TAHOE WATER SUPPLIERS ASSOCIATION
PROTECT THE SOURCE

TWSA BOARD MEETING

PACKET for 03/01/2023

Refer to RED page numbers in the TOP left corner.

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TAHOE WATER SUPPLIERS ASSOCIATION
PROTECT THE SOURCE

TWSA Board Meeting - Quarter 1
Wed., March 1, 2023 1:00 PM - 4:00 PM (PST)

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AGENDA

A. Introductions

B. Public Comment Conducted in accordance with Nevada Revised Statute (NRS) Chapter 214.020 and limited to a maximum of 3 minutes in duration.

C. Presentations: TERC staff – Microplastics Report – Q&A session - 1:05 pm to 1:20 pm - prepare your questions ahead

D. Approval of Agenda for the March 1, 2023 TWSA Board Meeting

E. Approval of Minutes for the Dec. 7, 2022 TWSA Board Meeting

F. Reports

a. **Staff Reports**

b. **Budget** - see enclosed information for current expense details.
Open Gov. link for current budget and expenses: https://bit.ly/3wxURUA

c. **TWSA Chair Report**

G. General Business (verbal updates/discussion/for possible action):

a. 2023-24 Proposed Budget
b. TKPOA Control Methods Test
c. Tahoe Water for Fire Suppression Partnership
d. TERC Microplastics sampling summary report
e. DRINK TAHOE TAP® refill grant program
f. TRPA mooring/buoy field/pier notifications (Suzi)
g. Mutual Aid - lead operations contact list (Brad)
h. Exterior fire suppression sprinkler systems (Brad)

H. Purveyor Updates

I. Public Comment

J. Adjournment

Lahontan / TRPA - TKPOA Control Methods Test

Final project and environmental documents: https://tahoekeysweeds.org

2023 TWSA Board Meetings

First Wednesdays, quarterly, held from 1 to 4 pm; virtual until further notice.

Meeting dates:

- **March 1, 2023**
- **June 7, 2023**
- **September 6, 2023**
- **December 6, 2023**

Event Dates:

- **Tahoe Truckee Earth Day (Palisades) - Sat. April 15, 11 am - 5 pm**
- **South Lake Tahoe Earth Day (Bijou Park) - Sat. April 22, 10 am - 5 pm**
- **Snapshot Day (regionwide) - Sat. May 20, 9 am- 2 pm**

TWSA Board of Directors

Suzi Gibbons (Chair)	North Tahoe Public Utility District
Andrew Hickman	Round Hill General Improvement District
Tom White; Richard Robilliard (alt.)	Douglas County Systems
Patrick McKay; Mike McKee (alt.)	Edgewood Water Company
Cameron McKay	Glenbrook Water Cooperative
Brad Underwood	Incline Village General Improvement District
Mitch Dion; Brandon Garden (alt.)	Kingsbury General Improvement District
Nakia Foskett	Lakeside Park Association
Kim Boyd; Tony Laliotis (alt.)	Tahoe City Public Utility District
Shelly Thomsen (Vice-chair)	South Tahoe Public Utility District

For more information, please contact: Madonna Dunbar, TWSA Executive Director
1220 Sweetwater Road, Incline Village, Nevada 89451
(775) 832-1212 office / (775) 354-5086 cell /email: mod@ivgid.org

Certification of posting of agenda = Physical Posting Suspended - Covid-19 restrictions. Online posting and email delivery of notice provided one week ahead of meeting. In compliance with State of Nevada Executive Department, Declaration of Emergency Directive 006, 016 and 018, this meeting is closed to the public and attendance is limited to members of the Board of Trustees and essential staff. Public comment is allowed and the public is welcome to make their public comment either via e-mail (please send your comments to mod@ivgid.org by 5 p.m. on Tuesday, Feb. 28, 2023 or via telephone (775-354-5086) on the day of the meeting. By, Madonna Dunbar, Executive Director, TWSA

Notes: Items on the agenda may be taken out of order; combined with other items; removed from the agenda; moved to the agenda of another meeting; moved to or from the Consent Calendar section; or may be voted on in a block. Items with a specific time designation will not be heard prior to the stated time, but may be heard later. Members of the public who are disabled and require special accommodations or assistance at the meeting are requested to call IVGID at 832-1212 at least 24 hours prior to the meeting.

TWSA agenda packets are available at the TWSA website www.TahoeH2O.org
or the TWSA office at 1220 Sweetwater Road, Incline Village, Nevada 89451.

TWSA Board Meeting
Wednesday, December 7, 2022 – 1:00 pm to 3:00 pm
Minutes

A. Introductions
No guests were present.

B. Public Comment
No public comments were given.

C. Presentations
No presentations were given.

Roll Call of Members in Attendance
Suzi Gibbons (NTPUD), Cameron McKay (Glenbrook), Mitch Dion (KGID), Kim Boyd (TCPUD), Tom White (Douglas County), Nakia Foskett (LPA), Patrick McKay (Edgewood), Brad B. Underwood (IVGID), Shelly Thomsen (STPUD).
TWSA Staff in attendance: Madonna Dunbar and Sarah Vidra
Guests: John Williams (IVGID), Sarah Letton (City of South Lake Tahoe)

D. Approval of Agenda for the December 7, 2022, TWSA Board Meeting
Motion to approve the agenda, made by Nakia Foskett, second by Mitch Dion, all in favor; motion carried.

E. Approval of Minutes for the September 7, 2022, TWSA Board Meeting
Motion to approve the minutes from September 7, 2022, made by Nakia Foskett, second by Kim Boyd, all in favor; motion carried.

F. Reports

a. Staff Reports

Staff highlighted several activities from the quarter; a full activity report is available in the Board Packet.

- Annual Report, hard copy with a flash drive, will be sent out by the end of the month.
  - Weather data in comparison to clustered total coliform results on November 9, 2022.
  - Lack of deep water mixing, creating warmer water temperatures into November and to depths of raw water intakes.
  - TMDL 10-Year Report
  - TRPA EIP 10-Year Report
- Microplastic final report in Winter 2022
  - Present in the water of Lake Tahoe, intake depth has reduced concentrations of microplastics versus surface tows.
- UCMR5 sampling in 2023-2025, several members.
- Snapshot Day 2023 Saturday May 20, 2023.

b. Current Budget

TWSA account summary is provided in the board packet.

Link to OpenGov: https://tinyurl.com/29z7bb65

i FY 22-23 current operating balance $83K.
ii The current reserve budget is $170K

c. TWSA Chair Report

The Tahoe Truckee Area Mutual Aid Agreement for Sewer and Water is now fully executed, with all signatures.

The Chair would like to circulate the study produced for the TWSA by Dr. Schladow.

Tahoe Fire and Fuels Team will be asking for critical water and sewer infrastructure information. The Chair asked members to reach out to neighboring utilities to participate.

G. General Business (for possible action):

a. TKPOA Control Methods Test – Verbal Update

Draft control methods test report is available here: https://tahoekeysweeds.org/wp-content/uploads/2022/10/CMT-Interim-Report-09-30-2022-FINALv5.pdf

TKPOA Homeowners had a special assessment of up to $900 per unit, for the $1.2M overage in year 1 of the three-year control methods test.

The source of the overage is being presented as the cost of the monitoring program, and the requirement of two consecutive non-detect results 48 hours apart before turbidity curtain removal. The CMT required were Endothall of 5 ppb and Triclopyr of 1 ppb. These requirements were selected by regulators, and are set at the laboratory minimum detection limit. The standard of laboratory minimum detection limit should be required for future herbicide applications.

Years' 2-3, will not have herbicide treatment and will focus on diver-assisted suction, and bottom barriers. The TRPA supports more use of UV-C Light.

Board Comments:
The communication from the TKPOA has not met the standards required for water quality protection. TKPOA needs to be held more accountable for distributing information.

b. Tahoe Water for Fire Suppression Partnership – Verbal Update

The partnership has ranked and selected projects for the next round of Lake Tahoe Restoration act funding. $14M of projects were proposed, and the group hopes to get a definitive amount of funds vs the "*up to*" language previously used with the forest service.

c. DRINK TAHOE TAP® in reusable aluminum water bottles; co-branding opportunity with the City of South Lake Tahoe and Mananalu Water.

The TWSA board was joined by Sara Letton of the City of South Lake Tahoe. Staff presented the co-branding opportunity. The City of South Lake Tahoe has expanded its ordinance to ban the sale of single-use plastic water bottles:

1. Within the City of South Lake Tahoe by Earth Day 2023 including concessionaire with city contracts.
2. Within the City limits by 2024.

TWSA staff see this as the water protection ordinance by removing plastic from the watershed with the action in favor of the more recyclable options.

Mananalu has a 1:1 litter removal from the ocean for every bottle sold.

The City of South Lake Tahoe would like to purchase the co-branded bottles for Earth Day 2023. The TWSA cost of the printing of 100,000 bottles is 0.50 per bottle.

The Executive Director proposed to the board:

> Do we want to be in this market if, in the future, the aluminum bottle holds Tahoe Tap water? This could lead to a Mananalu franchise of Tahoe Tap. Do we want to see Tahoe Tap in this pre-packaged market as a bigger vision? I have researched canning lines and package plants to produce Tahoe Tap, with the goal of being in the market in three years as a long-term goal.
> There are benefits to this partnership with Mananalu, including distribution and brand recognition with celebrity endorsement. Edgewood resort currently purchases Mananalu water for the hotel and golf course.

In clarification of the board packet information.

- The event center is not a City of SLT property, but a partner on the Nevada side.
- The co-branding opportunity is for the 22 oz. Mananalu reusable water bottle, not the smaller 16 oz. or flavored varieties.
- There is concern from City of South Lake Tahoe board members that removing water bottles from convenience stores and food vendors will have negative health impacts because a non-water option will be chosen at convenience.
  Providing *constituents/community members/customers* with a co-branded, reusable, non-plastic option is a middle ground, with an option for businesses to market share.
- The one-time investment of $50K is to print 100,000 (20 oz. bottles) with the co-branded messaging to be finalized. What's provided is not the completed product.
- The 100,000 bottles will be stored in a warehouse and filled when ordered through the *U.S. Foods* Distribution System. The bottles will not be in the possession of the TWSA or City of South Lake Tahoe.
- The City of South Lake Tahoe cannot require the sale of Mananalu by a concessionaire or business within their jurisdiction. The bottle will be available to *Companies, Businesses, and For-Profit Companies* to purchase to then sell as inventory.
- There is no distribution plan for the first 100,000 co-branded bottles.
- The cost recovery potential of the project, was an initial interpretation of the Executive Director. The distribution strategy of Mananalu prevents cost recovery for the TWSA.

- The source water system of Mananalu in the state of Montana is unknown to staff at this time.
- Mananalu's status as a non-profit organization is unknown at this time.
- The messaging on the bottle can have more of a refill with Tahoe Tap message vs. Drink Tahoe Tap.

Chair Requested Full Board Involvement

LPA – In favor of co-branding opportunity and having Drink Tahoe Tap represented in the commercial market of South Lake Tahoe. The preferred option would be to have Lake Tahoe water within the bottles. The long-term option of Tahoe tap in this type of package would be amazing.

IVGID – Excited about the opportunity, and the long-term project. Buying a metal bottle of air vs. something with water in it, even if not *Tahoe Tap* right now for the initial purchase, is something we can overcome with the prevalence of Tahoe Tap on the bottle. The whole perspective is getting people out of plastic bottles.

New information that the inventory isn't going to the City of South Lake Tahoe for immediate use.

There is a lot of fund balance that makes the IVGID board nervous. The investment of $0.50 a unit is similar to that of a sticker, which will come with a lot of effort into the distribution of the first 100,000 units. Great idea. I would vote in favor; opportunities like this don't come along all the time.

TCPUD – Amazing to have a ban on plastic bottles in the City of South Lake Tahoe; commend the city for doing that.

