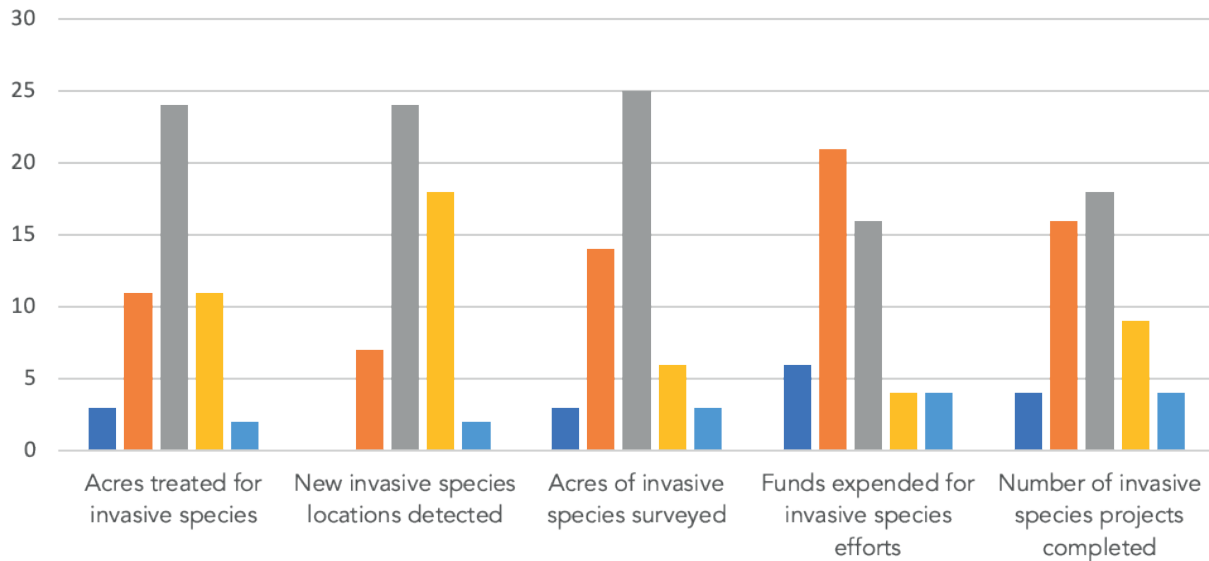


Figure 5. Ratings of efforts associated with control of AIS in the region (n=53).

Respondents that answered “Somewhat effective” or “Ineffective” to the previous question were given an opportunity to explain their response. A total of 35 respondents provided additional information. Respondents described the spread of aquatic invasive plants from the Tahoe Keys to other portions of the lake, and the lack of effective controls for Asian clams, Signal crayfish, bullfrogs, and invasive fishes. One respondent noted that bullfrogs and Curlyleaf pondweed should be priorities because of their ability to spread. Several respondents noted both the spread of AIS throughout the region and the need to address AIS in the Tahoe Keys portion of the lake. One respondent commented there needs to be more consistency among marinas and boat owners relative to compliance with *Clean, Drain, Dry* practices. Another commented on the need for more financial resources and capacity coupled with an aggressive approach to address existing invasives; one respondent stated control activities are limited by funding, which limits long-term effectiveness for comprehensive AIS control. One respondent noted that control efforts have been somewhat effective, but a plan needs to be implemented to reverse the damage caused by invasives. One respondent described the need to address non-plant AIS with the same level of effort as plant AIS, and several commented on the need to increase the pace and scale of control efforts to address increasing AIS populations. One respondent stated that proven, safe, and fully integrated methods have not been implemented to date because of regulatory agencies.

Respondents were asked to order a list relative to the criteria that should be used to prioritize AIS control efforts. The chart below (Figure 6) identifies the top 3 criteria that respondents (n=53) selected.

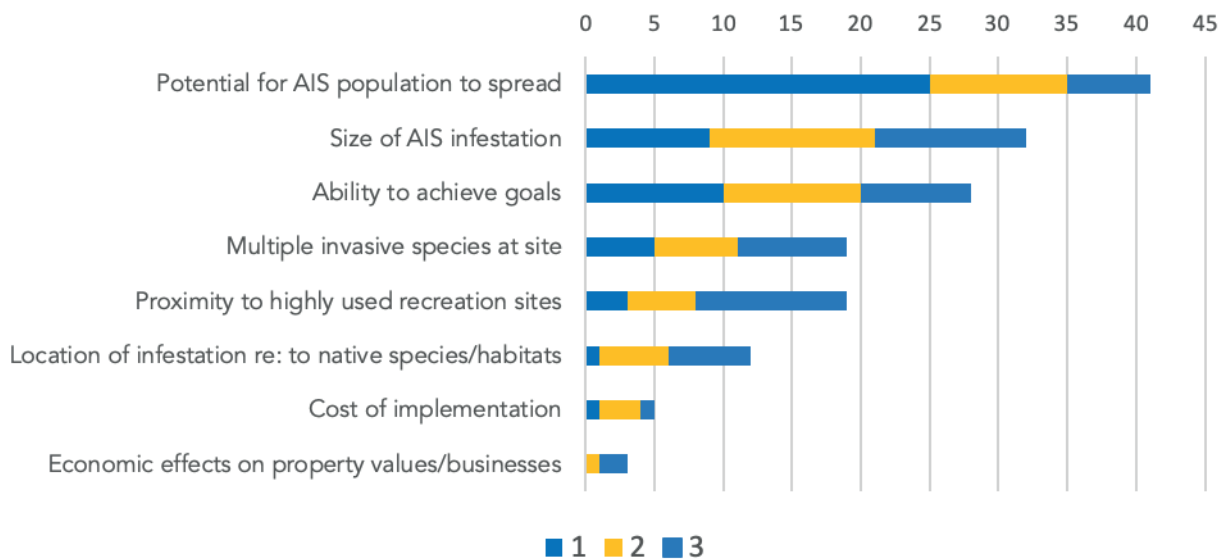


Figure 6. Criteria that should be used to prioritize AIS control efforts (n=53).

Respondents were asked if they were satisfied with the amount of resources that have been expended since 2010 to control AIS in the region.

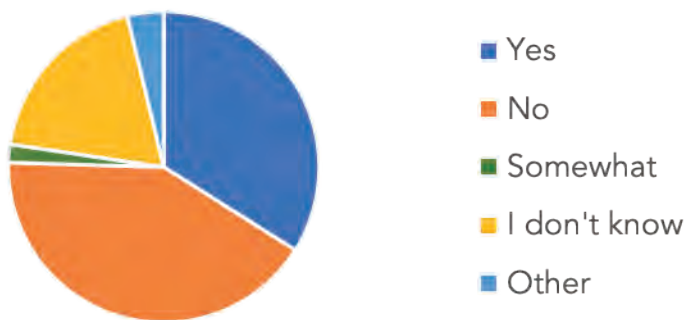


Figure 7. Satisfaction with the amount of resources that have been expended since 2010 to control AIS in the region (n=53).

Respondents that answered “No” to the previous question were given an opportunity to state their reasoning. Comments included: Existing financial resources are neither solving the problem nor addresses barriers to success, there are shrinking contributions from federal and California government agencies (e.g., federal share has not been fully realized during the past 3-5 years), resources are being used opportunistically versus strategically, permanent boat inspection stations and enhanced control efforts are needed, there are no correlations to out-

comes (which makes it difficult to assess whether funding levels are adequate), Nevada needs to fund more of its share, investments are too variable through time (resulting in piecemeal efforts versus programmatic implementation), visitors could contribute \$1 each (contributing a total of \$8 million annually), there is lack of recognition by policy makers regarding the potential cost to the environment and Tahoe communities if invasive species become established, a cost-benefit analysis needs to be conducted to determine if investments are making a difference in AIS control, and private and local governments should contribute to AIS control (n=24).

Respondents were asked if they support a diversity of entities contributing to AIS control efforts in the region. A total of 51 respondents answered “Yes”, one responded, “No,” and one responded, “I don’t know” (n=53).

Respondents were asked what percentage of funding entities should contribute to AIS control in the region.

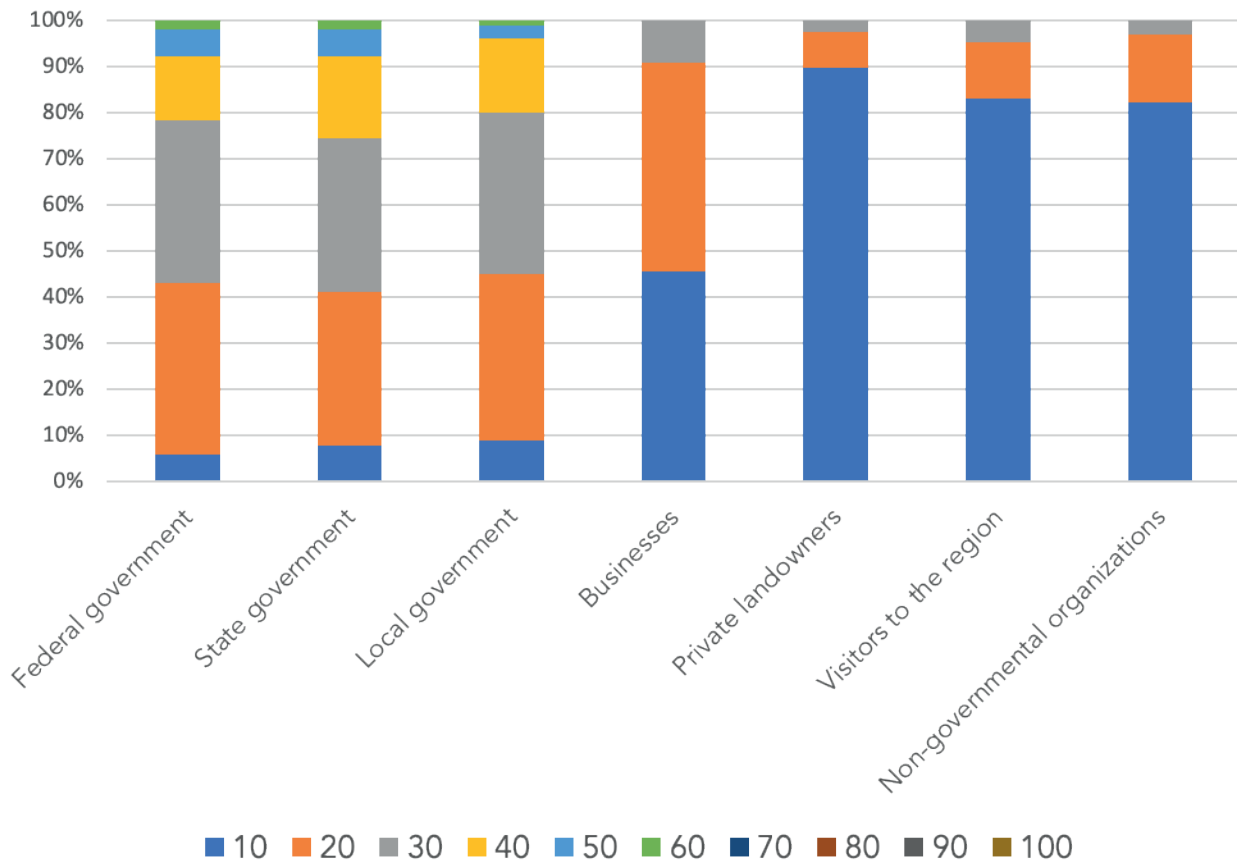


Figure 8. Percentage of funding entities should contribute to AIS in the region (n=53).

A total of 12 of the 50 survey respondents indicated their entities did not financially support AIS control in the Lake Tahoe region. Of the 12 respondents that indicated, “No”, six were local government entities, four were state government entities, one was a community organization, and one was a federal agency.

Respondents were asked if they support local revenue generation for AIS control in the Lake Tahoe region. A total of 48 respondents stated, “Yes”, five respondents stated, “Maybe”, and one respondent stated “No” (n=54).

Respondents were asked what ideas they have for revenue generate to support AIS control in the Lake Tahoe region. Answers included enlisting the aid of the Tahoe Shoreline Owners Association, enhancing cost-share with marinas for control efforts, developing an AIS Mitigation Free for projects involving AIS impacts (and using the funds for control projects), volunteers to help control AIS, implementing local property taxes for basin residents and businesses (e.g., property parcel fee), implementing access and user fees as well as local bonds, restructuring how the Department of Motor Vehicles allocates funds from boat licenses and requesting a statewide increase in vehicle registration and boater registration fees, instituting toll stations conducting special events, disbursing grants for research projects to address AIS that current have no known control method (e.g., Asian clams), instituting a business improvement district tax (defining the district by its relationship to the lake), receiving additional support from local businesses, requesting public donations, hosting competitions for invasive fish and Signal crayfish, working with the boating industry to support a point of sale fee to support nationwide research on AIS control, instituting recreation fees for boats, developing a local beer and using the proceeds to benefit AIS while raising awareness, creating a market for AIS on local menus, instituting an occupancy tax dedicated to AIS, increasing inspection fees, implementing tourism fees and taxes as well as fees added to rental activities (e.g., skiing, water sports), instituting marina fees, considering marina and pier developments that do not encourage AIS establishment and spread, develop a region-wide point of purchase opt-out surcharge, use SB 630 funds for AIS control and scientific studies to inform management and monitoring, and contributions from non-governmental organizations (n=39).

Metrics to Evaluate Progress and Success

Respondents were asked to rate the effectiveness of five Environmental Improvement Project performance measures relative to their ability to evaluate progress in protecting the biological diversity of the Lake Tahoe region from AIS.

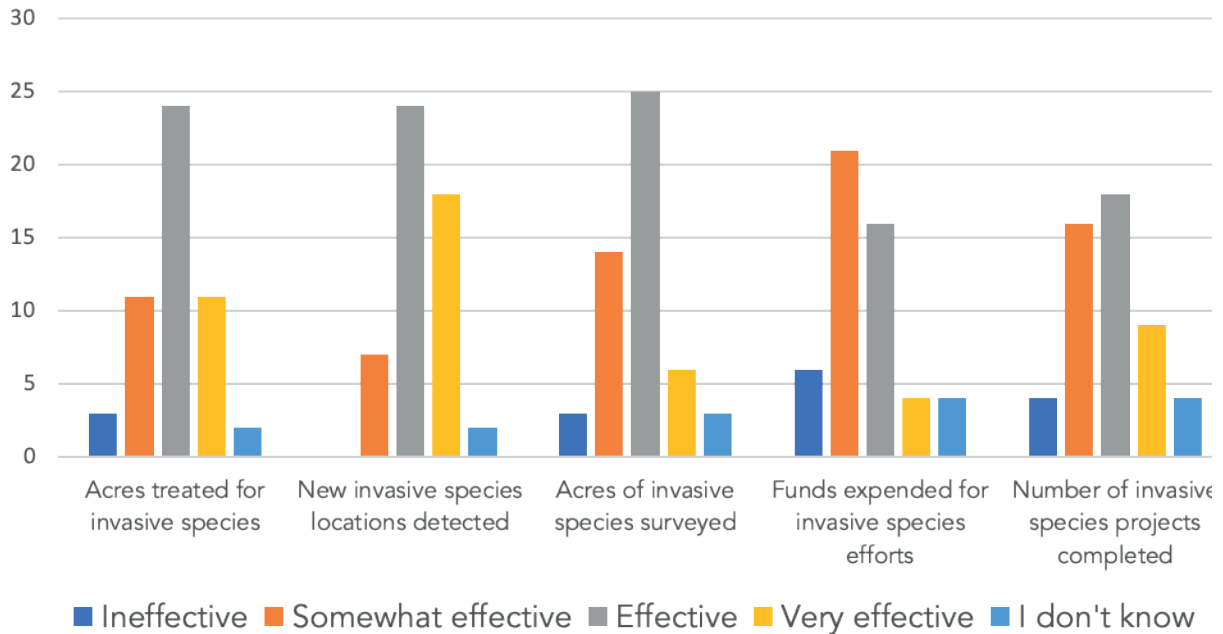


Figure 9. Rating of effectiveness of five Environmental Improvement Project performance measures relative to their ability to evaluate progress in protecting the biological diversity of the Lake Tahoe region from AIS (n=51).

Respondents that provided “Ineffective” or “Somewhat effective” to the previous question were given an opportunity to describe their answers. They indicated the number of acres surveyed indicates neither progress nor solutions, metrics need to focus on priority locations, number of AIS projects is merely bean counting and does not assess effectiveness of control efforts, there is no standardized progress per dollar invested, EIP indicators are “too static”, the metrics fall short of determining whether progress is being achieved and are more output versus outcome related, a percentage of acres treated would be a more effective metric, cost-benefit would be a more useful metric, the metrics don’t apply to all species, funding levels don’t equate to success, the metrics don’t necessarily focus on the priorities, protocols need to be enhanced for “acres surveyed”, the number of projects that receive regular monitoring would be a beneficial metric, and cost per acre should be documented (n=30).

Respondents were asked to provide suggestions for performance metrics that would be more effective in evaluating progress in protecting the biological diversity of the Lake Tahoe region from AIS. Responses included (n=28):

- Locations
 - o Address priority areas (e.g., Tahoe Keys, Meeks Bay, Ski Run Marina, etc.)
 - o New invasive species locations detected and eradicated

Location and species-specific population status and trends

- Acres/Size
 - o Plants
 - Acres treated in priority areas
 - Acres of invasive species surveyed using stratified random design
 - Rate of spread
 - Acres of AIS in the basin as a total from one year to the next
 - Acres at maintenance level
 - Areas eradicated
 - Acres of invasive species removed
 - Percentage treated followed by surveys that indicate the percentage of regrowth
 - # and % increase or decrease in infested area (acres) per species
 - % of areal coverage of each AIS infestation fully controlled
 - Acres of infestation reduced and under active surveillance
 - Acres under active management
 - Percent of attainment
 - Increase in relative abundance within targeted sites.
 - Acres (and/or biomass) of target AIS reduced from (starting) baseline.
 - Increase in relative abundance of native plants within targeted sites.
 - Acreage of plants reduced (measured as a percent of known infestation from a baseline survey of the watershed. We need a multi-average baseline of coverage of invasive plants from our lakes, streams, ponds, and other small lakes in the basin developed from a multi-year monitoring effort to document a baseline based on differing environmental conditions (low water, high water, warm versus cold years).
 - We have hot spots of invasions that we know contribute to developing satellite populations of plants (Fig 10 in the Implementation Plan). A second metric would be the percentage of key “hots spots” that have eliminated plant infestations. The Implementation has up to 6 or 7 hot spots with the Tahoe Keys as priority number 1.
 - o Invasive fishes
 - Densities (measured as catch per unit effort) of invasive fishes per area for each site.
 - Number of hot spots (measured as a percentage of a known baseline of infestations).
 - \$/acres treated and \$/acres treated/treatment method
- Organizations
 - o Organizations and entities involved in AIS control

- Species
 - o Eradication of invasive plants and invasive fishes
 - o Species eradicated
 - o Number of new species introductions to the lake
 - o Focus on the highest threat AIS that pose the greatest ecological and economic risks to Lake Tahoe and its communities
 - o Increase in native fish species populations
- Funding
 - o Funding streams and trends for AIS control
 - o Funding per acre
- Public awareness levels
- Monitoring
 - o Times visited for monitoring of known populations
 - o Reduction monitoring in treated areas
- Boat inspection AIS detections
- Nutrients
 - o Changes to water quality or nutrient conditions that encourages AIS growth and propagation
 - o Decrease in nutrients
- Cost effectiveness
 - o Increased cost effectiveness through time based on actual reduction or possible eradication of target species.

Respondents were asked to list any datasets they have access to, or that they know are available, to inform a new performance metric. Responses (n=8) included:

- University of Reno – Nevada: Baseline surveys for fishes and plants
- University of California – Davis
- The League to Save Lake Tahoe – complete data set of known locations of invasive plants as well as where people are actively surveying for aquatic invasive plants
- Nevada Division of State Lands – survey data from 2017 and 2018 for Asian clams at San Harbor
- www.keysweedsmanagement.org
- EIP Tracker information
- Eyes on the Lake data set
- Contact the Wisconsin Department of Natural Resources for their monitoring protocol for AIS (statewide ecologist in Lakes and Rivers Program)

Interview Results

Several follow-up interviews and discussions post-survey to dive deeper into survey responses and obtain perspectives from executive level staff re: AIS control in the region. The following is a summary of these discussions:

- **Priorities**—Regional entities have created a framework for addressing AIS issues in the region, preventing the introduction of new species via boat inspections. Interviewees expressed a desire to improve the sophistication of the program to ensure the highest priority species are being addressed. A formula is needed to identify priorities; resolve the issues associated with receiving funding for locations that are not the highest priorities.
- **Goals**—Identify what it means to control to ecological significance.
- **Adaptive Management**—A system and process needs to be established to integrate new information to inform management decisions. Today's top priority issue may not be next years' highest priority.
- **Science advisors**—Create a welcoming space to include the science community outside the basin.
- **Collaboration and Leadership**—Collaboration within the basin is good, but lead agencies need to provide decision-making authority to staff that serve on the LTAISCC, or bring in additional staff from those agencies with decision-making authority.
- **Assessments and Metrics**—Pick a few simple metrics to evaluate AIS control and establish targets; keep it simple. Review every year, but avoid spending so much time on assessments that the plan cannot be implemented. The lake should be surveyed no less than every two years.
- **Monitoring**—Accelerate the pace and scale of monitoring and designate one organization responsible for AIS monitoring.
- **Revenue generation**—Consider a business improvement district tax, but ensure there is coordination with other revenue generating initiatives (e.g., transportation) in the region. Consider funding sources that have more direct links to users.
- **Marinas**—Marinas need additional infrastructure to enhance AIS prevention, control, and monitoring efforts.

Appendix C

Crosswalk of proposed performance metrics of 2019 AIS Action Agenda, 2015 Implementation Plan, Environmental Improvement Program metrics, and Tahoe Regional Planning Agency thresholds.

	2021–3030 AIS Action Agenda	AIS Management Plan/ Implementation Plan	Environmental Improvement Program	TRPA Thresholds
			Focus Area – 01 – Watersheds, Habitat and Water Quality	Water Quality
			Program – 01.04 – Invasive Species	
			Action Priority – 01.04.02 – Managing AIS	
	By 2030, no new AIS of fish, plants, or invertebrates are established in the region.	Prevent new introductions of AIS to the Lake Tahoe Region. Limit the spread of existing AIS populations in the Lake Tahoe Region by employing strategies that minimize threats to native species, and extirpate existing AIS populations, when possible.	Protect the biological diversity and scenic resources of the Lake Tahoe Region from AIS.	Prevent the introduction of new aquatic invasive species into the region’s waters and reduce the abundance and distribution of known aquatic invasive species. Abate harmful ecological, economic, social and public health impacts resulting from aquatic invasive species.