- The big issue is confusion about the water source. People will see Drink Tahoe Tap and assume it's Tahoe Tap in the bottle, and it's not.
- Corporations taking money from our constituents for a bottle with our messaging on it, with their product in it.
- The project is in conflict with our own bottles that aren't moving in the stores. The idea that people will take the Mananalu bottle and continue to refill them is a stretch when customers aren't purchasing the Klean Kanteen to refill.
- How many grocery stores have fill stations where you can fill a 1-5 gallon container? We may have a better place to market our water.
- This proposal isn't solving the single-use issue, only the plastic issue.
- Money in reserve comes from our constituents/customers, and it's a hard sell to say we're funding a cooperate project.
- There isn't a full plan for the distribution of the 100,000 bottles, and the requirements are for keeping them within the Tahoe Basin.

Appreciates the larger vision. It's a lot of money for what we're getting out of it. Not sold on this as the end, but how we get to the end goal.

Edgewood – Having Drink Tahoe Tap on the bottles is contradictory when the water isn't from Lake Tahoe. Refill with Tahoe Tap is a better message with Mananalu's label on it. Agree with doing our own bottled water.

KGID – Lots of issues:

1. The TWSA member agencies are not in competition with bottled water; our product is service.
2. Getting aluminum out of products was the goal 45 years ago. If aluminum cans are recycled more, does that mean beer drinking are more environmentally concerned than water drinkers? Not a fan of bringing aluminum in. There will be the same issue with aluminum as there are with plastic, with aluminum already listed as a toxin by the EPA.
3. Wrong issue for the TWSA. The confusion is the focus on single-use material avoidance when the focus needs to be on watershed protection.
4. Caution against celebrity production/sponsorships; they can cause more trouble than good. The TWSA has done a lot to build our brand, and it's respected and embraced by the community, and it will continue to be. In co-branding opportunities like this, who is lending creditability to whom?
5. Bottling our water is not economically viable. Lots of utilities have tried, and there are no success stories other than for use as promotional items.

Great discussion, but the focus of the TWSA is on behaviors, not consumer products.

Glenbrook – Not that much in favor of this. Let's look at our mission statement and stick to the core of what we are here to do. We don't want to sell water from three states over to promote Drink Tahoe Tap. Our bottles can sit empty as a souvenir, and the business owner can choose to fill them for their customer if they would like. Let's stick to our mission statement and that's to protect the lake and protect our drinking water source. Not much in favor of promoting anyone else's water.

STPUD – Acknowledges that the Executive Directors' strengths are new ideas and things. The messaging is confusing without Lake Tahoe water in the Mananalu bottle. Suggests that the refill station grant be used as an opportunity to support the City of South Lake Tahoe, but changing the grant allotment and focusing on funding a specific amount of stations in the South Lake Tahoe Region. The fill station grant is a better use of funds than putting our logo on a private company's water bottle. STPUD will provide the language used in their High-Efficiency appliance rebate update for possible use to update water station grant forms.

NTPUD – Issues with the Co-Branding opportunity:

- Large ask, a big chunk of reserve budget.
- The City of South Lake Tahoe is not a member agency.
- This project is not similar to previous funding projects that benefited Lake Tahoe as a whole.
- The vendors are all for-profit businesses, and this uses public funds for the private sector.

- NTPUD is a no - due to the requested amount of $50K.
- The TWSA shouldn't get into the bottled water business and compete with for-profit businesses.

Alternative Board Actions for partnership with the City of South Lake Tahoe to promote source water protection by promoting Drink Tahoe Tap:

- Fill station grant project expansion.
- Fill station location network and mobile app.

The Chair entertained a motion, no motion was made.

H. Purveyor Updates

KGID - The district will be advertising for materials for the next fiscal years' water main projects. KGID has purchased materials for this years' water main projects and has seen a benefit in cost and provided predictable material for the contractors. Developing the budget for FY 23-24 and will include a 10% reduction in operational expenses as a goal, with the FY 22-23 meeting an 8% reduction.

Edgewood – Edgewood has replaced the 14 inch treated water meter at the treatment plant. The 8" domestic line for the event center was tested and will be put into service next week.

TCPUD – West Lake Tahoe Regional Water Treatment Plant construction has been completed on the building, intake line, and conduits. Drone footage was taken during the construction process. The footage will be used for an outreach project in the future. The west shore storage augmentation project continues. The project includes rehabbing and upsizing two water tanks and installing additional new water tanks. Madden Creek system improvements and funding and phasing for the $37M for the Tahoe Cedars project.

Glenbrook – A feasibility study is being prepared to replace the water line that serves the fire station in parallel with NDOT project.

LPA – LPA is finalizing a water model for their system. LPA is looking into a mutual aid agreement with California Water/Wastewater Agency Response Network (CalWARN), which could be utilized by NV agencies in the future. LPA runs on a Calendar Year, and the 2023 project will include and automatic transfer switch at the water treatment plant and automation of filter operation, and media replacement in the two filter units.

STPUD – the *Take Care- Adopt a Hydrant* campaign is available online for outreach for the winter. Lead & Copper assessment of the waterline requirements will require 14K connection assessments, and the project will span two years.

RHGID – sent via email: sewer meter installation project is delayed until the spring, 2023.

NTPUD – NTPUD has completed the 12" water main project from Carnelian Bay to Watson Creek, replacing a 2" water main with no water hydrants. The new line has fire hydrants every 500 feet, and customer service lines. The district is experiencing long lead times on sewer station pumps and other materials.

IVGID – No update given.

Douglas County – No update given.

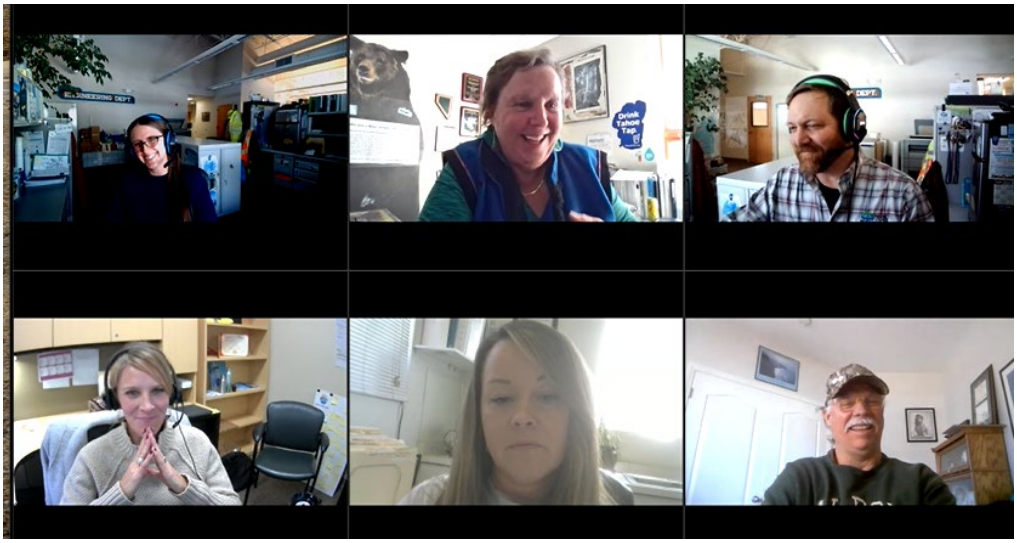
I. Public Comment

No public comments were given.

J. Adjournment

Motion to adjourn made by Mitch Dion, second by Patrick McKay, all in favor; motion carried.

Meeting adjourned at 2:57 pm.



TWSA Staff Report Q 1 2023

TWSA / Water Quality / Water Efficiency:
The City of South Lake Tahoe has enacted a single-use water bottle ban to become effecting 2023-24. TWSA staff are planning for intensive support role on implementation.
https://www.kolotv.com/2022/10/04/south-lake-tahoe-bans-single-use-plastic-water-bottles/
https://www.tahoedailytribune.com/news/south-lake-tahoe-bans-single-use-plastic-water-bottles/

The TWSA board is interested in support the City of South Lake Tahoe by expanding the current water bottle refill station incentive program.

Expanded TWSA messaging on Drink Tahoe Tap and dog waste collection are being further developed in the Take Care partnership workgroup for use on the Take Care and TWSA outreach platforms.

Snapshot Day 2023
Staff continues to work with regional partners on the Citizen Science monitoring event. The 32rd Annual Snapshot Day will be held on May 20, 2023. The event will be held at Tahoe Waterman's Landing, and increased public participation will be a goal of the 2023 project. The event website was updated by staff, and digital outreach materials are being produced.

The 2022 Tahoe Truckee Snapshot Day event report will be drafted by staff and published to the event website: www.tahoetruckeesnapshotday.org .

Aquatic Invasive Species (AIS):
Staff continues to monitor the progress of the TKPOA CMT. A draft report had been issued.
https://tahoekeysweeds.org/wp-content/uploads/2022/10/CMT-Interim-Report-09-30-2022-FINALv5.pdf

TWSA Watershed Control Program Annual Report
Staff finalized the production and publication of the 2022 TWSA Annual Report.

The TWSA Annual Report is posted at**:**
https://www.yourtahoeplace.com/uploads/pdf-public-works/2022_TWSA_Annual_Report_withoyt_maps_or_CCRs_(smallest).pdf

Outreach:
Staff has been tabling on Fridays at Diamond Peak; offer Waste Not, TWSA and Diamond Peak's STOKE Certification information.

Lakewide Microplastics Research Partnerships:
The most comprehensive characterization of microplastics in the Lake Tahoe Basin to date is occurring. Two TWSA Nevada members are participating with raw water samples for micro plastics analysis by TERC researchers. TWSA's sponsored Manta Trawl been used in lake wide sampling for more than a year now. The draft report is available upon request.

Raley's / Drink Tahoe Tap Collaboration

The TWSA has procured more Drink Tahoe Tap bottles from Raley's. The Raley's stores produced, funded and stocked custom 11,000 bottles for this campaign. Bottles are in in 116 Raley's stores to support the Drink Tahoe Tap campaign. Extensive details are provided in earlier Board reports. Staff is remaining in contact w/ Raley's to see where the campaign goes…

In 2022, Raley's and Tahoe Fund are collaborating with Pixlbank on a social media & photography crowd-source platform in 2022. https://www.ilovetahoe.org/drink-tahoe-tap

Water Bottle Refill Stations:

Grants: The TWSA/Tahoe Fund Water Bottle Filling Station Grant Program has become active again with easing of COVID restrictions for businesses. To date, 18 grants have been issued ($11,500) with several applications active. New signage has been developed for the refill stations. https://www.yourtahoeplace.com/news/twsa-water-bottle-refill-station- grant-program

Find a Fill Station: fill station locations are presently logged on the TAP APP: https://findtap.com

Tahoe Citizen Science App: https://citizensciencetahoe.org/home

TERC'S 2022 Tahoe Citizen Science App is now active with a DRINK TAHOE TAP refill station feature.

Mobile Water Stations:
10 units are prepared for summer event needs; 2 new units were built spring 2022. We are estimating 100,000+ contacts from 28 events in 2022.

A Take Care Tahoe focus group is addressing ways to increase compliance with dog owners on picking up dog waste to protect the watershed.

Staff has been monitoring the efforts of Clean Up the Lake as they conduct the 72 mile lake-wide cleanup. Staff has not acted on the Board approved $5000 match fundraiser yet with the organization; but both directors still anticipate a collaborative effort in 2022.

Staff attends the Nearshore Aquatic Weeds Working Group (NAAWG) quarterly.

Administration (TWSA)

- Staff facilitated the December 7 board meeting.
- Staff is supporting the City of SLT Sustainability programs on their bottled water ban.
- Staff reviewed TKPOA CMT preliminary reports released February 2023.
- Staff continues to monitor the monthly TRPA Shorezone Project Review Committee Project Application Meetings.
- DRINK TAHOE TAP®; and I DRINK TAHOE TAP ® trademarks are valid to 2026.