Lake Tahoe Region AIS Action Agenda 2021–2030

	2021–3030 AIS Action Agenda	AIS Management Plan/ Implementation Plan	Environmental Improvement Program	TRPA Thresholds
Strategies/ Objectives	Abate harmful ecological, economic, social and public health impacts resulting from AIS	Abate harmful ecological, economic, social and public health impacts resulting from AIS	Abate harmful ecological, economic, social and public health impacts resulting from AIS	Abate harmful ecological, economic, social, and public health impacts resulting from AIS
	Prevent new introductions of AIS into the region’s waters		Prevent new introductions of aquatic invasive species into Lake Tahoe	Prevent the introduction of new AIS into the Region’s waters
	Reduce the abundance and distribution of AIS in regional waters		Limit the spread of existing invasive species such as the Asian clam while minimizing impacts to native species	Reduce the abundance and distribution of known AIS
			Keep quagga mussels out of Lake Tahoe with an aggressive watercraft inspection and enforcement program	
Outcomes - Performance Measures	<u>AQUATIC INVASIVE PLANTS</u> % increase or decrease in infested area (acres) per species # of AIS-infested acres		15 - Acres Treated for Invasive Species 18 - Acres of Invasive Species Inventoried	Acres Treated for AIS

Lake Tahoe Region AIS Action Agenda 2021–2030

	2021–3030 AIS Action Agenda	AIS Management Plan/ Implementation Plan	Environmental Improvement Program	TRPA Thresholds
	<p><u>INVASIVE FISH, AQUATIC INVASIVE INVERTEBRATES, INVASIVE AMPHIBIANS</u></p> <p>Reductions in invasive fish biomass and size classes in regions of Lake Tahoe.</p> <p>Research into invasive cold water fish management, native fish population comprehensive monitoring.</p> <p>Reductions of Signal crayfish in designated regions (e.g., Crystal Bay) of Lake Tahoe.</p> <p>Reductions of bullfrogs in designated regions (e.g., Crystal Bay) of Lake Tahoe.</p>			
			16 - # of Watercraft Inspections for Invasive Species	
	Annually, no new AI plant populations become established in the region.		17 - New Invasive Species Locations Detected	# of New AIS, Areal Extent of AIS
			33 - Funds Expended	
			34 - # of Projects Completed	
	Annually, no new AI plant populations become established in the region.		17 - New Invasive Species Locations Detected	# of New AIS, Areal Extent of AIS
			33- Funds Expended	
			34 - # Projects completed	

Appendix D

Lake Tahoe Environmental Improvement Indicators, Thresholds, Water Quality Objectives, and other Targets and Goals

This section of the document provides background information intended to inform efforts associated with developing specific metrics to quantify the success of the overall aquatic invasive species (AIS) management/implementation program in the Lake Tahoe basin. The document includes a synthesis of Environmental Improvement Program (EIP) indicators, Tahoe Regional Planning Agency thresholds, water quality objectives, and other targets and goals to lay the foundation for the development of AIS-related metrics to evaluate progress in achieving AIS control through time. The development of specific metrics to quantify success will address a significant knowledge gap identified in the *Implementation Plan for the Control of Aquatic Invasive Species within Lake Tahoe* (Wittman and Chandra 2015).

Environmental Improvement Program (EIP) Aquatic Invasive Species (AIS) Indicators

The Lake Tahoe Environmental Improvement Program (EIP) was initiated by a consortium of entities in 1997 to protect and improve natural and recreational resources in the Lake Tahoe Basin in six areas:

Watersheds, Habitat, and Water Quality

- Invasive Species Program—Treat 400 terrestrial and aquatic invasive species sites annually to improve the biological integrity of ecosystems in the Basin, and ensure the existence of a full range of native species, seral stages, habitats, and ecological processes.
- Controlling invasive terrestrial species—Goal is to protect the biological diversity of the basin by identifying, mapping, managing, and eradicating noxious and invasive weeds within the Lake Tahoe watershed.

Program Support

EIP Focus Area – 01 – Watersheds, Habitat, and Water Quality

EIP Program – 01.04 – Invasive Species

EIP Action Priority – 01.04.02 – Managing Aquatic Invasive Species

Goal: To protect the biological diversity and scenic resources of the Lake Tahoe Basin from

aquatic invasive species. Priority projects include:

- Keeping quagga mussels out of Lake Tahoe with an aggressive watercraft inspection and enforcement program.
- Preventing new introductions of aquatic invasive species into Lake Tahoe.
- Limiting the spread of existing invasive species such as the Asian clam while minimizing impacts to native species.
- Abating harmful ecological, economic, social and public health impacts resulting from aquatic invasive species.

PERFORMANCE MEASURES

Performance Measure 15 – Acres Treated for Invasive Species

Definition – The amount of terrestrial and aquatic habitat treated to eradicate or control invasive species. Treatments include hand removal, vacuum-assisted removal, installing bottom barriers, chemical treatments and other methods. Eradication and control of invasive species has far-reaching effects on the biologic integrity of both aquatic and terrestrial ecosystems, Lake Tahoe clarity, and special status species, allowing native species to flourish and the full range of ecosystems processes to occur.

Units – acres

ACRES TREATED FOR INVASIVE SPECIES



YEAR	AQUATIC	TERRESTRIAL	TOTAL
2009	0.32	104	104.32
2010	2.9	0	2.9
2011	6.9	19.2	26.1
2012	9.27	542	551.27
2013	15.46	70.5	85.96
2014	2.62	46.5	49.12
2015	3.5	288.7	292.2
2016	4.87	37.77	42.64
2017	14.55	217.8	232.35
2018	0	0	0
TOTAL	60.39	1326.47	1386.86

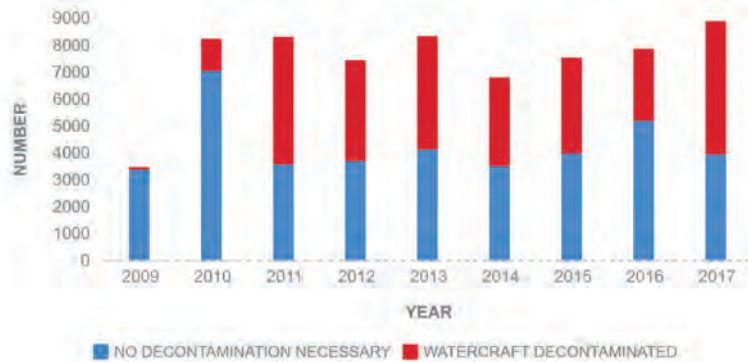
Lake Tahoe Region AIS Action Agenda 2021–2030

Performance Measure 16 – Watercraft Inspections for Invasive Species

Definition – The number of pre-launch watercraft inspections completed to search for aquatic invasive species and prevent their introduction into Lake Tahoe and other basin waterways. Currently, there are many aquatic invasive species of concern, including weeds, fish and invertebrates, which are not yet in Lake Tahoe. Of particular concern are quagga and zebra mussels. Reducing the risk of invasive species introductions will prevent impacts to aquatic ecosystems and the local economy. To this end, inspections are done on all watercraft before access is allowed to Lake Tahoe, Fallen Leaf Lake and Echo Lake.

Units - Number

WATERCRAFT INSPECTIONS FOR INVASIVE SPECIES

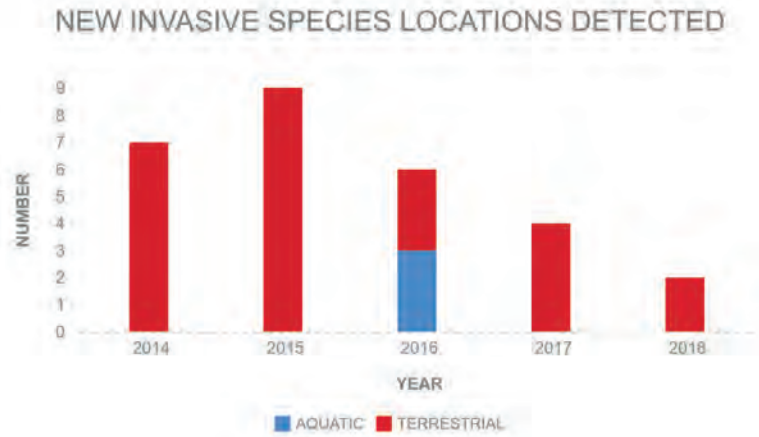


YEAR	NO DECONTAMINATION NECESSARY	WATERCRAFT DECONTAMINATED	TOTAL
2009	3361	104	104.32
2010	7040	1200	8240
2011	3560	4748	8308
2012	3691	3752	7443
2013	4117	4221	8338
2014	3500	3300	6800
2015	3964	3573	7537
2016	5180	2689	7869
2017	3928	4942	8870
TOTAL	38341	32576	70917

Performance Measure 17 – New Invasive Species Locations Detected

Definition – The number of new locations of an invasive species found in the Tahoe Basin. This PM tracks new locations of species already known to be present in the Tahoe Basin and does not track detections of species new to the Basin. Early detection reduces cost and increases effectiveness of control efforts. Control of eradication of invasive species allows natural ecosystem processes and habitats to support healthy populations of native species.

Units – number



YEAR	AQUATIC	TERRESTRIAL	TOTAL
2014	0	7	7
2015	0	9	9
2016	3	3	6
2017	0	4	4
2018	0	2	2
TOTAL	3	25	28

Performance Measure 18 – Acres of Invasive Species Inventoried

Definition – Area of the Tahoe Basin checked for terrestrial and aquatic invasive species. Strong surveillance enables strategic use of resources to fight invasive species. For instance, early detection of new locations facilitates the targeting of treatment, reducing the cost and increasing the effectiveness of control efforts.

Units – acres

ACRES OF INVASIVE SPECIES INVENTORIED

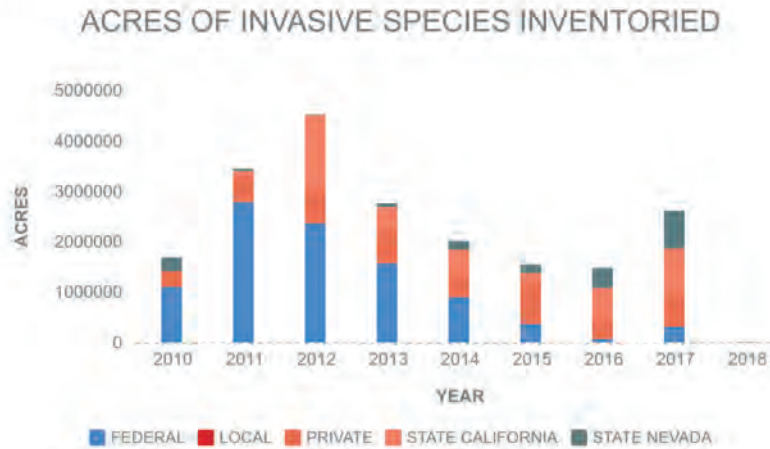


YEAR	AQUATIC	TERRESTRIAL	TOTAL
2012	0	6029	6029
2013	330	2236.29	2566.29
2014	0.75	3703	3703.75
2015	3	1459.373	1462.373
2016	42.36	908.5	950.86
2017	82.65	816	898.65
2018	10	17.5	27.5
Total	468.76	15169.663	15638.423

Performance Measure 33 – Funds Expended

Definition – Amount of money allocated and expended on all EIP projects annually, organized to allow analysis according to the structure of the EIP. A single project may have multiple sources of funds, all which are reported individually. Funding EIP projects accelerates progress towards meeting Tahoe Basin threshold standards when projects are designed to achieve action priorities.

Units – dollars



YEAR	FEDERAL	LOCAL	PRIVATE	CALIFORNIA	NEVADA	TOTAL
2010	1100814	0	312243	1	272890	1685948
2011	2784261	0	544461	71772	47722	3448216
2012	2364091	0	649439	1499660	11460	4524650
2013	1566548	0	635417	487736	76163	2765864
2014	897878	0	416902	533207	163112	2011099
2015	362530	12626	810706	187741	171655	1545258
2016	61894	0	398410	623216	388000	1471520
2017	310657	12060	617311	927342	744050	2611420
2018	8000	0	0	0	0	8000
Total	9456673	24686	4384889	4330675	1875052	20071975

Performance Measure 34 – Number of Projects Completed

Definition – All completed projects that are part of the EIP. Projects are categorized by the EIP program they predominantly affect. However, any one project can contribute to many EIP programs. Projects are also categorized by stage of completion based on whether funds have been allocated or implementation is complete.

Units – number



TRPA Thresholds

In 1982, TRPA adopted nine environmental threshold carrying capacities (thresholds), which set environmental standards for the Lake Tahoe basin. Many of the environmental thresholds are forecast to take decades to achieve, and acknowledge the need for a long-term commitment. The Environmental Improvement Program is intended to accelerate threshold attainment. In 2011 and 2015, scientific experts questioned the siloed approach of artificially segmenting issues, such as water quality, fisheries, and aquatic invasive species because of the potential to divert focus to key drivers and pressures affecting the health of natural resources in the basin. Correlating individual threshold standards to larger system dynamics precipitates the development of management actions to address the drivers and pressures.

Nine environmental thresholds and 178 standards were adopted by the Tahoe Regional Planning Agency in 1982:

- **Water Quality:** Return the Lake to 1960s water clarity and algal levels by reducing nutrient and sediment in surface runoff and groundwater.
- **Soil Conservation:** Preserve natural stream environment zones (SEZ), restore 25% of disturbed urban SEZ areas (1,100 acres), and reduce total land coverage.
- **Air Quality:** Achieve strictest of federal, state, or regional standards for carbon monoxide, ozone, and particulates; increase visibility; reduce U.S. 50 traffic; and reduce vehicle miles of travel.
- **Vegetation:** Increase plant diversity in forests, preserve uncommon plant communities, including deep water plants, enhance late seral forests and reduce forest fuels, and maintain minimum sustainable populations of sensitive plants including Tahoe Yellow Cress.
- **Wildlife:** Provide habitat for special interest species, prevent degradation of habitats of special significance.
- **Fisheries:** Maintain 180 miles of good to excellent stream habitat, achieve nearly 6,000 acres of excellent lake habitat, and attempt to reintroduce Lahontan Cutthroat Trout.
- **Scenic Resources:** Maintain or improve 1982 roadway and shoreline scenic travel route ratings, maintain or improve views of individual scenic resources, and maintain or improve quality of views from public outdoor recreation areas.

- **Noise:** Minimize noise disturbance from single events, and minimize background noise disturbance in accordance with land use patterns.
- **Recreation:** Preserve and enhance a high-quality recreational experience. Preserve undeveloped shore zone and other natural areas, and maintain a fair share of recreational capacity for the general public.

A Threshold Evaluation Report is completed every four years as part of the Agency’s adaptive management cycle: Plan-Do-Check-Adjust. The report compiles information from monitoring more than 100 indicators throughout the basin. The results are compiled and evaluated every four years to assess if the Regional Plan is achieving intended targets and to advise the TRPA Governing Board on making adjustments in the Code of Ordinances and other planning documents.

ID	42	43	44	45	46	47	48
Threshold Indicators	Water Quality						
Applicable Indicator Reporting Category	AIS						
Name of Standard	AIS Prevention	AIS Abundance	AIS Distribution	AIS Ecological Impacts	AIS Social Impacts	AIS Economic Impacts	AIS Public Health Impacts
Status (2015)	No status determination						
Trend (2015)	Little or no change	N/A	N/A	N/A	N/A	N/A	N/A
Confidence (2015)	Low	N/A	N/A	N/A	N/A	N/A	N/A
Adopted TRPA Threshold Standard	Prevent the introduction of new aquatic invasive species into the region’s waters and reduce the abundance and distribution of known aquatic invasive species. Abate harmful ecological, economic, social and public health impacts resulting from aquatic invasive species.						
TRPA Indicator	Number of new AIS/Areal Extent AIS	N/A	N/A	N/A	N/A	N/A	N/A
Unit of Measure	# of AIS/M ² of AIS	N/A	N/A	N/A	N/A	N/A	N/A
Source	2015 Threshold Evaluation						

TRPA Threshold Category – Water Quality

TRPA Threshold Indicator Reporting Category – Aquatic invasive species (nearshore/littoral)

Adopted Standard – Prevent the introduction of new aquatic invasive species into the Region’s waters and reduce the abundance and distribution of known aquatic invasive species. Abate harmful ecological, economic, social and public health impacts resulting from aquatic invasive species.

Type of Standard – Management standard

Indicators (Unit of Measure) – Number of new AIS/areal extent of AIS distribution, acres treated for AIS.

Human & Environmental Drivers – Non-native species have been both intentionally and unintentionally introduced to Lake Tahoe over the last 150 years (see background for a more detailed description). Habitat modification such as channelization and modification of the Truckee Marsh for the Tahoe Keys also created micro-environments within the lake that may be more suitable for colonization by AIS. Climate change further threatens to alter the lake’s physical environment, with the potential for making further AIS establishment more likely.

Seven subparts of adopted standard:

- Prevent the introduction of new AIS into the Region’s waters.
- Reduce the abundance of known AIS.
- Reduce the distribution of known AIS.
- Abate harmful ecological impacts resulting from AIS.
- Abate harmful economic impacts resulting from AIS.
- Abate harmful social impacts resulting from AIS.
- Abate harmful public health impacts resulting from AIS.

Interim Control Program Targets

1. Prevent the spread of existing AIS to new areas in the lake.
2. Finalize and implement the Tahoe Keys Integrated Weed Management Plan.
3. Complete lake-wide programmatic environmental review for all invasive species.
4. Treat 20 to 50 acres of existing AIS by the end of 2019 (includes retreatment work).
5. Implement the use of one or more new (not currently in use in the Region) techniques to treat known AIS infestations.

AIS are classified into three categories based on the feasibility and effectiveness of existing control options (Wittman and Chandra 2015):

- Species with “feasible control actions” included Eurasian watermilfoil, Curlyleaf pondweed, and invasive fish species.
- Species with “potential” control options included Signal crayfish and American bullfrog.
- Species with “no feasible control option at this time” include mysid shrimp and Asian clams.

Lake Tahoe Nearshore Evaluation and Monitoring Framework

The establishment of invasive aquatic species in nearshore areas can precondition those areas for the introduction and establishment of subsequent undesired species by changing substrate and habitat conditions. Establishment of invasive aquatic macrophytes can increase nutrient concentrations in surrounding nearshore water by transporting nutrients from below the sediment surface. In turn, algae growth may be enhanced.

Invasive species may change nutrient cycling and increase the amount of benthic algae growth and macrophytes, and the spatial distributions of these groups. For example, it has been shown that Asian clams released ammonium-nitrogen and soluble reactive phosphorus in their excretion products, which stimulated bloom-like growths of green metaphyton (benthic filamentous algae that grow on the nearshore lake bottom surface). Because they are not attached, these are easily transported by currents and wave action.

The presence of invasive species, such as watermilfoil and beds of clam shells, can cause a direct nearshore aesthetic impact. Selection of primary metrics was largely based on the following criteria: 1) directly measurable, 2) sufficiently sensitive for signaling changes in the environment – both improvement and degradation, 3) relevant to existing standards, 4) complementary for developing a comprehensive set of metrics, and 5) minimum redundancy with other metrics. Because invasive species can have considerable impact on native species and the aquatic community structure, composition-distribution-abundance (CDA) metrics is included and links directly to AIS and its effects on nearshore condition. Much of the monitoring of status and trends in community structure is expected to be coordinated and supported as part of the Lake Tahoe AIS Program (USACE 2009).

Nearshore fishery metrics:

- Composition, distribution, and abundance of nonnative species and the link to light (ultraviolet light transparency).
- Distribution and abundance of crayfish.

Water Quality Objectives

The Federal Clean Water Act defines water quality standards to include beneficial uses and water quality objectives.

Beneficial uses

- **AGR Agricultural Supply.** Beneficial uses of waters used for farming, horticulture, or ranching, including, but not limited to, irrigation, stock watering, and support of vegetation for range grazing.
- **AQUA Aquaculture.** Beneficial uses of waters used for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, and harvesting of aquatic plants and animals for human consumption or bait purposes.
- **BIOL Preservation of Biological Habitats of Special Significance.** Beneficial uses of waters that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, and Areas of Special Biological Significance (ASBS), where the preservation and enhancement of natural resources requires special protection.
- **COLD Freshwater Habitat.** Beneficial uses of waters that support cold water ecosystems including, but not limited to, preservation and enhancement of aquatic habitats, vegetation, fish, and wildlife, including invertebrates.
- **COMM Commercial and Sportfishing.** Beneficial uses of waters used for commercial or recreational collection of fish or other organisms including, but not limited to, uses involving organisms intended for human consumption.
- **FLD Flood Peak Attenuation/Flood Water Storage.** Beneficial uses of riparian wetlands in flood plain areas and other wetlands that receive natural surface drainage and buffer its passage to receiving waters.
- **FRSH Freshwater Replenishment.** Beneficial uses of waters used for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).
- **GWR Ground Water Recharge.** Beneficial uses of waters used for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.
- **IND Industrial Service Supply.** Beneficial uses of waters used for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, geothermal energy production, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization.
- **MIGR Migration of Aquatic Organisms.** Beneficial uses of waters that support habitats necessary for migration, acclimatization between fresh and salt water, or temporary activities by aquatic organisms, such as anadromous fish.
- **MUN Municipal and Domestic Supply.** Beneficial uses of waters used for community, military, or individual water supply systems including, but not limited to, drinking water

- supply.
- NAV Navigation. Beneficial uses of waters used for shipping, travel, or other transportation by private, military, or commercial vessels.
 - POW Hydropower Generation. Beneficial uses of waters used for hydroelectric power generation.
 - PRO Industrial Process Supply. Beneficial uses of waters used for industrial activities that depend primarily on water quality.
 - RARE, Threatened, or Endangered Species. Beneficial uses of waters that support habitat necessary for the survival and successful maintenance of plant or animal species established under state and/or federal law as rare, threatened or endangered.
 - REC-1 Water Contact Recreation. Beneficial uses of waters used for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, and use of natural hot springs.
 - REC-2 Non-contact Water Recreation. Beneficial uses of waters used for recreational activities involving proximity to water, but not normally involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, and aesthetic enjoyment in conjunction with the above activities.
 - SAL Inland Saline Water Habitat. Beneficial uses of waters that support inland saline water ecosystems including, but not limited to, preservation and enhancement of aquatic saline habitats, vegetation, fish, and wildlife, including invertebrates.
 - SPWN Spawning, Reproduction, and Development. Beneficial uses of waters that support high quality aquatic habitat necessary for reproduction and early development of fish and wildlife.
 - WARM Freshwater Habitat. Beneficial uses of waters that support invasive ecosystems including, but not limited to, preservation and enhancement of aquatic habitats, vegetation, fish, and wildlife, including invertebrates
 - WILD Wildlife Habitat. Beneficial uses of waters that support wildlife habitats including, but not limited to, the preservation and enhancement of vegetation and prey species used by wildlife, such as waterfowl.
 - WQE Water Quality Enhancement. Beneficial uses of waters that support natural enhancement or improvement of water quality in or downstream of a water body including, but not limited to, erosion control, filtration and purification of naturally occurring water pollutants, streambank stabilization, maintenance of channel integrity, and siltation control.