- We continue to collaborate with the Tahoe Environmental Research Center (TERC) and Sierra Watershed Education Partnership (SWEP) to support regional peer student on-line education efforts.
- A DRINK TAHOE TAP ®ad is running year-round in the Tahoe.com regional print publication and website.

Professional Development/Other:
Staff attended the RCAC Source Water Protection Webinar on January 11, 2023

Staff attended the Nevada Water Resource Association's Annual Conference from January 31-Feb 2, 2023. Topics included water conservation, tools for resource management, climate change and adaptation, State Water Initiative, State Water Plan, Key Note from the State Engineer, and Tribal viewpoints on water issues.

Public Outreach and Sustainability:
Staff has been conducting public outreach tabling events at the base lodge at Diamond Peak every Friday from 8:00am to 4:30pm. Over 300 people were engaged and given reuable water pouches to refill at the Diamond Peak water refill stations, diverting more disposable plastic water bottles from the waste stream.

TWSA Staff Memo

TO: **TWSA Board**

FROM: **Madonna Dunbar, TWSA Executive Director & IVGID Resource Conservationist**

SUBJECT: **DRINK TAHOE TAP® water refilling station grant program**

DATE: **February 20, 2023**

1) Staff requests the TWSA Board discuss/possibly take action to set a maximum $40,000 allocation for funding for an enhanced water refill station grant program for FY 2023-24. Funding to be accessed from TWSA Reserve current balance $171,920.86. (account # 200.00.000.2805) This line item is not included in proposed 2023-24 operating budget.

2) Discuss/set maximum allocation for City of SLT grant applications from above.

3) Discussion/possible action is to increase the grant award for indoor station from $500 to $1000 and outdoor station from $1000 to $2500.

Current program information is at: https://www.yourtahoeplace.com/uploads/pdf-public-works/Water_Bottle_Filling_Station_TWSA_TF_GRANT_Program_-_whole_packet_UPDATED_for_2022-24.pdf

TWSA Staff Memo

TO: TWSA Board

FROM: Madonna Dunbar, TWSA Executive Director & IVGID Resource Conservationist

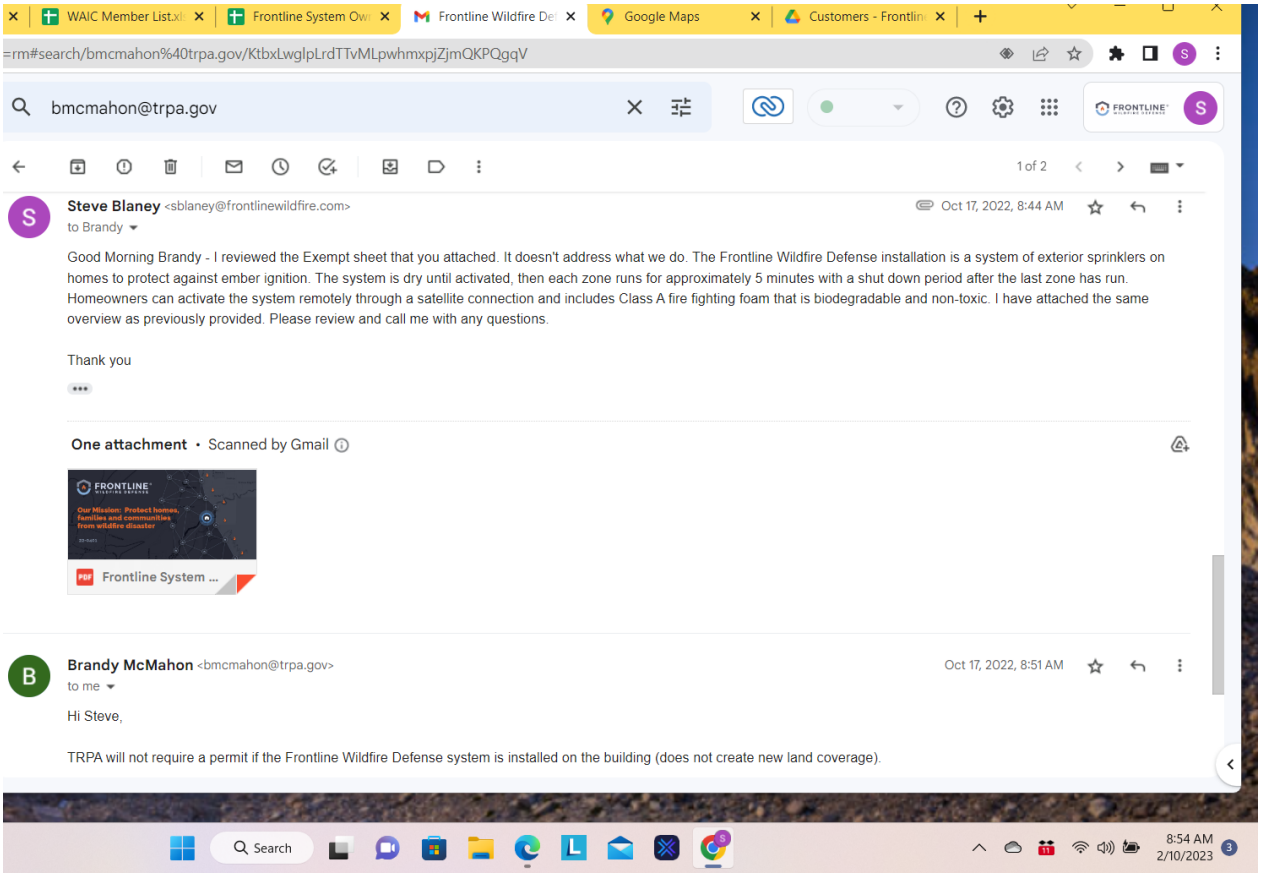
SUBJECT: Frontline Wildfire Defense / Class A Foam outdoor property sprinklers

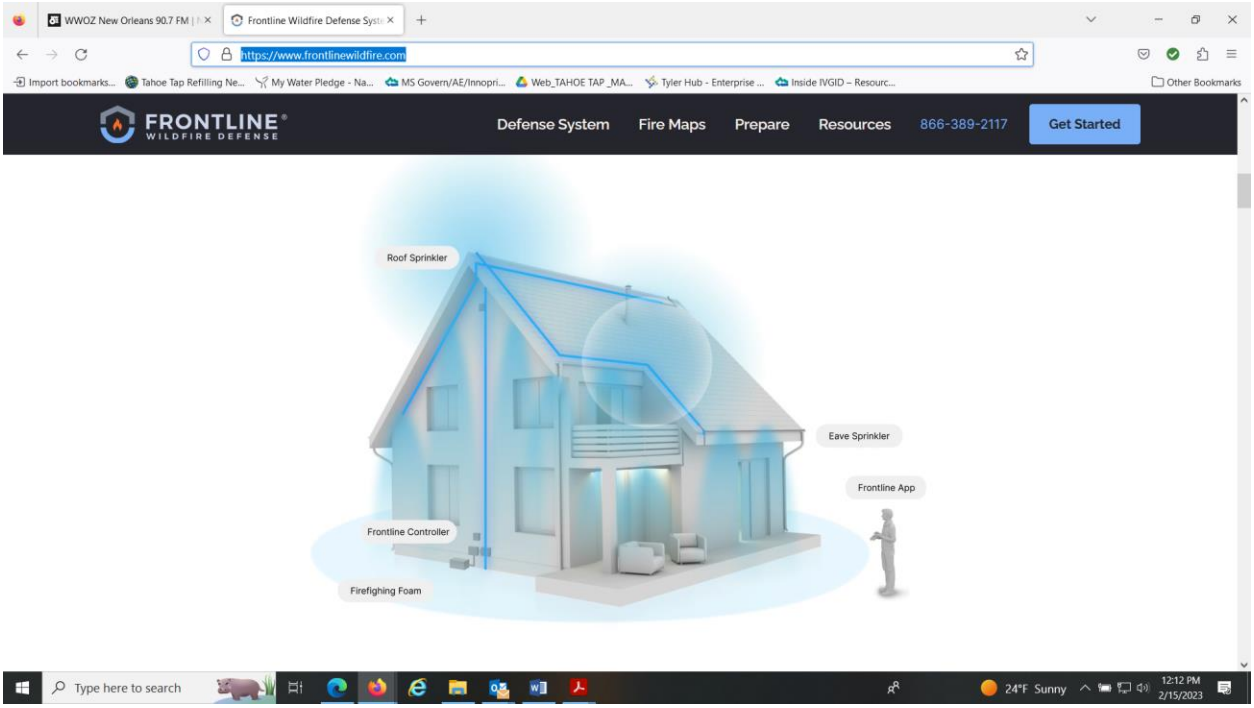
DATE: February 20, 2023

1) Staff requests the TWSA Board discuss/possibly take action on evaluation/best practices for emerging technology use of smart outdoor property irrigation systems for wildfire protection. https://www.frontlinewildfire.com/

2) These systems are dry systems designed to apply a biodegradable Class A foam dry product which is activated with water via sensor or wireless app.

3) TRPA is not requiring a permit for installation (see below).




WWOZ New Orleans 90.7 FM
Frontline Wildfire Defense Syste
https://www.frontlinewildfire.com
Import bookmarks...
Tahoe Tap Refilling Ne...
My Water Pledge - Na...
MS Govern/AE/Innopri...
Web_TAHOE TAP_MA...
Tyler Hub - Enterprise ...
Inside IVGID – Resourc...
Other Bookmarks
FRONTLINE
WILDFIRE DEFENSE
Defense System
Fire Maps
Prepare
Resources
866-389-2117
Get Started
Roof Sprinkler
Eave Sprinkler
Frontline App
Frontline Controller
Firefighing Foam
Type here to search
24°F Sunny
12:12 PM
2/15/2023

Account Trial Balance to 12/31/2022

2023 Period 1 to 6
Expense Accounts

Accounts	Description	Organization	Beginning Bal	Debits	Credits	Net Change	Ending Balance
200 Utility Fund			**0.00**	**83,616.41**	**4,760.47**	**78,855.94**	**78,855.94**
20002899 5010	Salary	20002899	0.00	31,422.43	0.00	31,422.43	31,422.43
20002899 5050	Taxes	20002899	0.00	2,370.42	0.00	2,370.42	2,370.42
20002899 5100	Retirement Fringe Ben	20002899	0.00	5,423.94	0.00	5,423.94	5,423.94
20002899 5200	Medical Fringe Ben	20002899	0.00	5,504.72	281.78	5,222.94	5,222.94
20002899 5250	Dental Fringe Ben	20002899	0.00	427.21	17.83	409.38	409.38
20002899 5300	Vision Fringe Ben	20002899	0.00	49.54	1.12	48.42	48.42
20002899 5400	Life Ins Fringe Ben	20002899	0.00	20.88	0.00	20.88	20.88
20002899 5500	Disability Fringe Ben	20002899	0.00	159.56	0.00	159.56	159.56
20002899 5600	Unemployment Fringe Ben	20002899	0.00	479.79	0.00	479.79	479.79
20002899 5700	Work Comp Fringe Ben	20002899	0.00	752.39	0.00	752.39	752.39
20002899 7010	Advertising - Paid	20002899	0.00	2,787.50	0.00	2,787.50	2,787.50
20002899 7405	Office Supplies	20002899	0.00	119.97	0.00	119.97	119.97
20002899 7415	Operating	20002899	0.00	30,286.55	4,454.74	25,831.81	25,831.81
20002899 7460	Postage	20002899	0.00	163.98	0.00	163.98	163.98
20002899 7470	Printing & Publishing	20002899	0.00	3,416.53	0.00	3,416.53	3,416.53
20002899 7680	Training & Education	20002899	0.00	100.00	0.00	100.00	100.00
20002899 7685	Travel & Conferences	20002899	0.00	35.00	5.00	30.00	30.00
20002899 7840	Telephone	20002899	0.00	96.00	0.00	96.00	96.00
Total			0.00	83,616.41	4,760.47	78,855.94	78,855.94
Grand Total			**0.00**	**83,616.41**	**4,760.47**	**78,855.94**	**78,855.94**

2023-24 TWSA BUDGET WORKSHEET (200.28.990)

		Proposed 2023-24		Approved 2022-23
Paid Advertising				
ADS: TV/Radio/Print	$	6,000	$	6,000
Tahoe In Depth Sponsorship ($500 x 3)	$	1,500	$	1,500
Earth Day events (North and South Shore) sponsorships ($500 each)	$	1,000	$	1,000
Regional event sponsorships	$	1,500	$	1,500
State of the Lake Report sponsorship	$	2,500	$	2,500
Total:	**$**	**12,500**	$	12,500
Office Supplies				
Monthly Xerox machine costs,				
Board materials, brochures, in-house printing	$	1,600	$	1,600
Total:	**$**	**1,600**	$	1,600
Operating General				
TWSA logo trademarked clothing	$	1,000	$	1,000
TWSA Water Bottles	$	20,000	$	30,000
Board meeting hospitality (lunches)				
Monitoring Supplies	$	600	$	600
Snapshot Day	$	600	$	600
Water Fill Station Rebate Program		existing budget rollover /reserve		existing budget rollover/reserve
Citizen Science / Tahoe Tap App	$	5,000	$	5,000
Dog Waste Campaign (bags, small dispensers)	$	4,000	$	4,000
misc event supplies	$	1,000	$	1,000
Total:	**$**	**32,200**	$	42,200
Printing / Publishing				
'Drink Tahoe Tap' stickers	$	6,000	$	6,000
Postage	$	200	$	200
Annual Report Printing (outsourced)	$	3,300	$	3,300
Watershed Protection signs	$	1,000	$	1,000
Total:	**$**	**10,500**	$	10,500
Professional Services				
Professional Services (WQTS estimate for technical reviews)		existing budget rollover /reserves		existing budget rollover /reserves
Reserve fund		na		na
Total:				
Education/conferences				
Annual Mileage - personal vehicles	$	1,000	$	1,000
Phone	$	500	$	500
Trainings/Professional Memberships	$	800	$	800
Conference Call service for meetings	$	500	$	500
Total:	**$**	**2,800**	$	2,800
Grand Total Operating:	**$**	**59,600**	$	69,600
Total Budgeted Salary and Benefits	**$**	**100,000**	$	90,000
1366 combined hours, annual (MOD&SGV)				
IVGID Central Service costs included ($900 month)				
Total Annual Budget (Operating & Salaries)	**$**	**159,600**	$	159,600
Revenue from reserves allocated to WQTS professional services^		0		0
Grant Funds		0		
Total Budget minus reserves/grant funds		**159,600**		
STPUD Fee ($3000 flat fee associate membership)		**3,000**		was added in afterward
Members Cost share TOTAL	**$**	**156,600**		**159,600**

REFERENCE (as of 2 14 2023):
TWSA Total Reserve (deferred revenue 200.00.000.2805) = $171,920.86

Shared Costs are 25% staff/75% operating
Dependent Costs are 75% staff/25% operating

TWSA Program Expenses

Cat	Description	Budget	23-24 adjusted
Staff Total		$ 100,000	
Op Exp Total		$ 59,600	
Grand Total Budget		$ 159,600	
		$ 159,600	
	Shared Costs (25% staff 75% operating)	$ 69,700	
	Dependent Costs (75% staff 25% operating)	$ 89,900	
		159,600	

$69700 reduced by $3000 to $66700 by STPUD contibution >

		TOTAL TO SHARE
Shared	**$66,700**	
Depend	**$89,900**	**$156,600**

2022-23 TWSA Cost Share (PROPOSED) based on 3 year average / production daily flow

200.28.990	Shared Costs	Dependent Costs	Avg Daily Flow gpd	**Member cost share - FINAL**	% of Total	Shared Cost	Depend Cost	Flow Ratio	Member cost share - previous year
Incline Village General Improvement District	9.10%	36.53%	2,655,000	**$ 38,908**	24.85%	$6,070	$ 32,839	0.365	**$ 36,658**
Kingsbury General Improvement District	9.09%	10.17%	739,504	**$ 15,210**	9.71%	$6,063	$ 9,147	0.102	**$ 15,223**
Round Hill General Improvement District	9.09%	2.68%	194,612	**$ 8,470**	5.41%	$6,063	$ 2,407	0.027	**$ 9,002**
Edgewood Water Company	9.09%	7.61%	553,327	**$ 12,907**	8.24%	$6,063	$ 6,844	0.076	**$ 13,316**
Zephyr Water Utility	9.09%	2.67%	193,872	**$ 8,461**	5.40%	$6,063	$ 2,398	0.027	**$ 9,033**
Glenbrook Water Company	9.09%	3.58%	260,549	**$ 9,286**	5.93%	$6,063	$ 3,223	0.036	**$ 9,814**
Tahoe City Public Utility District	9.09%	16.86%	1,225,310	**$ 21,218**	13.55%	$6,063	$ 15,155	0.169	**$ 21,624**
Skyland	9.09%	2.39%	173,750	**$ 8,212**	5.24%	$6,063	$ 2,149	0.024	**$ 8,849**
Cave Rock	9.09%	2.39%	173,750	**$ 8,212**	5.24%	$6,063	$ 2,149	0.024	**$ 8,849**
Lakeside Park Association	9.09%	1.5%	109,245	**$ 7,414**	4.73%	$6,063	$ 1,351	0.015	**$ 8,548**
North Tahoe Public Utility District	9.09%	13.61%	989,467	**$ 18,301**	11.69%	$6,063	$ 12,238	0.136	**$ 18,685**
Total to split	100.00%	100.00%	7,268,386	**$ 156,600**	100.00%	$66,700	$ 89,900	1	**$ 159,601**
			IVGID share	**$ 38,908**					
			STPUD	**$ 3,000**					
			other member shares	**$ 114,692**					
			Grand Total all full membership fees	**$ 156,600**					
			STPUD associate	**$3,000**					
				$ 159,600					

To Sink or Swim

A Snapshot Evaluation of the Fate and Types of Microplastics in Lake Tahoe

Surface and Municipal Waters Summary for TWSA

A collaborative original research study conducted by the
University of California Davis Tahoe Environmental Research Center and One Health Institute
with funding by the Nevada Division of Environmental Protection and the Tahoe Water Suppliers Association

Report prepared for:
Nevada Division of Environmental Protection
901 S. Stewart Street, Suite 4001, Carson City, NV 89701

Final Report Date: Feb. 6, 2023

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ACKNOWLEDGEMENTS

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PROJECT OVERVIEW

ENVIRONMENTAL MICROPLASTIC POLLUTION

Due to the ubiquitous and largely unrestricted use of plastics, its frequent unintended release into the environment, and increasing recognition of potentially harmful effects; there is an urgent need to better understand the current levels, environmental fate, as well as the hazards posed to human, wildlife, and ecosystem health in order to appropriately assess risks associated with its presence.

Plastics are composed of synthetic (human-made) polymers typically derived from petroleum oils. These synthetic polymers are made up of repeating identical molecular sub-units (monomers) that are chemically linked together into long chains. The characteristics of a plastic are determined by the particular sub-unit's chemical properties that can be augmented with additive chemicals (like plasticizers, flame retardants, other polymers, or dyes) that are mixed into the plastic to adjust specific properties including rigidity, flexibility, durability, melting point, color, and clarity. Table 1 describes the characteristics and uses of the most commonly produced plastics are outlined below.

Table 1. Characteristics and uses of the most commonly produced plastics worldwide.

Commonly Produced Plastics						
Synthetic Polymer (Plastic)	**Abbr**	**Density g/cm^3**	**Sink or float**	**Global Plastic Product**	**Key Characteristics**	**Typical uses**
Polyethylene	PE	0.91 - 0.97	Float	36%	Durable Easily molded Lightweight	Bottles/food containers/bags Pipes Fishing gear/nets
Polypropylene	PP	0.9 - 0.91	Float	21%	Rigid and tough Fatigue resistant Susceptible to solvents Heat resistant	Food packaging Automotive parts Medical supplies Upholstery, consumer goods
Polyester & Polyethylene Terephthalate	PES PET	1.23 - 2.3 1.37 - 1.45	Sink	10%	Strong and stiff Resistant to shatter Lightweight	Clothing and textiles Bottles/food containers
Polyvinyl chloride	PVC	1.16 - 1.58	Sink	12%	Hard and durable Tensile strength Rigid or flexible forms	Constructions materials Pipes/Flooring/wiring Packaging
Polystyrene	PS	1.04 - 1.1	Sink	10%	Hard Rigid/brittle Forms plastic mixtures	Foam food containers Disposable cutlery Building insulation
Polyurethane	PU	1.2	Sink	10%	Abrasion resistant Rigid or flexible forms Bonds well	Building insulation Insulating foams/mattresses
Polyamide (Nylon)	PA	1.02 - 1.05	Sink	-	Tensile strength Low friction Resists abrasion Dries quickly	Clothing Industry/construction Fishing gear/nets Electronics/machine parts

PROJECT OVERVIEW

The term 'microplastic' is colloquially used to refer to any small piece of plastic and are generally defined as synthetic polymers measuring between 1 µm and 5 mm in size. Table 2 defines the more precise terminology is used in the scientific communities to refer to different size classes of plastic, however, debate continues as to the exact size encompassed by each term (Padervand et al. 2020).

Table 2. Size class definitions and descriptions of common "microplastic" terminology.

Commonly Terminology used for Microplastic Research	
Term	**Description**
Particle	General term referring to any small piece of matter with physical and chemical properties that may be used when the underlying composition is plastic, non-plastic, or unknown
Suspected Plastic Particle	Term referring to a particle that has characteristics consistent with or similar to plastic but that has not been definitively identified or confirmed to be composed of plastic.
Nanoplastic	A piece of plastic commonly measured in nanometers (usually 1-1000nm) by its longest dimension
Microplastic	A piece of plastic commonly measured in micrometers (usually 1-1000µm) by its longest dimension
Mesoplastic	A piece of plastic measuring 1-10mm by its longest dimension
Macroplastic	A piece of plastic measuring larger than 1cm by its longest dimension

Plastic is refractory to biodegradation, which makes it a resilient and durable material that is useful for many applications. Its chemical resilience means that pieces of plastic often physically break into smaller pieces long before it can chemically degrade. Because chemical degradation tends to occur at a much slower rate than physical break-down into smaller pieces, an accumulation of ever-smaller pieces of plastic (microplastics) may persist in contaminated environments for many decades to centuries or even millennia after being released.

While harmful effects of microplastic exposure have been researched and described, there is currently only a rudimentary understanding of the hazards posed by microplastic pollution. Much remains unknown about how microplastic characteristics and composition may contribute to harmful effects, how environmental fate of microplastics may affect exposure pathways, and at what environmental level harmful effects occur for different environmental matrices.

Although risk to human health from drinking water is considered low at this time, this conclusion assumes drinking water undergoes standard treatment and is based on currently understood health effects. This conclusion may not be appropriate to extrapolate to untreated water sources, other routes of exposure, and wildlife and ecosystem health.