Water Quality Objectives that have a potential nexus with invasive species (See Appendix F for a comprehensive list of all water quality objectives):

- Algae Growth Potential – Mean potential at any point in the lake shall not be greater than twice the mean annual algal growth potential at the limnetic reference station (located in the north central portion of Lake Tahoe).
- Ammonia – Ammonia concentrations shall not exceed the values listed in tables 3-1 to 3-4 (USEPA ammonia criteria for freshwater).
- Clarity – The vertical extinction coefficient shall be less than 0.08 per meter when measured below the first meter. Turbidity shall not exceed 3 Nephelometric Turbidity Units (NTU) when water is too shallow to determine a reliable extinction coefficient. Turbidity shall not exceed 1 NTU in shallow waters not directly influenced by stream discharges.
- Dissolved Oxygen – DO concentration shall not be depressed by more than 10%, not shall the minimum DO concentration be less than 80% of saturation. For waters with the beneficial uses of COLD, COLD with SPWN, WARM, and WARM with SPWN, the minimum dissolved oxygen concentration shall not be less than that specified in Table 3-6 (California Regional Water Quality Control Board 2016).
- Floating Materials – Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect the water for beneficial uses. For natural high-quality waters, the concentrations of floating material shall not be altered to the extent that such alterations are discernable at the 10 percent significance level.
- Non-degradation of Aquatic Communities and Populations – All wetlands shall be free from substances attributable to wastewater or other discharges that produce adverse physiological responses in humans, animals, or plants; or that lead to the presence of undesirable or nuisance aquatic life. All wetlands shall be free from activities that would substantially impair the biological community as it naturally occurs due to physical, chemical and hydrologic processes.
- Plankton Counts – The mean seasonal concentration of plankton organisms shall not be greater than 100 per ml, and the maximum concentration shall not be greater than 500 per ml at any point in the lake.
- Sediment - The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect the water for beneficial uses.
- Settleable Materials – Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or that adversely affects the water for beneficial uses. For natural high-quality waters, the concentration of settleable materials shall not be raised by more than 0.1 milliliter per liter.
- Suspended Materials – Waters shall not contain suspended materials in concentrations that cause nuisance or that adversely affects the water for beneficial uses. For natural high-quality waters, the concentration of total suspended materials shall not be altered to the extent that such alterations are discernible at the 10 percent significance level.
- Taste and Odor - Waters shall not contain taste or odor-producing substances in con-

centrations that impart undesirable tastes or odors to fish or other edible products of aquatic origin, that cause nuisance, or that adversely affect the water for beneficial uses. For naturally high-quality waters, the taste and odor shall not be altered.

- Transparency – Annual average Secchi disk deep water transparency shall not be decreased below 29.7 meters (the levels recorded in 1967–71).
- Turbidity - Waters shall be free of changes in turbidity that cause nuisance or adversely affect the water for beneficial uses. Increases in turbidity shall not exceed natural levels by more than 10 percent.

Examples of references for effects of AIS on water quality:

- Turbidity: Non-native fish (e.g., carp) can increase turbidity by physically resuspending sediment while eating and swimming. Turbidity is also increased indirectly via excretions by fish, which increase phytoplankton levels, which cloud the water (University of Michigan – http://animaldiversity.ummz.umich.edu/site/accounts/information/Cyprinus_carpio.html)
- Recreational uses, visual aesthetics, integrity of aquatic communities: Eurasian water-milfoil can increase nutrient loading, affecting beneficial uses (USGS - <http://nas.er.usgs.gov/queries/StateSearch.asp>)
- Dissolved oxygen, phosphate, ammonia, nuisance algal blooms: Zebra mussels cause low dissolved oxygen, and increases phosphate and ammonia levels in water (NOAA 2002).
- Taste and odor: Zebra and quagga mussels can negatively alter taste and odor of water (Water Research Foundation 2017).

Lake Tahoe Region AIS Indicators and Thresholds Matrix

EIP Indicators	Watersheds, Habitat, and Habitat Quality	<p>Goal: To protect the biological diversity and scenic resources of the Lake Tahoe Basin from aquatic invasive species.</p> <ul style="list-style-type: none"> Keeping quagga mussels out of Lake Tahoe with an aggressive watercraft inspection and enforcement program Preventing new introductions of aquatic invasive species into Lake Tahoe Limiting the spread of existing invasive species such as the Asian clam while minimizing impacts to native species Abating harmful ecological, economic, social and public health impacts resulting from aquatic invasive species. 		<p>15 - Acres treated for invasive species 16 - Watercraft inspections for invasive species 17 - New invasive species locations detected 18 - Acres of invasive species inventoried 33 - Funds expended 34 - # of projects completed</p>
TRPA Thresholds	Water Quality	<p>Threshold Standard: Prevent the introduction of new aquatic invasive species into the region's waters and reduce the abundance and distribution of known aquatic invasive species. Abate harmful ecological, economic, social and public health impacts resulting from aquatic invasive species.</p> <ul style="list-style-type: none"> Prevent the introduction of new AIS into the Region's waters. Reduce the abundance and distribution of known AIS. Abate harmful ecological, economic, social, and public health impacts resulting from AIS. 	AIS Prevention, Abundance, Distribution, Ecological Impacts, Social Impacts, Economic Impacts, and Public Health Impacts	Number of new AIS, Areal extent of AIS, and Acres treated for AIS
Water Quality Objectives	Water Quality	<p><i>Algae growth potential</i> - For Lake Tahoe, the mean algal growth potential at any point in the Lake shall not be greater than twice the mean annual algal growth potential at the limnetic reference station.</p> <p><i>Ammonia</i> - Ammonia (dependent on temperature and pH) shall not exceed the values listed by EPA ammonia criteria for freshwater.</p> <p><i>Biostimulatory substances</i> - Cannot exist in concentrations that promote aquatic growths such that the growths cause nuisance or adversely affect the water for beneficial uses.</p> <p><i>Clarity</i> - For Lake Tahoe, the vertical extinction coefficient shall be less than 0.08 per meter when measured below the first meter. When water is too shallow to determine a reliable extinction coefficient, the turbidity shall not exceed 3 Nephelometric Turbidity Units (NTU). In addition, turbidity shall not exceed 1 NTU in shallow waters not directly influenced by stream discharges.</p> <p><i>Dissolved oxygen</i> - Shall not be depressed by more than 10%; minimum concentration shall not be less than 80% of saturation. Basin tables define minimums for waters with beneficial uses of COLD, COLD with SPWN, WARM, and WARM with SPWN.</p> <p><i>Floating materials</i> - Solids, liquids, forms, and scum shall not exist in concentrations that cause nuisance, or adversely affect the water for beneficial uses. Natural high-quality waters should not have concentrations of floating materials discernable at the 10% significance level.</p> <p><i>Non-degradation of aquatic communities and populations</i> - Wetlands shall be free of substances that lead to the presence of undesirable or nuisance aquatic life.</p> <p><i>Plankton counts</i> - For Lake Tahoe, the mean seasonal concentration of plankton organisms shall not be greater than 100 per ml and the maximum concentration shall not be greater than 500 per ml at any point in the Lake.</p> <p><i>Sediment</i> - Suspended sediment load and discharge rate of surface waters shall not be altered to cause nuisance or adversely affect beneficial uses.</p> <p><i>Settleable materials</i> - Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or adversely affect beneficial uses. Natural high-quality water shall not have concentrations of settleable materials that are raised by more than 0.1 ml/L.</p> <p><i>Suspended materials</i> - Waters shall not contain suspended materials in concentrations that cause nuisance, or that adversely affect water for beneficial uses. Natural high-quality waters shall not be altered such that alterations are discernable at the 10% significance level.</p> <p><i>Taste and odor</i> - Waters shall not contain taste or odor-producing substances in concentrations that impart undesirable tastes or odors to fish or other edible products of aquatic origin, that cause nuisance, or that adversely affect the water for beneficial uses. For naturally high-quality waters, the taste and odor shall not be altered.</p> <p><i>Transparency</i> - For Lake Tahoe, the annual average Secchi disk deep water transparency shall not be decreased below 29.7 meters, the levels recorded in 1967-71.</p> <p><i>Turbidity</i> - Waters shall be free of changes in turbidity that cause nuisance or adversely affect the water for beneficial uses. Increases in turbidity shall not exceed natural levels by more than 10%.</p>		

AIS Indicators and Thresholds from other Locales

Great Lakes Ecosystem Indicator Project Report 2014: Biological Indicators: AIS Invasion Rates and Impacts

Measures the rates of invasion and status and impact. Rate of invasion is the # of new AIS arriving in the Great Lakes since the last assessment (3 years), an analysis of pathway of introduction, and quantifying trends of invasion. Excludes species that are benign or deemed beneficial. Indicator Relevance: Relevant to the objective of preventing impacts from AIS. And measures success of management actions to reduce the rate of new species arriving; quantifies the extent to which they are populated by AIS; and evaluates the detrimental impact and success of mitigation measures.

Measures:

- Measure Description - Rate of invasion of AIS – plotting cumulative #s of invasions versus time
 - o Status and impacts of AIS – Relative abundance versus target established (sea lamprey); occurrence, abundance, and potentially reproduction (Asian Carp); relative abundance and occurrence (phragmites); eDNA

Minnesota Department of Natural Resources – Guidance for Conducting AIS ED and Baseline Monitoring in Lakes 2018. Monitoring for shoreline/emergent plants, submerged plants/algae, floating-leafed. Plants, and animals.

Target-species monitoring (which most directly and efficiently incorporates knowledge of imminent AIS) and broad-spectrum monitoring (which enables the discovery of unexpected AIS) (Trebitz et al. 2017).

University of Minnesota Aquatic Invasive Species Research Center (MAISRC): Established biomass thresholds to assess when carp become damaging to lake ecosystems, allowing managers to set clear management goals. Species that cannot be eradicated could have established thresholds in abundance not associated with ecological damage (decline in the density and diversity of aquatic macrophytes was used to assess the impact of carp – at 50kg/ha, effects of carp on macrophytes were minor; at 100 kg/ha, there were about 50% declines in macrophyte cover, and at 200 kg/ha, almost no rooted vegetation remained in lakes – a 100kg/ha management level was established as a threshold for carp populations).

Northeast British Columbia (2003)

Species presence (e.g., designated invasive plants present on no more than 2% of an area).

Foxcroft and McGeoch (2011)

Indicators are dependent variables (e.g., the number of alien species or area of a park invaded by invasive alien species), whereas a Threshold of Potential Concern (TPC) is the specific value(s) of that indicator for which well-considered intervention is needed (e.g., the introduction of one new alien species to a park or a 10% increase in the area invaded). The indicators should be assessed according to a 3–5-year time frame and any thresholds which have been breached at this point should be raised. If a TPC has been breached at any other time, it should also be documented and presented at the appropriate science–management forum. In this way any unacceptable trends that suggest potential deleterious ecological or biodiversity consequences are given specific attention. Using TPCs as a reference point for management interventions does not imply that ongoing control operations are stopped and initiated only when a TPC is breached. Where a TPC is breached, the background, cause of concern, potential impacts or consequences and proposed management actions should be discussed.