PROJECT OVERVIEW

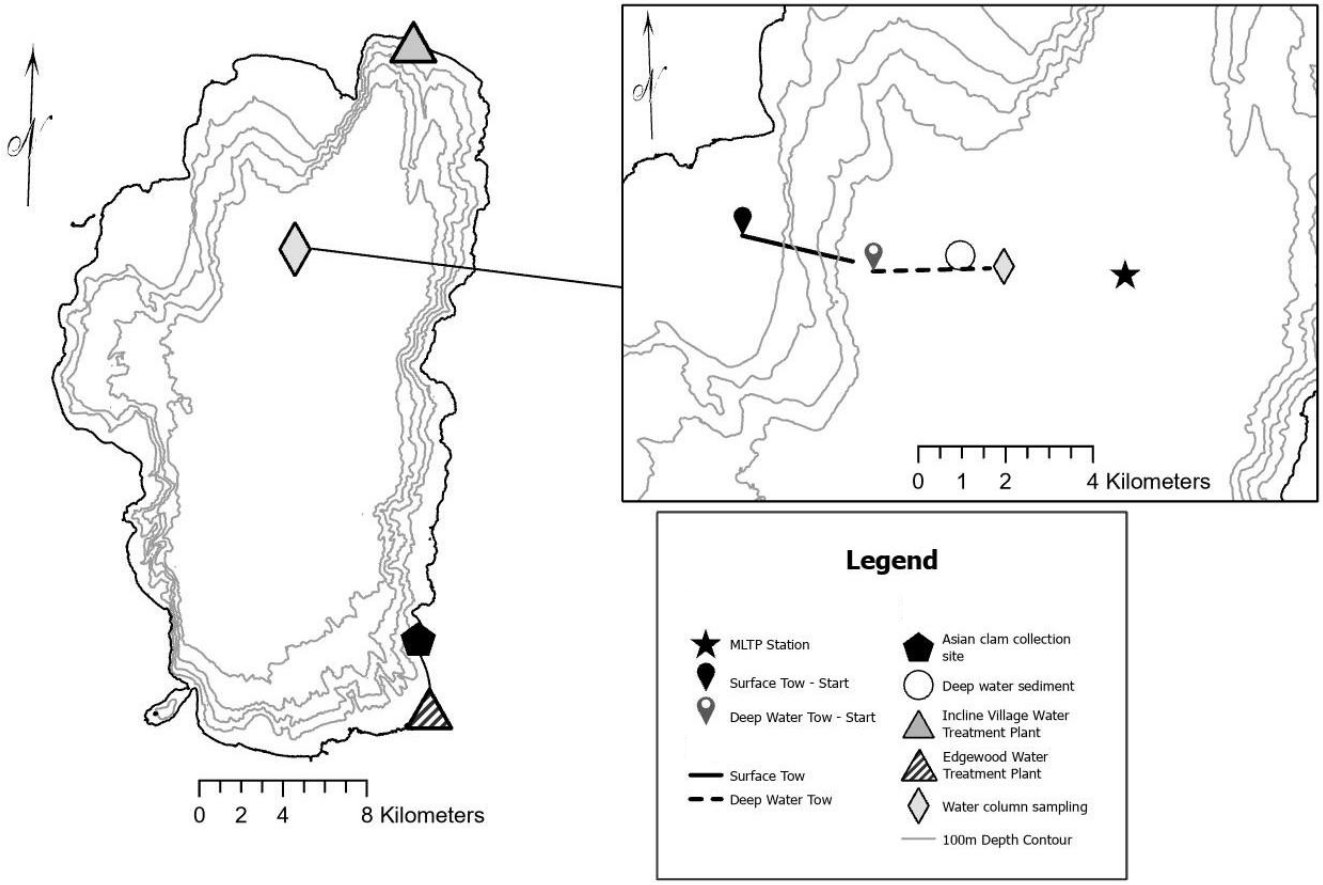


FIGURE 1. MAP OF LAKE TAHOE INDICATING PROJECT SAMPLING LOCATIONS. THE MAP INDICATES THE LOCATIONS WHERE EACH TYPE OF SAMPLE WAS COLLECTED. THESE LOCATIONS ARE CONSIDERED TO BE REPRESENTATIVE OF EACH TYPE OF ENVIRONMENT AT LAKE TAHOE, ALTHOUGH NO SPATIAL RECORD OF MICROPLASTIC POLLUTION EXISTS TO CONFIRM THIS ASSUMPTION. HOWEVER, BASED ON MANY DECADES OF LAKE MONITORING OF A BROAD RANGE OF ENVIRONMENTAL VARIABLES WE BELIEVE THAT THIS ASSUMPTION TO BE CORRECT

MATERIALS AND METHODS
HORIZONTAL TOWS OF SURFACE AND SUBSURFACE WATERS

MATERIALS AND METHODS
HORIZONTAL TOWS OF SURFACE AND SUBSURFACE WATERS

Sample Collection

A horizontal oceanic sampling trawl net with mesh size of 335µm was used to collect 12 monthly samples from surface and subsurface waters of Lake Tahoe during the period of August 27th, 2020 to August 4th, 2021. The trawl net was towed by boat for 30 minutes at 3 knots along a fixed heading transect between the Tahoe City Marina and Mid Lake Tahoe Profile (MLTP) monitoring site (see figure 1). The sampling net was towed alongside the vessel to prevent contamination from the boat or interference from the propeller. A water level data logger was attached to the net to measure actual tow depth during subsurface sample collection. GPS location, heading, speed and duration were recorded during each tow.

Following completion of a tow, the net was carefully brought onboard and all collected material was flushed into a pre-cleaned glass jar using de-ionized water. Field blank samples were collected prior to tows by rinsing two liters of pre-filtered de-ionized water through the suspended trawl net. Sample jars were stored in coolers until they were transferred to the lab.

FIGURE 1. SAMPLING OF SUSPECTED PLASTIC PARTICLES FROM LAKE TAHOE SURFACE WATERS. A TOW NET WAS USED TO COLLECT SAMPLES FROM SURFACE AND SUBSURFACE WATERS (LEFT IMAGE). FOLLOWING A TOW, ALL MATERIAL FROM THE NET WAS TRANSFERRED INTO A SAMPLING JAR (MIDDLE IMAGE). SAMPLES FROM EACH JAR WERE PROCESSED AT THE LAB TO REMOVE ORGANIC MATERIAL AND ISOLATE ANY POTENTIALLY PLASTIC PARTICLES FOR FURTHER ANALYSIS.

Sample Preparation

Each sample was then processed to isolate particles suspected to be plastic from other natural materials. These suspected particles were mounted onto double-sided tape attached to a pre-cleaned transparent plastic disc for validation using Raman microspectroscopy (see figure 3). See the full report for a detailed description of all field and laboratory methods.

MATERIALS AND METHODS
HORIZONTAL TOWS OF SURFACE AND SUBSURFACE WATERS

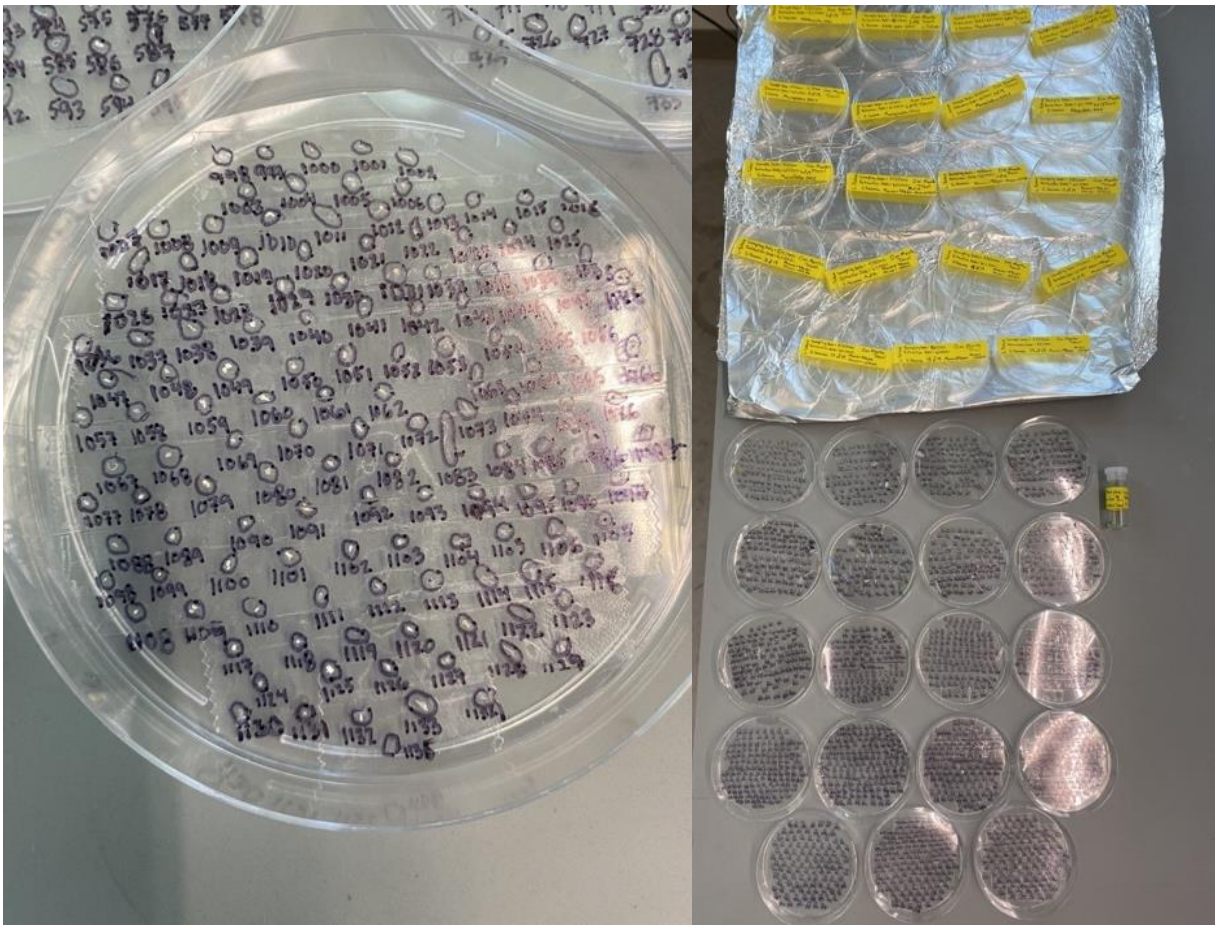


FIGURE 3. PREPARATION OF TRAWL NET SAMPLES FROM LAKE TAHOE SURFACE WATERS. FOLLOWING DIGESTION OF ORGANIC MATERIAL, EACH SUSPECT PARTICLE WAS TRANSFERRED AND MOUNTED FOR CHARACTERIZATION AND ANALYSIS.

MATERIALS AND METHODS - MUNICIPAL WATER

MUNICIPAL WATER

Sample Collection

Working with the Tahoe Water Suppliers Association (TWSA), quarterly samples were collected at two municipal drinking water intakes within the Lake Tahoe Basin. The Incline Village pump station, operated by the Incline Village General Improvement District (IVGID), served as the north shore sampling location. While the Edgewood pump station, operated by the Edgewood Water Company, served as the south shore sampling location. Municipal water samples for this project were collected from the same sample collection spigots used by the water operator to collect their water quality samples. At the Edgewood pump house, the sampling point was located off a large metal pipe which is estimated to have consistent high-water flows moving through it. All samples at the Edgewood pump house were collected from this point except for the summer quarterly sample due to repairs taking place on the spigot. An alternative sampling spigot was identified by the pump house manager and used for this one event. The sampling point for the Incline Village pump house was not off a main water pipe but a small PVC pipe that ran approximately 15m off the main line before the water could be collected from the sampling spigot. It is suspected that water inside the small PVC pipe was often stagnant since it was not a part of the main line constantly pumping water.

At the sampling spigots, water was flushed for 10 minutes prior to collecting the sample in order to move any stagnant water through the system. Once the water line had been purged, municipal water was collected directly into pre-cleaned 3.75 L glass jars. A duplicate sample was also collected at the Edgewood pump house. Field blanks were collected at each pump house by placing a pre-cleaned 3.75 L glass jar filled with DI water next to the sampling spigot with the lid off for the same amount of time it took to collect the municipal water. This was done in order to account for any airborne contamination which may have occurred during sample collection. Municipal water samples, duplicates, and blanks were stored in a dark 4° C cooler or cold room until samples could be filtered.

Municipal samples collected for the summer quarter were collected on different dates due to staffing changes at one of the pump houses. During the summer collection at the Edgewood pump house in August 2021, the Tahoe Basin was experiencing heavy smoke effects from the Caldor wildfire activity. Wildfire smoke had dissipated from the basin for approximately 2 weeks prior to the September 2021 water collection at the IVGID pump house.

Table 6. Sampling dates and locations for municipal water sampling at Lake Tahoe.

Municipal Water Sample Collection Dates		
Edgewood Water Company	**Incline Village GID**	**Quarter**
June 10, 2021	June 10, 2021	Spring
August 24, 2021	September 19, 2021	Summer
December 2, 2021	December 2, 2021	Fall
February 8, 2022	February 8, 2022	Winter

MATERIALS AND METHODS - MUNICIPAL WATER

Table 7: TWSA partner agencies' intake length, depth, and distance from the lake bottom. Intake water depth is reported based on measurements from the lake's rim since water depth varies depending on water level.

Municipal Water Intake Pipe Systems			
Municipal Water Source	**Length (m)**	**Depth (m)**	**Bottom (m)**
Incline Village GID	204.2	9.1	1.2
Edgewood Water Company	1676.4	182.9	1.2

Sample Preparation

Samples were vacuum filtered onto a polycarbonate filter (10 µm pore size). All detectable particles on the filter surface were identified with the aid of a dissecting microscope. Each was mounted onto double-sided tape attached to a pre-cleaned transparent disc and labeled as previously described. The discs were stored inside pre-cleaned petri dishes until Raman microspectroscopic analysis and characterization could be performed.

RAMAN SPECTROSCOPY VALIDATION

Particle Classification and Identification

Following collection, processing, and isolation of particles suspected to be plastic, the particle composition must be determined. Raman spectroscopy is considered one of the current gold standards for confirming whether a particle is composed of plastic or another type of material. A Horiba XploRA™ Plus confocal Raman microspectroscopic unit operated using LabSpec6 spectroscopy suite software (Horiba Instruments Inc., 2890 John R Road, Troy, MI 48083, USA) was used for analysis.

Raman spectra from each particle were identified by peak matching comparisons to Raman spectral libraries using KnowItAll™ software (Wiley) in conjunction with KnowItAll™, SLOPP, SLOPP-E, and in-house Raman spectral libraries. Spectral library matches were then screened individually for appropriate particle identification. All full detailed description particle classification can be found in the final report.

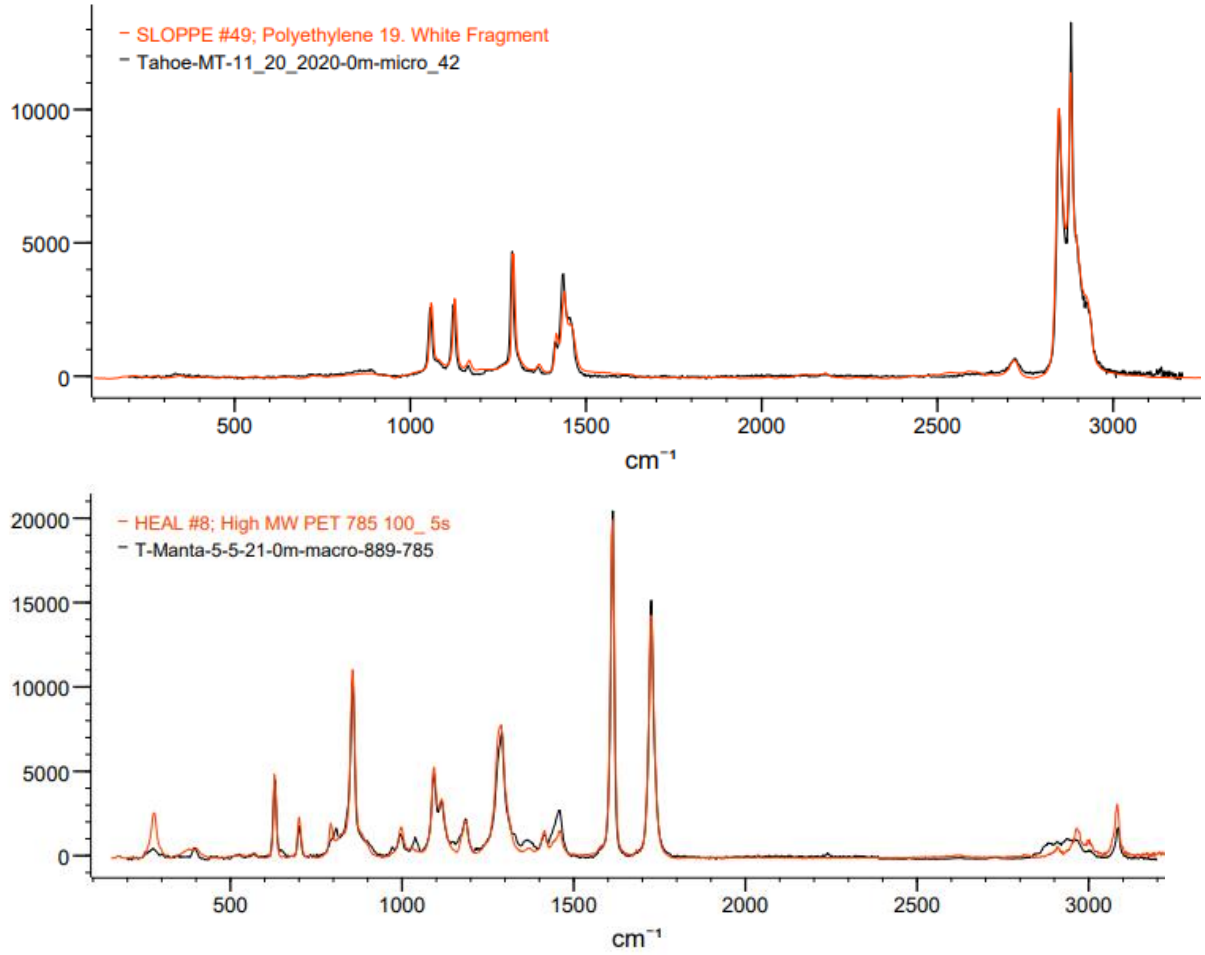


FIGURE 5. EXAMPLES OF SYNTHETIC POLYMER (PLASTIC) TYPES IDENTIFIED USING RAMAN MICROSPECTROSCOPY FOR MICROPLASTIC PARTICLES COLLECTED FROM SURFACE AND SUBSURFACE WATERS OF LAKE TAHOE. THE BLACK LINE IS THE SPECTRA OBTAINED FROM A SUSPECTED PLASTIC PARTICLE THAT IS COMPARED TO A REFERENCE LIBRARY SPECTRA INDICATED BY THE RED LINE TO IDENTIFY THE PARTICLE.

RESULTS AND DISCUSSION - HORIZONTAL TOW SAMPLES

RESULTS OF HORIZONTAL TOW SAMPLES

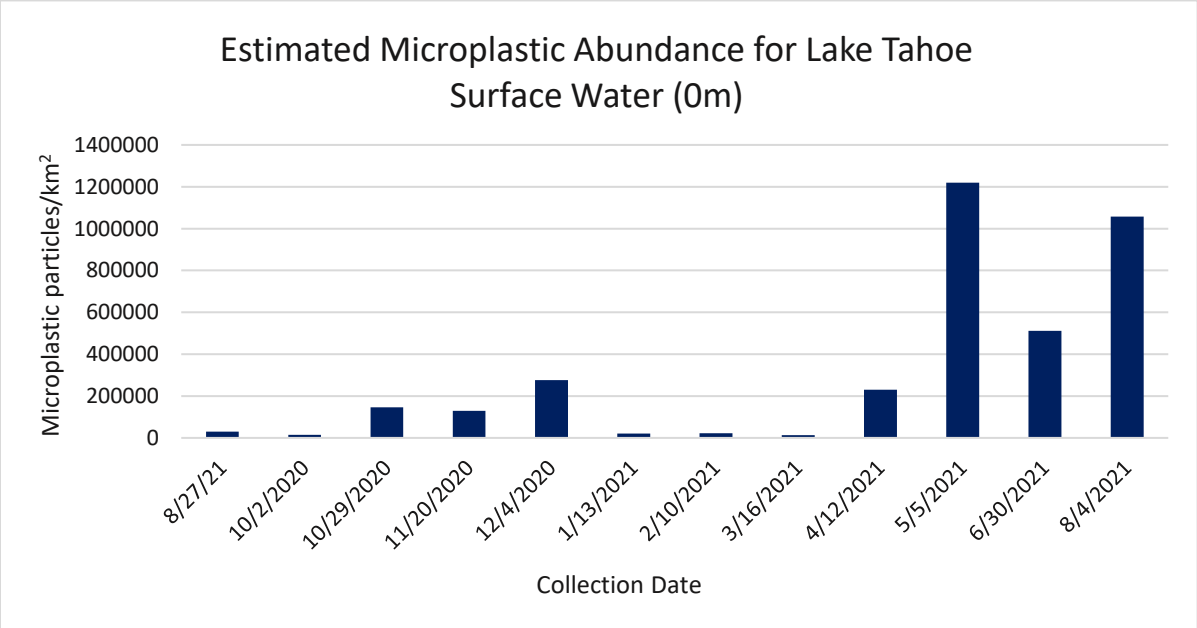
Microplastic Abundance

Estimated microplastic abundances in surface and subsurface waters of Lake Tahoe were calculated for each sampling date using the following formulas:

Microplastics/km^2 = (Total # Suspected Plastic Particles x % Confirmed Microplastics) / (Towing Distance x Trawl Net Width)

Microplastics/km^3 = (Total # Suspected Plastic Particles x % Confirmed Microplastics) / (Towing Distance x Trawl Net Area)

Assuming particles are evenly distributed throughout each water column plane, the average estimated abundance of microplastics at the lake surface (0m) was 306,044 (SD 417,012) microplastic particles/km^2 and 0.043 (SD 0.04) microplastic particles/km^3 in the lake's subsurface waters during the sampling period.



RESULTS AND DISCUSSION - HORIZONTAL TOW SAMPLES

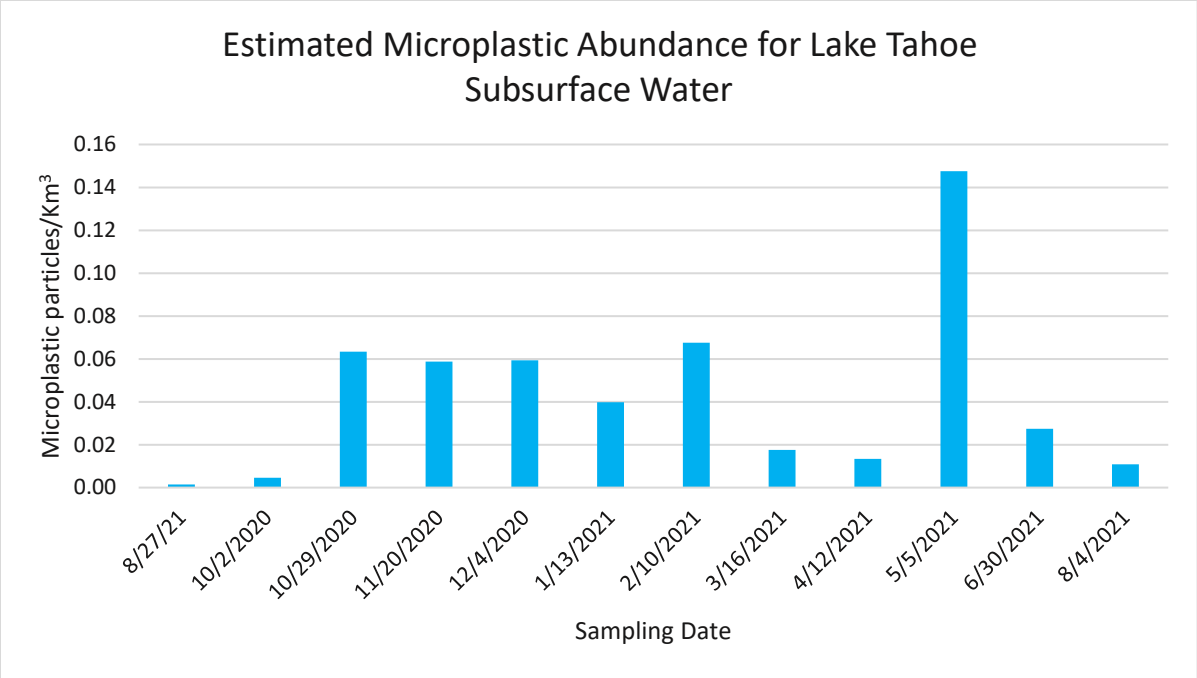


FIGURE 8. ESTIMATED MICROPLASTIC PARTICLE ABUNDANCE IN SURFACE AND SUBSURFACE WATERS OF LAKE TAHOE DURING THE PERIOD OF 8/27/2020 TO 8/4/2021.