Appendix E

Water Quality Objectives

Surface water objectives:

- *Algae Growth Potential* – Mean potential at any point in the lake shall not be greater than twice the mean annual algal growth potential at the limnetic reference station (located in the north central portion of Lake Tahoe).
- **Ammonia** – Ammonia concentrations shall not exceed the values listed in tables 3-1 to 3-4 (USEPA ammonia criteria for freshwater).
- **Bacteria, Coliform** – Waters shall not contain concentrations of coliform organisms attributable to anthropogenic sources, including human and livestock wastes. Fecal coliform concentration during any 30-day period shall not exceed a log mean of 20/100ml, not shall more than 10% of all samples collected during any 30-day period exceed 40/100 ml.
- *Biological Indicators* – Algal productivity and biomass of phytoplankton, zooplankton, and periphyton shall not be increased beyond the levels recorded in 1967-71 based on statistical comparison of seasonal and annual means.¹
- **Biostimulatory Substances** – Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect the water for beneficial uses.
- **Chemical Constituents** - Waters designated as MUN shall not contain concentrations of chemical constituents in excess of the maximum contaminant level (MCL) or secondary maximum contaminant level (SMCL) based upon drinking water standards specified in the following provisions of Title 22 of the California Code of Regulations. Waters designated AGR shall not contain concentrations of chemical constituents in amounts that adversely affect the water for beneficial uses. Waters shall not contain concentrations of chemical constituents that adversely affect the water for beneficial uses.
- **Chlorine, Total Residual** – Total chlorine residual shall not exceed either a median value of 0.002 mg/L or a maximum value of 0.003 mg/L. Median values shall be based on daily measurements within any six-month period.
- *Clarity* – The vertical extinction coefficient shall be less than 0.08 per meter when measured below the first meter. Turbidity shall not exceed 3 Nephelometric Turbidity Units (NTU) when water is too shallow to determine a reliable extinction coefficient. Turbidity

¹ 1967-71 levels are published by the California Nevada-Federal Joint Water Quality Investigation of Lake Tahoe published by the California Department of Water Resources.

- shall not exceed 1 NTU in shallow waters not directly influenced by stream discharges.
- **Color** – Waters shall be free of coloration that causes nuisance or adversely affects the water for beneficial uses.
 - *Conductivity, Electrical* – Mean annual electrical conductivity shall not exceed 95 umhos/cm at 25 degrees C at any location in the lake.
 - **Dissolved Oxygen** – DO concentration shall not be depressed by more than 10%, not shall the minimum DO concentration be less than 80% of saturation. For waters with the beneficial uses of COLD, COLD with SPWN, WARM, and WARM with SPWN, the minimum dissolved oxygen concentration shall not be less than that specified in Table 3-6 (California Regional Water Quality Control Board 2016).
 - **Floating Materials** – Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect the water for beneficial uses. For natural high-quality waters, the concentrations of floating material shall not be altered to the extent that such alterations are discernable at the 10 percent significance level.
 - **Oil and Grease** - Waters shall not contain oils, greases, waxes or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect the water for beneficial uses. For natural high-quality waters, the concentration of oils, greases, or other film or coat generating substances shall not be altered.
 - **Non-degradation of Aquatic Communities and Populations** - All wetlands shall be free from substances attributable to wastewater or other discharges that produce adverse physiological responses in humans, animals, or plants; or that lead to the presence of undesirable or nuisance aquatic life. All wetlands shall be free from activities that would substantially impair the biological community as it naturally occurs due to physical, chemical and hydrologic processes.
 - *pH* – The pH shall not be depressed below 7.0 nor raised above 8.4 in the lake.
 - *Plankton Counts* – The mean seasonal concentration of plankton organisms shall not be greater than 100 per ml, and the maximum concentration shall not be greater than 500 per ml at any point in the lake.
 - **Radioactivity** - Radionuclides shall not be present in concentrations that are deleterious to human, plant, animal, or aquatic life or that result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal, or aquatic life. Waters designated as MUN shall not contain concentrations of radionuclides in excess of the limits specified in Table 4 of Section 64443 (Radioactivity) of Title 22 of the California Code of Regulations, which is incorporated by reference into this plan. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.
 - **Sediment** - The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely

affect the water for beneficial uses.

- **Settleable Materials** - Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or that adversely affects the water for beneficial uses. For natural high-quality waters, the concentration of settleable materials shall not be raised by more than 0.1 milliliter per liter.
- **Suspended Materials** - Waters shall not contain suspended materials in concentrations that cause nuisance or that adversely affects the water for beneficial uses. For natural high-quality waters, the concentration of total suspended materials shall not be altered to the extent that such alterations are discernible at the 10% significance level.
- *Suspended Sediment* – Suspended sediment concentrations in streams tributary to Lake Tahoe shall not exceed a 90th percentile value of 60 mg/L.
- **Taste and Odor** - Waters shall not contain taste or odor-producing substances in concentrations that impart undesirable tastes or odors to fish or other edible products of aquatic origin, that cause nuisance, or that adversely affect the water for beneficial uses. For naturally high-quality waters, the taste and odor shall not be altered.
- **Temperature** - The natural receiving water temperature of all waters shall not be altered unless it can be demonstrated to the satisfaction of the Board that such an alteration in temperature does not adversely affect the water for beneficial uses. For waters designated WARM, water temperature shall not be altered by more than five degrees Fahrenheit (5 degrees F) above or below the natural temperature. For waters designated COLD, the temperature shall not be altered. Temperature objectives for COLD interstate waters and WARM interstate waters are as specified in the “Water Quality Control Plan for Control of Temperature in The Coastal and Interstate Waters and Enclosed Bays and Estuaries of California” including any revisions.
- **Toxicity** - All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration and/or other appropriate methods as specified by the Regional Board. The survival of aquatic life in surface waters subjected to a waste discharge, or other controllable water quality factors, shall not be less than that for the same water body in areas unaffected by the waste discharge, or when necessary, for other control water that is consistent with the requirements for “experimental water” as defined in Standard Methods for the Examination of Water and Wastewater (American Public Health Association, et al. 2012, or subsequent editions).
- *Transparency* – Annual average Secchi disk deep water transparency shall not be decreased below 29.7 meters (the levels recorded in 1967-71).
- **Turbidity** - Waters shall be free of changes in turbidity that cause nuisance or adversely affect the water for beneficial uses. Increases in turbidity shall not exceed natural levels by more than 10 percent.

Appendix F

Estimated Control Costs

Costs for AIS control (Tahoe RCD 2018):

- UVC Light
 - o UV-C treatment system 160 ft²
 - Equipment - \$200,000
 - Labor - \$28,000/acre (8 days labor/acre – 2 people/day)
 - o UV-C treatment system 320 ft²
 - Equipment - \$334,000
 - Labor - \$14,000/acre (4 days labor/acre – 2 people/day)
 - o UV-C treatment system 640 ft²
 - Equipment - \$558,000
 - Labor - \$7,000/acre (2 days labor/acre – 2 to 3 people/day)
- Diver-assisted suction removal (\$50,000/acre) (estimated 4-person dive team @ \$3,500/day for 2 weeks for light to moderate infestation; suction equipment owned by Lake Tahoe Aquatic Invasive Species Program)
- Hand pulling (\$400–\$1,000/acre for divers)
- Benthic barriers (\$40,000/acre for labor and \$40,000/acre for barrier – barrier can be reused for up to 5 years)

Other AIS control cost estimates:

- Bubble curtain (\$50,000)
- Herbicides (\$1,000–\$2,000/ acre – cost significantly influenced by travel, access, and other logistics)

Appendix G

AIS Implementation Permits

► Table 7. Potential permits needed to implement AIS actions in the Lake Tahoe Region.

	Plants				Asian Clams	Invertebrates	Invasive Fish	Bullfrogs
	UV Light Treatment	Pesticide Applications (Tahoe Keys)	Diver Suctioning and Hand Removal	Benthic Barriers	Benthic Barriers	Harvest	Electro-fishing and fish removal	Harvest
Lahontan Water Board								
NPDES Permit		X		X	X			
Lahontan Basin Plan Pesticide Discharge Prohibition Exemption		X						
Section 13260 – Waste Discharge Report		X	X	X	X			
Anti-degradation Policy compliance		X	X					
13267 Order								
Section 401 Water Quality Certification	X	X	X	X	X			
Environmental Impact Report	X	X						
State Water Resources Control Board								
Statewide General NPDES Permit								
Tahoe Regional Planning Agency								
Environmental Impact Statement	X	X						
TRPA Regional Plan compliance	X	X	X	X	X	X	X	X
Code of Ordinances (Chapter 3) compliance	X	X	X	X	X	X	X	X
Article VI Rules of Procedure	X	X						
Commercial Crayfish Harvest Permit						X		
Project Permit	X	X	X	X	X	X	X	X
Finding of No Significant Effect	X							
Initial Environmental Checklist	X	X						

▶ **Table 7. Potential permits needed to implement AIS actions in the Lake Tahoe Region (continued)**

	Plants				Asian Clams	Invertebrates	Invasive Fish	Bullfrogs
	UV Light Treatment	Pesticide Applications (Tahoe Keys)	Diver Suctioning and Hand Removal	Benthic Barriers	Benthic Barriers	Harvest	Electrofishing and fish removal	Harvest
California Environmental Quality Act (CEQA)								
Environmental Impact Report	X	X	X	X	X	X	X	X
California Department of Fish and Wildlife								
1600 Agreement	X	X						
CEQA	X	X						
Lake and Streambed Alteration Agreement	X	X	X	X	X			
Section 8491 – Crayfish permit/commercial fishing license						X		
California State Lands Commission								
Letter of non-objection	X	X	X	X	X	X	X	X
Nevada Department of Wildlife								
NAC503.540 - commercial crayfish harvest						X		
Nevada Division of State Lands								
Authorization to use state-owned submerged lands	X		X	X	X	X		X
Nevada Division of Environmental Protection								
Temporary Discharge/working in a waterway permit			X					
US Army Corps of Engineers								
Section 404 of Clean Water Act - Permit 27	X	X						
Rivers and Harbors Act (Section 10)								
US Environmental Protection Agency								
Pesticide General Permit (PGP)		X						
US Fish and Wildlife Service								
ESA-listed species								
1600 RMA amendment for new treatment methods								
US Forest Service								
Special use permit to provide access								

Appendix H

Examples of Invasive Species Emergency Funds

Several PWN states have created emergency funds to prepare for significant invasive species invasions.

- Idaho established The Idaho Invasive Species Act of 2008 (Appendix H) within the State Treasury (22-1911), authorizing the Director of the Idaho Department of Agriculture to determine when funds can be appropriated for control and eradication purposes. When cost of control and eradication exceeds money appropriated or otherwise available, the state board of examiners may authorize the issuance of deficiency warrants against the general fund for up to \$5 million dollars in any one year for control and eradication.
- Oregon established the Invasive Species Control Account in 2009 (House Bill 2020) (Appendix I) for the purposes of eradicating, or controlling, new infestations or infections of invasive species in Oregon (ORS 570.810). The fund describes eligible applicants, standards to determine eligibility for release of funds, and the process for delegation and release of funds. Seed funding for the account included a one-time appropriation from the Oregon State Parks and Recreation Department ATV Fund. The goal has been to establish a \$5 million fund. The fund is administered by the Oregon Invasive Species Council, a consortium of federal, state, and local government agencies and nonprofit organizations that address statewide invasive species issues.
- Montana established an Invasive Species Account in the State Revenue Fund, administered by the Department of Fish, Wildlife & Parks, in 2015. Montana Code 80-7-1004 adopted in 2019, incorporates language that allows money from any source to be deposited into the account for prevention or control of aquatic invasive species, transfers interest, earnings, and unreserved funds in the account to the invasive species trust fund, and prevents Montana Fish, Wildlife & Parks from recovering indirect costs from the account.