Types of Microplastics

In addition to classifying particles as microplastics, the type of plastic composition for each microplastic particle was also determined using Raman microspectroscopy (Figure 10). The majority of analyzed plastic particles from surface waters were identified as polypropylene (41%) and polyethylene (39%) with a smaller proportion of particles identified as polyesters (15%). Additional synthetic polymers including polystyrene, nylon, acrylics, and co-polymer mixtures were also identified but made up less than 5% of all analyzed particles.

** Additional graphs and results available in the full final report**

DISCUSSION OF HORIZONTAL TOW SAMPLE RESULTS

The microplastic abundance on the surface waters of Lake Tahoe are some of the highest reported amongst North American lakes (range: 13,000 – 1,220,000 particles/km^2, mean: 306,000 particles/km^2) although higher values have been report in other systems such as Lake Taihu, China (range: 10,000 – 6,800,000 particles/km^2) and the San Francisco Bay (range: 34,000 – 1,800,000 particles/km^2, mean: 390,000 particles/km^2) (Su et al., 2016; Sutton et al., 2019). A comparison of surface water microplastic abundance in Lake Tahoe and other large North

RESULTS AND DISCUSSION - HORIZONTAL TOW SAMPLES

American lakes is provided (Table 11). There are a number of factors which may contribute to this high abundance compared to other systems.

Table 11. Comparison of microplastic abundance in the surface waters of North American lakes.

Microplastic abundance in the surface waters of North American lakes						
	Lake Winnipeg	**Lake Superior**	**Lake Michigan**	**Lake Erie**	**Flathead Lake**	**Lake Tahoe**
Surface area (km^2)	25,514	82,100	58,030	25,744	510	490
Mean depth (m)	12	147	85	19	50	300
Residence time (years)	4	191	99	2.6	2.2	650
Population in watershed	7,000,000	600,000	12,000,000	12,000,000	121,000	40,000
Watershed area (km^2)	982,900	127,700	118,000	78,000	7,615	1,298
Wastewater treatment	30% combined, 70% sanitary with separate system for stormwater treatment	Combined	Combined	Combined	~70% of residents and business' on spectic systems	All wastewater removed from basin. No treatment of stormwater
Mean microplastic abundance (# per km^2)	193,420	30,000	17,276	105,503	189,000	306,044
Standard deviation	± 115,567			± 173,587		± 417,012
Dominate particle type	Fiber (90%)	Fiber (67%)	Fragment (79%)	Pellets (48%)	Fiber (79%)	Fragment (61%)
Dominate polymer	n/a	Polyethylene (51%)	Polyethylene (46%)	n/a	Polyethylene	Polyethylene (44%)
Sample collection	Manta trawl, 333 µm	Paired nueston net, 500 µm	Manta trawl, 333 µm	Manta trawl, 333 µm	Paneled trawling net, 330 µm	Manta trawl, 335 µm
Sample analysis	WPO digestion, SEM/EMS validation	WPO digestion, FTIR validation	WPO digestion, FTIR and SEM/EMS validation	Density separation, SEM/EMS validation	WPO digestion, Raman validation	Density separation, KOH digestion, Raman validation
Sample size (n=)	36	187	59	8	12	12
Citation	Anderson et al., 2017	Cox et al., 2021	Mason et al., 2016	Eriksen et al., 2013	Xiong et al., 2022	Present study

RESULTS AND DISCUSSION - HORIZONTAL TOW SAMPLES

Sampling Methodology

The field of microplastics has long struggled with inconsistent sampling methods making it difficult to compare results across multiple studies (Tamminga et al., 2019). The studies in Table 11 were chosen for comparison because the methodology was most similar, although not identical, to our own. Larger mesh sizes (Cox et al., 2021) and the lack of sample digestion (Eriksen et al., 2013) may have caused an underestimation of microplastics in lakes Superior and Erie compared to what would have been detected using methods described in this study.

Treatment of Stormwater Effluent

Combined sewer systems are common in the Great Lakes watershed potentially preventing the release of microplastics collected from the landscape, into local waters. Combined sewer systems collect both household wastewater and stormwater runoff from rain and snowmelt for processing at a wastewater treatment plant (WWTP) prior to release back into the environment. While combined sewer systems can have a number of drawbacks, the most critical being the system can be overwhelmed by copious volumes of wastewater during large precipitation events causing untreated stormwater and wastewater to discharge directly into nearby waterbodies, they may still prevent many microplastics found in stormwater, from entering local waterways. Grbić et al. (2020) found anthropogenic particle concentrations in untreated stormwater runoff from the Lake Ontario watershed averaged 15.4 particles L^{-1}. There is currently no treatment system for stormwater in the Tahoe Basin prior to it flowing into the lake potentially contributing to a large microplastic load from a range of sources such as trash, rubber tire wear and road paint. Microplastics deposited by atmospheric deposition may also be a contributor.

As an initial step towards understanding factors that may influence the presence of microplastics in surface water of Lake Tahoe, data for environmental factors and human activities were obtained for the months during the study period (Figure 13). As a proxy measurement for snow melt, average monthly water discharge data for Ward Creek was obtained (located 7 km southwest of the horizontal tow sampling transect). Monthly average hotel room nights for South Lake Tahoe obtained from the Lake Tahoe Visitors Authority was used as an indicator of tourism activity in the vicinity of the lake. Monthly precipitation data for Tahoe City was obtained from the National Oceanic and Atmospheric Administration. Out of these factors, it appears there could be relationships related to runoff from precipitation and snow melt that warrant further investigation. Due to the unusual circumstances related to the COVID-19 Pandemic and its effect on the tourism industry during the period of this study, it is unclear whether there is any relationship between tourism activity in the region and the abundance of microplastics in Lake Tahoe.

RESULTS AND DISCUSSION - HORIZONTAL TOW SAMPLES

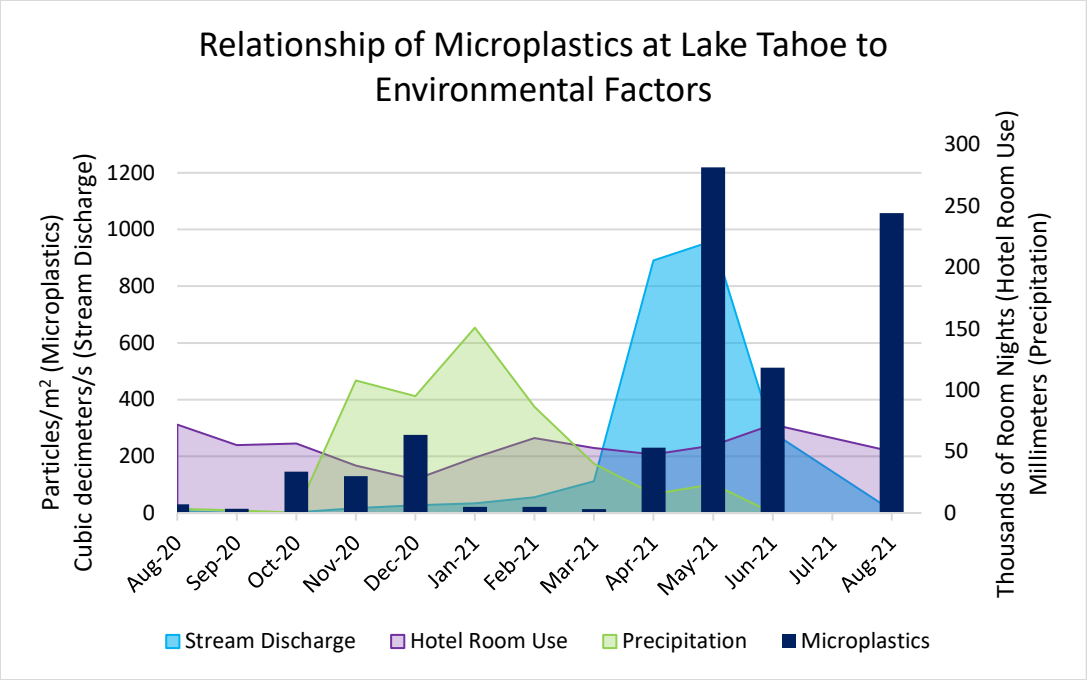


FIGURE 23. ESTIMATED MICROPLASTIC ABUNDANCE AT THE SURFACE OF LAKE TAHOE IS SHOWN OVERLAYED WITH DATA FOR STREAM DISCHARGE, HOTEL ROOM USE, AND PRECIPITATION FOR THE SAMPLING PERIOD AS A PRELIMINARY EXPLORATION INTO POTENTIAL RELATIONSHIPS BETWEEN MICROPLASTIC ABUNDANCE, SNOW MELT, TOURISM ACTIVITY, AND PRECIPITATION.

Tourism and Litter in the Tahoe Basin

The Tahoe Basin sees an enormous fluctuation in population throughout the year. 40,000 – 60,000 people reside year-round in the basin with 15 million visitors estimated as coming to the lake each year. During peak days, the Tahoe Basin can see a total population of 300,000 people putting immense pressure on local resources and intensifying anthropogenic impacts. The majority of microplastics removed from surface tow samples in the present study were identified as fragments (61%). Fragments are likely secondary microplastics created by the weathering and subsequent breakdown of anthropogenic trash which has been improperly disposed of. From 2014 to 2020, community beach clean ups conducted after popular summer holidays (e.g. Fourth of July, Labor Day, etc.) have removed over 48,500 lbs of trash from the shoreline of Lake Tahoe (The League to Save Lake Tahoe, 2022). Additionally, over 25,000 lbs of submerged anthropogenic waste was removed from Tahoe's nearshore areas in 2020 – 2021 (Clean Up The Lake, 2022).

RESULTS - MUNICIPAL SAMPLES

MUNICIPAL WATER

A total of 155 suspected plastic particles were collected from municipal waters obtained via samples collected quarterly from two separate sites. A total of 19 particles were composed of plastic based on Raman microspectroscopic analysis. Out of these 19 particles, 84% (n=16) matched to control spectra obtained from blanks and background spectra. Three microplastic particles were composed of plastics not found in control samples. Two particles were composed of polypropylene and one particle was composed of polyester.