The Idaho Invasive Species Act of 2008

TITLE 22 AGRICULTURE AND HORTICULTURE

CHAPTER 19

THE IDAHO INVASIVE SPECIES ACT OF 2008

22-1901. TITLE. This chapter shall be known as “The Idaho Invasive Species Act of 2008.” [22-1901, added 2008, ch. 387, sec. 1, p. 1062.]

22-1902. LEGISLATIVE FINDINGS. The legislature finds that:

The purpose of this chapter is to address the concerns about the increasing threat of invasive species by providing policy direction, planning and authority to combat invasive species infestations throughout the state and to prevent the introduction of new species that may be harmful;

The land, water and other resources of Idaho are being severely affected by invasions of an increasing number of harmful, invasive species;

These invasions are damaging Idaho’s environment and causing economic hardships;

Idaho is a national leader in the control of invasive species, particularly noxious weeds and agricultural pests, and has a strong network of local, state, federal, tribal and private entities actively and cooperatively combating the threat;

Prevention, early detection, rapid response and eradication are the most effective and least costly strategies against invasive species because they combat new invasions before they expand beyond feasible control;

Implementing these strategies requires the state of Idaho to enhance its capacity to prioritize risks, prevent new invasions, employ early detection and rapid response techniques, apply state of the art control and management strategies, coordinate multiple public and private efforts and involve the public;

An effective invasive species program must foster and support local initiatives; and

The multitude of public and private entities with an interest in controlling and preventing the spread of harmful invasive species in Idaho need a mechanism for cooperation and collaboration to meet the threat of invasive species.

[22-1902, added 2008, ch. 387, sec. 1, p. 1062.]

22-1903. ADMINISTRATION. This chapter shall be administered by the Idaho state department of agriculture.

[22-1903, added 2008, ch. 387, sec. 1, p. 1063.]

22-1904. DEFINITIONS. Unless otherwise noted in this chapter the definitions as set forth in section 22-2005, Idaho Code, are adopted by reference.

“Conveyance” means a terrestrial or aquatic vehicle or a vehicle part that may carry or contain an invasive species or plant pest. A conveyance includes a motor vehicle, a vessel, a motorboat, a sailboat, a personal watercraft, a trailer or any other means or method of transportation. “Conveyance” also includes a live well or a bilge area of a watercraft.

“Environmental harm” means to cause significant adverse effects on uses of natural resources or on plants or animals.

“Invasive species” means species not native to Idaho, including their seeds, eggs, spores, larvae or other biological material capable of propagation, that cause economic or environmental harm and are capable of spreading in the state. “Invasive species” does not include crops, improved forage grasses, domestic livestock, or other beneficial nonnative organisms.

[22-1904, added 2008, ch. 387, sec. 1, p. 1063; am. 2010, ch. 342, sec. 1, p. 898.]

22-1905. PROHIBITED ACTIONS. No person may import, export, purchase, sell, barter, distribute, propagate, transport or introduce an invasive species into or within the state of Idaho and no person may possess an invasive species, except:

Under a permit issued by the director;

When being transported to an appropriate state authority, or another destination as such authority may direct, in a sealed container for purposes of identifying the species or reporting the presence of the species;

When being transported for disposal as part of an approved control activity under a permit issued pursuant to section 22-1906, Idaho Code;

When the specimen has been lawfully acquired dead and, in the case of plant species, all seeds are removed or are otherwise rendered nonviable;

In the form of herbaria or other preserved specimens, so long as such specimens are rendered nonviable; or

As the director may otherwise prescribe by rule. [22-1905, added 2008, ch. 387, sec. 1, p. 1063.]

22-1906. DUTIES OF THE DEPARTMENT AND DIRECTOR. The department may prevent and control, by such means as shall be prescribed and provided by law, rule or by order of the department, all invasive species that may cause economic or environmental harm to the state. The director shall:

After due investigation, report the detection of new invasive species within the state to the appropriate state and federal officials;

Issue permits for the transport or possession of an invasive species into, within or through the state of Idaho. Permits shall include requirements to ensure the containment of that species, as may be prescribed in rule.

These duties shall not usurp existing provisions of the Idaho Code, programs that deal with invasive species issues, or the individual missions of any state agency or duplicate efforts existing upon passage of this act.

[22-1906, added 2008, ch. 387, sec. 1, p. 1063.]

22-1907. RULES AND ORDERS. The director is hereby authorized to promulgate rules necessary for the efficient enforcement of the provisions of this chapter. Rulemaking authority shall include, but not be limited to, the determination of which species are invasive and the establishment of procedures for testing, sampling, inspection, certification, permitting, compliance verification and recordkeeping. The director may by written order designate a species as invasive until such time as it may be added to the official rules of the department.

[22-1907, added 2008, ch. 387, sec. 1, p. 1064.]

22-1908. AUTHORITY TO CONDUCT INSPECTIONS. (1) In order to accomplish the purposes of this chapter, the director may enter upon and inspect any public or private premises, lands, bodies of water, or means of conveyance, or article of any person within this state, for the purpose of inspecting, surveying, treating, controlling, collecting samples, or destroying any invasive species.

The director may establish check stations at points of entry to the state, or other facilities and sites throughout the state, as necessary to carry out the provisions of this chapter.

No person shall proceed past or travel through an established inspection station during its hours of operation while towing, carrying or transporting any conveyance without presenting such conveyance for inspection.

[22-1908, added 2008, ch. 387, sec. 1, p. 1064; am. 2010, ch. 342, sec. 2, p. 898.]

22-1909. DISPOSITION OF INVASIVE SPECIES. The director is authorized to seize, decontaminate or destroy any invasive species found in this state from public or private ownership or control as necessary to carry out the provisions of this chapter.

[22-1909, added 2008, ch. 387, sec. 1, p. 1064.]

22-1910. HOLD ORDER. The director may issue hold orders to take prompt regulatory action in invasive species emergencies on any article, commodity, conveyance, vehicle or other means of transportation entering this state when it is reasonably believed that the article, commodity, conveyance, vehicle or other means of transportation is in violation of this chapter or rules promulgated hereunder. The hold order shall contain contact information for the owner of the article, commodity, conveyance, vehicle or other means of transportation, the reason for the hold order, and the conditions for release.

[22-1910, added 2008, ch. 387, sec. 1, p. 1064; am. 2010, ch. 342, sec. 3, p. 899.]

22-1910A. LAW ENFORCEMENT. (1) It shall be the duty of all peace officers within the state of Idaho, as defined by section 19-5101(d), Idaho Code, to enforce the provisions of this chapter by making a complaint or citation as described in section 19-3901, Idaho Code.

Peace officers within the state of Idaho, upon reasonable suspicion that a conveyance is infested with quagga mussels or zebra mussels, may require a driver of a vehicle to stop and submit to an inspection of the exterior of any conveyance(s) in plain view.

If the peace officer has probable cause to believe that the conveyance(s) are contaminated with quagga mussels or zebra mussels, or when a conveyance is found to be contaminated or otherwise carrying quagga mussels or zebra mussels, the peace officer shall detain the vehicle and conveyance(s) and immediately summon a tow truck to transport the conveyance(s) to the nearest available impound yard.

Upon impoundment, the director shall issue a hold order as provided in this chapter specifying the conditions for release.

[22-1910A, added 2010, ch. 342, sec. 4, p. 899.]

22-1911. INVASIVE SPECIES FUND. There is hereby established in the state treasury an invasive

species fund.

The fund shall receive such appropriations as deemed necessary by the governor and the legislature to accomplish the goals of this chapter. The fund shall also receive moneys from the collection of reasonable fees for permits or as otherwise required by this chapter or rules promulgated hereunder. The fund may also receive, at the discretion of the director, moneys from any other lawful source including, without limitation, fees, penalties, fines, gifts, grants, legacies of money, property, securities or other assets, or any other source, public or private.

Moneys in the invasive species fund are subject to appropriation for the purposes of this chapter. The fund shall be used to support activities related to the prevention, detection, control and management of invasive species in Idaho.

All interest or other income accruing from moneys deposited to the fund shall be redeposited and accrue to the fund. Any unexpended balance left in the fund at the end of any fiscal year shall carry forward without reduction to the following fiscal year.

[22-1911, added 2008, ch. 387, sec. 1, p. 1064.]

22-1912. CONTROL AND ERADICATION COSTS -- DEFICIENCY WARRANTS -- COOPERATION WITH OTHER ENTITIES AND CITIZENS. Whenever the director determines that there exists the threat of an infestation of an invasive species on state-owned land or water, private, forested, range or agricultural land or water, and that the infestation is of such a character as to be a menace to state, private, range, forest or agricultural land or water, the director shall cause the infestation to be controlled and eradicated, using such moneys as have been appropriated or may hereafter be made available for such purposes. Provided however, that whenever the cost of control and eradication exceeds the moneys appropriated or otherwise available for that purpose, the state board of examiners may authorize the issuance of deficiency warrants against the general fund for up to five million dollars (\$5,000,000) in any one (1) year for such control and eradication. Control and eradication costs may include, but are not limited to, costs for survey, detection, inspection, enforcement, diagnosis, treatment and disposal of infected or infested materials, cleaning and disinfecting of infected premises or vessels and indemnity paid to owners for infected or infested materials destroyed by order of the director. The director, in executing the provisions of this chapter insofar as it relates to control and eradication, shall have the authority to cooperate with federal, state, county and municipal agencies and private citizens in control and eradication efforts; provided, that in the case of joint federal/state programs, state moneys shall only be used to pay the state's share of the cost of the control and eradication efforts. Such moneys for which the state shall thus become liable shall be paid as a part of the expenses of the Idaho state department of agriculture out of appropriations that shall be made by the legislature for that purpose from the general fund of the state. In all appropriations hereafter made for expenses of the department, account shall be taken of and provision made for this item of expense.

[22-1912, added 2008, ch. 387, sec. 1, p. 1065.]

22-1913. PENALTIES FOR VIOLATIONS. (1) Any person who knowingly violates any provision of this chapter, or of the rules promulgated hereunder for carrying out the provisions of this chapter, or who fails or refuses to comply with any requirements herein specified, or who interferes with the department, its agents, designees or employees, in the execution, or on account of the execution of its or their duties under this chapter or rules promulgated hereunder, shall be guilty of a misdemeanor and upon conviction thereof, shall be fined not more than three thousand dollars (\$3,000) or be imprisoned in a county jail for not more than twelve (12) months or be subject to both such fine and imprisonment.

Any person who violates or fails to comply with any of the provisions of this chapter or any rules promulgated hereunder may be assessed a civil penalty by the department or its duly authorized agent of not more than ten thousand dollars (\$10,000) for each offense and shall be liable for reasonable attorney's fees.

Assessment of a civil penalty may be made in conjunction with any other department administrative action.

No civil penalty may be assessed unless the person charged was given notice and opportunity for a hearing pursuant to the Idaho administrative procedure act.

If the department is unable to collect such penalty or if any person fails to pay all or a set portion of the civil penalty as determined by the department, it may recover such amount by action in the appropriate district court.

Any person against whom the department has assessed a civil penalty under the provisions of this section may, within twenty-eight (28) days of the final action by the agency making the assessment, appeal the assessment to the district court of the county in which the violation is alleged by the department to have occurred.

All civil penalties collected pursuant to this section shall be remitted to the invasive species fund as authorized under section 22-1911, Idaho Code.

Nothing in this chapter shall be construed as requiring the director to report minor violations for prosecution when he believes that the public interest will be best served by suitable warnings or other administrative action.

[22-1913, added 2008, ch. 387, sec. 1, p. 1065.]

22-1914. COOPERATIVE AGREEMENTS. (1) The department may enter into cooperative agreements with persons and entities including, but not limited to, civic groups and governmental

agencies, to adopt and execute plans to detect and control areas infested with invasive species. Such cooperative agreements may include provisions for funding to implement agreements.

If an invasive species occurs and cannot be adequately controlled by individual persons, owners, tenants or local units of government, the department may conduct the necessary control measures independently or on a cooperative basis with federal or other units of government.

The department shall have the authority to delegate selected and clearly identified elements of its authorities and duties to another agency of the state with appropriate expertise or administrative capacity upon mutual agreement with that agency. The department is authorized to enter into memoranda of agreement with other state agencies to implement the delegations authorized in this subsection. Such delegation may include provisions of funding for implementation of the delegations. The department shall retain primary authority and responsibility for all requirements of this chapter unless otherwise directed herein.

[22-1914, added 2008, ch. 387, sec. 1, p. 1066.]

22-1915. NO EFFECT ON EXISTING LIABILITY. The enactment of this chapter does not terminate or modify any civil or criminal liability relating to plant pests which exists prior to the effective date of this chapter.

[22-1915, added 2008, ch. 387, sec. 1, p. 1066.]

22-1916. HOLD HARMLESS. Any state or federal agency or contractor, its officers, agents and employees implementing or enforcing the provisions of this chapter shall be held harmless against all claims arising from the good faith enforcement and implementation of the provisions of this chapter and rules promulgated hereunder, in accordance with the Idaho tort claims act, chapter 9, title 6, Idaho Code.

[22-1916, added 2008, ch. 387, sec. 1, p. 1066.]

22-1917. SEVERABILITY. The provisions of this act are hereby declared to be severable and if any provision of this act or the application of such provision to any person or circumstance is declared invalid for any reason, such declaration shall not affect the validity of the remaining portions of this act.

[22-1917, added 2008, ch. 387, sec. 1, p. 1067.]

Oregon Invasive Species Control Account

Oregon Invasive Species Council - Chapter 609

Division 10

OREGON INVASIVE SPECIES CONTROL ACCOUNT

609-010-0100

Definitions

As used in this division of administrative rules, unless the context requires otherwise:

(1) "Agreement" means a document describing an understanding between the Council and a recipient of Funds, including but not limited to a grant, loan, or memorandum of understanding.

(2) "Council" means the Oregon Invasive Species Council.

(3) "Emergency" means that one or more Invasive Species that is new to the state, or that exhibits a substantial range expansion within the state, threatens the health and integrity of Oregon's native flora and fauna.

(4) "Funds" means money in or disbursed from the Invasive Species Control Account.

(5) "Invasive Species" has the meaning given that term in ORS 570.755.

(6) "Invasive Species Emergency" means a declaration by the Council that an Emergency exists or is imminent, and that the Emergency is of such magnitude that Funds are needed to terminate or lessen the threat.

Statutory/Other Authority: ORS 570.800

Statutes/Other Implemented: ORS 570.800 & 570.810

History:

OISC 1-2010, f. & cert. ef. 5-28-10

609-010-0110

Purpose

The purpose of this division of rules is to provide criteria and procedures for administration of the Oregon Invasive Species Control Account.

Statutory/Other Authority: ORS 570.800

Statutes/Other Implemented: ORS 570.800 & 570.810

History:

OISC 1-2010, f. & cert. ef. 5-28-10

609-010-0120

Eligible Applicants

- (1) A person, state or local government, unit of state or local government, an Indian tribe, or a unit of the federal government, may request that the Council declare an Invasive Species Emergency and release Funds.
- (2) The request must be sent to the Council in writing and include a response plan with the following elements:
 - (a) A risk assessment for the Invasive Species;
 - (b) Information about efforts implemented to control or eradicate the Invasive Species in other locales;
 - (c) Methodology proposed to eradicate or control the infestation;
 - (d) Budget to respond to the infestation;
 - (e) Timeline for activities associated with response to the infestation; and
 - (f) Methods to evaluate control or eradication success.
- (3) Requests not meeting review standards may be returned for correction or completion, or may be denied further consideration.

Statutory/Other Authority: ORS 570.800

Statutes/Other Implemented: ORS 570.800 & 570.810

History:

OISC 1-2010, f. & cert. ef. 5-28-10

609-010-0130

Standards to Determine Eligibility for Release of Funds

- (1) The Council may release Funds only after declaring an Invasive Species Emergency and determining that the action items that are described in the response plan:
 - (a) Are economically, scientifically, and environmentally defensible and sound;
 - (b) Contribute to the effective control or eradication of Invasive Species populations or infections;
 - (c) Achieve a favorable cost/benefit ratio relative to other options considered; and
 - (d) Respond to an Invasive Species that the Council has deemed to be a high risk to Oregon's economy and environment.
- (2) The following expenditures are not eligible for funding through the Oregon Invasive Species Control Account:

- (a) Operational costs of managing Invasive Species that are widely established in Oregon; and
- (b) Any cost that the Council deems is not necessary to respond to an Emergency.
- (3) Outreach, education, and research related to Invasive Species are not generally eligible, but in a specific Emergency they might be part of an appropriate response plan and may be approved by the Council.

Statutory/Other Authority: ORS 570.800

Statutes/Other Implemented: ORS 570.800 & 570.810

History:

OISC 1-2010, f. & cert. ef. 5-28-10

609-010-0140

Process for Declaration and Release of Funds

- (1) Council members will review the request to declare an Invasive Species Emergency.
- (2) During the review process, the Council may consider technical and other information obtained from sources other than the applicant, including, but not limited to, the Governor's Natural Resources Cabinet.
- (3) If the Council declares an Invasive Species Emergency, the Council may enter an agreement with a person, state or local government, unit of state or local government, Indian tribe, or federal government that will be responsible for implementing a portion or all of the response plan. The agreement must include all terms required by law and include provisions for the following:
 - (a) Incorporation of the response plan.
 - (b) The maximum amount of Funds to be disbursed.
 - (c) Disbursement of the Funds according to a payment schedule that is incorporated as an integral part of the agreement.
 - (d) The recipient of Funds shall submit one or more interim reports for evaluation by the Council. The recipient of Funds shall submit the reports either on a schedule that is incorporated into the agreement or upon the request of the Council. Each report must include:
 - (A) Documentation of project results to date;
 - (B) Projections of short-range and long-range results;
 - (C) Any modifications to the response plan;
 - (D) Budget status; and
 - (E) An update on the likelihood of successful eradication.
 - (e) In the event an interim report is deemed unsatisfactory by the Council, the Council reserves the right to cancel the agreement and stop payments.
 - (f) Within six months of the official close of the action items designated in the agreement, the Fund recipient shall submit a final report to the Council. This report will provide the most cur-

rent and detailed information on project benefits as compared with the original criteria.

(g) In the event that a Fund recipient cannot complete any project within the agreement time-lines, the Fund recipient shall inform the Council and request a formal extension for use of the Funds.

(h) The Fund recipient shall return all unexpended Funds to the Council for deposit in the Invasive Species Control Account.

Statutory/Other Authority: ORS 570.800

Statutes/Other Implemented: ORS 570.800 & 570.810

History:

OISC 1-2010, f. & cert. ef. 5-28-10

Montana Invasive Species Trust Fund

Montana Code Annotated 2017
TITLE 80. AGRICULTURE
CHAPTER 7. DISEASE, PEST, AND WEED CONTROL

Part 10. Aquatic Invasive Species

80-7-1016. Invasive species trust fund.

- (1) There is an invasive species trust fund. The board of investments shall invest the money of the fund, and the investment income must be deposited in the fund.
- (2) The principal of the invasive species trust fund shall forever remain inviolate in an amount of \$100 million unless appropriated by a vote of three-fourths of the members of each house of the legislature.
- (3) Except as provided in 80-7-1013 and subsection (2) of this section, money deposited in the invasive species trust fund may not be appropriated until the principal reaches \$100 million.
- (4) On July 1 of each fiscal year, the principal of the invasive species trust fund in excess of \$100 million and the interest and income generated from the trust fund, excluding unrealized gains and losses, must be deposited in the invasive species account established in 80-7-1004.
- (5) Deposits to the principal of the trust fund may include but are not limited to grants, gifts, transfers, bequests, or donations from any source.

Effective 3/1/2020:

- (1) There is an invasive species account in the state special revenue fund. The account is administered by the department of fish, wildlife, and parks.
- (2) Money transferred from any lawful source, including but not limited to fees collected pursuant to 87-2-130, gifts, grants, donations, securities, or other assets, public or private, may be deposited in the account.
- (3) Subject to subsection (4), money deposited in the account must be used for projects that prevent or control any nonnative, aquatic invasive species pursuant to this part.
- (4) Any private contribution deposited in the account for a particular purpose, as stated by the donor, must be used exclusively for that purpose.
- (5) At the end of each fiscal year, unreserved funds in the account, including any interest and earnings, must be transferred to the invasive species trust fund established in 80-7-1016.
- (6) The department of fish, wildlife, and parks may not recover indirect costs from the invasive species account. (Subsection (6) terminates June 30, 2027--sec. 21(2), Ch. 387, L. 2017.)§ 80-7-1004, MCA

Amended by Laws 2017, Ch. 387, Sec. 7, eff. 3/1/2020.

Amended by Laws 2017, Ch. 387, Sec. 6, eff. 5/15/2017, terminating 2/29/2020.

Appendix I

Sources of Funds for AIS Control - EIP Tracker

The EIP Tracker compiles information about AIS projects funded and implemented, and includes the source of funding for those projects dating back to 2009. According to the EIP Tracker (as of July 27, 2019):

- Four federal entities (US Army Corps of Engineers, US Bureau of Reclamation, US Fish and Wildlife Service, and US Forest Service) have contributed a total of \$3,831,984 toward seven AIS projects in the region.
- Eight state entities (California Department of Parks and Recreation, California Division of Boating and Waterways, California State Water Resources Control Board, California Tahoe Conservancy, Lahontan Regional Water Quality Control Board, Nevada Division of Environmental Protection, and Tahoe Regional Planning Agency) have contributed a total of \$5,081,639 toward 17 AIS projects in the region.
- Three nonprofit organizations (Tahoe Fund, Truckee River Fund, and Truckee Meadows Water Authority) have contributed \$268,299 toward six AIS projects in the region (Note: This does not include the *Eyes on the Lake* program administered by the League to Save Lake Tahoe).
- Four private entities (Commercial property owners, Elk Point homeowners, Crystal Shores Homeowners Association, and Tahoe Keys Property Owners Association) have contributed \$300,870 toward four AIS control projects.

The total listed in the EIP Tracker for AIS control projects, as of July 27, 2019 is \$9,482,792, however, at the time of this compilation, all of the information for 2019 had not yet been entered.