Microplastic Particles From Municipal Water Samples

Date	Site (# replicates)	Total Sample Volume (L)	Suspected plastic particles	Confirmed plastic particles	Microplastic abundance	Plastic type
		L	number	number	particles/L	
6/13/2021	Edgewood (3)	10.49	10	1	0.100	PP
	IVGID (2)	6.91	18	1	0.055	PP
8/24/2021	Edgewood (2)	7.45	8	0	0.000	
	IVGID (2)	7.38	10	0	0.000	
11/15/2021	Edgewood (3)	10.67	21	1	0.094	PES
	IVGID (2)	7.21	39	0	0.000	
2/9/2022	Edgewood (3)	10.99	38	0	0.000	
	IVGID (2)	7.34	11	0	0.000	
All dates	Edgewood (11)	39.6	77	2	0.050	
	IVGID (8)	28.84	78	1	0.035	
All dates	**All sites**	**68.44**	**155**	**3**	**0.044**	**PP, PES**

Discussion

Pivoknosky et al. (2018) monitored three water treatment plants in the Czech Republic for microplastic presence in treated drinking water using methods similar to those in the present study. A microplastic abundance of 338 ± 76 to 628 ± 28 particles L^{-1} was found in the treated water from those plants which is orders of magnitude greater than the results of this study. Additionally, Oßmann et al. (2018) found the amount of microplastics in bottled mineral water varied from 2649 ± 2857 per liter in single use PET bottles and up to 6292 ± 10521 per liter in glass bottles illustrating that packaging water has the potential to contribute a significant amount of microplastics to drinking water. One notable difference between the present study and the others discussed, is the lower size detection limit. Both studies are of the very few to determine microplastics down to the size of 1µm, while the lower size detection limit of the Lake Tahoe study is 10µm. Pivoknosky found microplastics smaller than 10µm were the most plentiful treated water samples, accounting for up to 95% while Oßmann concluded 90% of microplastics detected in bottled water were smaller than 5µm.

RESULTS - MUNICIPAL SAMPLES

Additional research on microplastic abundance in drinking water sources is needed but monitoring microplastics in drinking water has struggled with lack of standardized methods as seen in other branches of the field. In May 2022, California's State Water Resources Control Board issued the world's first standard protocols for monitoring microplastics in drinking water (SWB-MP2-rev1) establishing a critically important standard for future research and monitoring programs to adhere to.

Beginning in 2023, water suppliers within the TWSA will begin mandatory water sample collections in compliance with the Fifth Unregulated Contaminant Monitoring Rule (URCM 5) established by the U.S. Environmental Protection Agency (EPA). URCM 5 requires nationwide monitoring for 29 per- and polyfluoroalkyl substances (PFAS) and lithium in public drinking water systems from 2023 – 2025. Microplastics, such as polytetrafluorethylene used as nonstick coating on cooking pans, can be composed of PFAS meaning they will be monitored in the municipal waters of Lake Tahoe under URCM 5. This monitoring is a critical first step but additional monitoring is recommended using protocols set forth by the California State Water Resources Control Board to understand microplastic presence in municipal water supplies for polymers that are not included under URCM 5.

RECOMMENDATIONS

This work has established the presence of microplastics throughout the water column of Lake Tahoe as well as in biota and municipal waters. It is not possible to say whether microplastics are increasing or decreasing. However, the data collected have established a baseline, one in which Tahoe is surprisingly high in microplastics relative to other water bodies. Additional data may indicate how large the year-to-year variability is in the short term.

Additional work with biota could be considered in the future as the amount of sampling in this project was not sufficient to come to strong conclusions. In particular zooplankton sampling for microplastics could be undertaken in the future. Because of the prey size of many Tahoe zooplankton, they could be an important pathway for removing accumulated microplastics.

Sediment results from this study were inconclusive so additional sampling may be warranted to understand polymer abundance and type potentially accumulating in Lake Tahoe. Given the variation in polymer density and ability to settle out of the water column, sampling sediment centered on stormwater inflows and urbanized tributaries in addition to mid lake sites may improve our understanding of microplastic abundance in lake sediments.

For any future microplastic research in Lake Tahoe, it is imperative to include analysis of smaller size classes, specifically the 1 – 10µm range. This work is critical as plastics continue to accumulate in our natural environment breaking into ever smaller pieces but not fully degrading. These smaller particles will impact lake clarity (the degree to which they do so is unknown until further research has been conducted). These small particles may also pose the greatest risk for accidental ingestion by humans and wildlife. The long-term health impacts of plastic consumption is an area of current research worldwide.

WORKS CITED

Anderson, P. J., Warrack, S., Langen, V., Challis, J. K., Hanson, M. L., and Rennie, M. D.2017. Microplastic contamination in lake Winnipeg, Canada. *Environmental pollution*, *225*, 223-231.

Boening, D. W. 1999. An evaluation of bivalves as biomonitors of heavy metals pollution in marine waters. *Environmental monitoring and assessment*, *55*, 459-470.

Clean Up The Lake. *2021 Projects*. Retrieved December 20, 2022, from https://cleanupthelake.org/2021-projects/

Cox, K., Brocious, E., Courtenay, S. C., Vinson, M. R., and Mason, S. A. 2021. Distribution, abundance and spatial variability of microplastic pollution on the surface of Lake Superior. *Journal of Great Lakes Research*, *47*(5), 1358-1364.

Eriksen, M., Mason, S., Wilson, S., Box, C., Zellers, A., Edwards, W., Farley, H., and Amato, S. 2013. Microplastic pollution in the surface waters of the Laurentian Great Lakes. *Marine pollution bulletin*, *77*(1-2), 177-182.

European Commission Joint Research Center. 2013. Guidance on monitoring of marine litter in European Seas. Publications Office of the European Union: Luxembourg, 10, 99475.

Grbić, J., Helm, P., Athey, S., and Rochman, C. M. 2020. Microplastics entering northwestern Lake Ontario are diverse and linked to urban sources. *Water research*, *174*, 115623.

Lake Tahoe Visitors Authority. Data and Statistics: ADR & Occupancy City of South Lake Tahoe. Retrieved January 20, 2023, from https://ltva.org/industry/data-statistics/

League to Save Lake Tahoe. *Community Beach Clean Up Map*. Keep Tahoe Blue. Retrieved December 20, 2022, from https://www.keeptahoeblue.org/join-us/cleanups/

Lenaker, P. L., Baldwin, A. K., Corsi, S. R., Mason, S. A., Reneau, P. C., and Scott, J. W. 2019. Vertical distribution of microplastics in the water column and surficial sediment from the Milwaukee River Basin to Lake Michigan. *Environmental science & technology*, *53*(21), 12227-12237.

Mason, S. A., Kammin, L., Eriksen, M., Aleid, G., Wilson, S., Box, C., Williamson, N., and Riley, A. 2016. Pelagic plastic pollution within the surface waters of Lake Michigan, USA. *Journal of Great Lakes Research*, *42*(4), 753-759.

National Oceanic and Atmospheric Administration. Monthly precipitation summary water year 2021. Retrieved January 20, 2023, from https://cnrfc.noaa.gov/monthly_precip_2021.php

Oßmann, B. E., Sarau, G., Holtmannspötter, H., Pischetsrieder, M., Christiansen, S. H., and Dicke, W. 2018. Small-sized microplastics and pigmented particles in bottled mineral water. *Water research*, *141*, 307-316.

Padervand, M., Lichtfouse, E., Robert, D., and Wang, C. 2020. Removal of microplastics from the environment. A review. *Environmental Chemistry Letters*, *18*, 807-828.

Pivokonsky, M., Cermakova, L., Novotna, K., Peer, P., Cajthaml, T., and Janda, V. 2018. Occurrence of microplastics in raw and treated drinking water. *Science of the total environment*, *643*, 1644-1651.

State Water Resources Control Board. Standard Operating Procedures for Extraction and Measurement by Raman Spectroscopy of Microplastic Particles in Drinking Water. May 27, 2022.

WORKS CITED

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/microplastics/swb-mp2-rev1.pdf

Su, L., Cai, H., Kolandhasamy, P., Wu, C., Rochman, C. M., and Shi, H. 2018. Using the Asian clam as an indicator of microplastic pollution in freshwater ecosystems. *Environmental pollution*, *234*, 347-355.

Su, L., Xue, Y., Li, L., Yang, D., Kolandhasamy, P., Li, D., and Shi, H. 2016. Microplastics in Taihu lake, China. *Environmental Pollution*, *216*, 711-719.

Sutton, R., Lin, D., Sedlak, M., Box, C., Gilbreath, A., Holleman, R., Miller, L., Wong, A., Munno, K., and Zhu, X. 2019. Understanding Microplastic Levels, Pathways, and Transport in the San Francisco Bay Region. SFEI Contribution No. 950. San Francisco Estuary Institute: Richmond, CA.

Tamminga, M., and Fischer, E. K. 2020. Microplastics in a deep, dimictic lake of the North German Plain with special regard to vertical distribution patterns. *Environmental pollution*, *267*, 115507.

Tamminga, M., Stoewer, S. C., and Fischer, E. K. 2019. On the representativeness of pump water samples versus manta sampling in microplastic analysis. *Environmental pollution*, *254*, 112970.

United States Geological Survey. Ward C at Hwy 89 NR Tahoe Pines CA August 2020 – September 2021. Retrieved January 15, 2023, from https://waterdata.usgs.gov/monitoring-location/10336676/#parameterCode=00065&startDT=2020-08-01&endDT=2021-09-01

Xiong, X., Tappenbeck, T. H., Wu, C., and Elser, J. J. 2022. Microplastics in Flathead Lake, a large oligotrophic mountain lake in the USA. *Environmental Pollution*, *306*, 119445.

Yang, R., Xu, X., Xue, Y., Zhang, L., Guo, J., Wang, L., Peng, M., Zhang, Q., and Zhu, Y. 2022. Horizontal and vertical distribution of microplastics in Gehu Lake, China. *Water Supply*, *22*(12), 8669-8681.

TWSA Staff Summary
TAHOE KEYS LAGOONS AQUATIC WEED CONTROL METHODS TEST YEAR 1 PRELIMINARY RESULTS
Document available here: https://tahoekeysweeds.org/wp-content/uploads/2023/02/CMT-Year-1-Prelim-Results-Final-02-10-2023-v3.pdf

The TKPOA has published the Tahoe Keys Lagoons Aquatic Weed Control Methods Test Year 1 Preliminary Results report. No conclusions were given in the report of the preliminary results. Key takeaways from the document are summarized below, along with fully cited answers to staff questions.

2022 TKPOA CMT Group A methods	CM Target Plants
Endothall, a contact herbicide	Coontail, native nuisance.
	Eurasian watermilfoil, aquatic invasive plant.
	Curlyleaf pondweed, aquatic invasive plant
Triclopyr, a systemic herbicide	Eurasian watermilfoil, aquatic invasive plant.
UV-C light, not plant-specific	Coontail, native nuisance.
	Eurasian watermilfoil, aquatic invasive plant.
	Curlyleaf pondweed, aquatic invasive plant.
LFA, oxygenates the sediment.	No target plant, reduces available nutrients.

92% of the proposed water quality data was collected. Reasons for missing data:
Equipment malfunction
Loss of sensors to bears
Severe weather

The delayed removal of the double turbidity curtains due to the extended degradation times for Triclopyr prevented the UV treatment vessels from accessing the combination sites. For these sites, the herbicide was applied to the 'edges' of the lagoons, and the sweep of the middle section with the UV-C boat was not completed in the same growing season (CMT Year 1).

The CMT Year 1 has revealed four key outcomes thus far, from page 2:

1. Although data from Year 1 are still being evaluated to determine if and where a 75% reduction in biovolume was achieved, the CMT herbicide and UV treatments reduced the prevalence of invasive target weed species and their biovolume. Certain herbicide (Endothall) treatments knocked back the invasive weeds, substantially increasing the relative presence of desirable and beneficial native plants.
2. Herbicides were successfully contained: No herbicides or degradants reached locations anywhere near the West Channel that connects with Lake Tahoe.
3. The CMT provided flexibility and adaptation to shifting environmental conditions.
4. LFA did not show reductions in target invasive weeds or total aquatic plant biovolume in Year 1, but will operate continuously through the entire 3-year CMT and be monitored for its long-term effectiveness in helping to control invasive aquatic weeds. For the CMT, LFA is being tested for its ability to reduce nutrients available for growth of invasive plants.

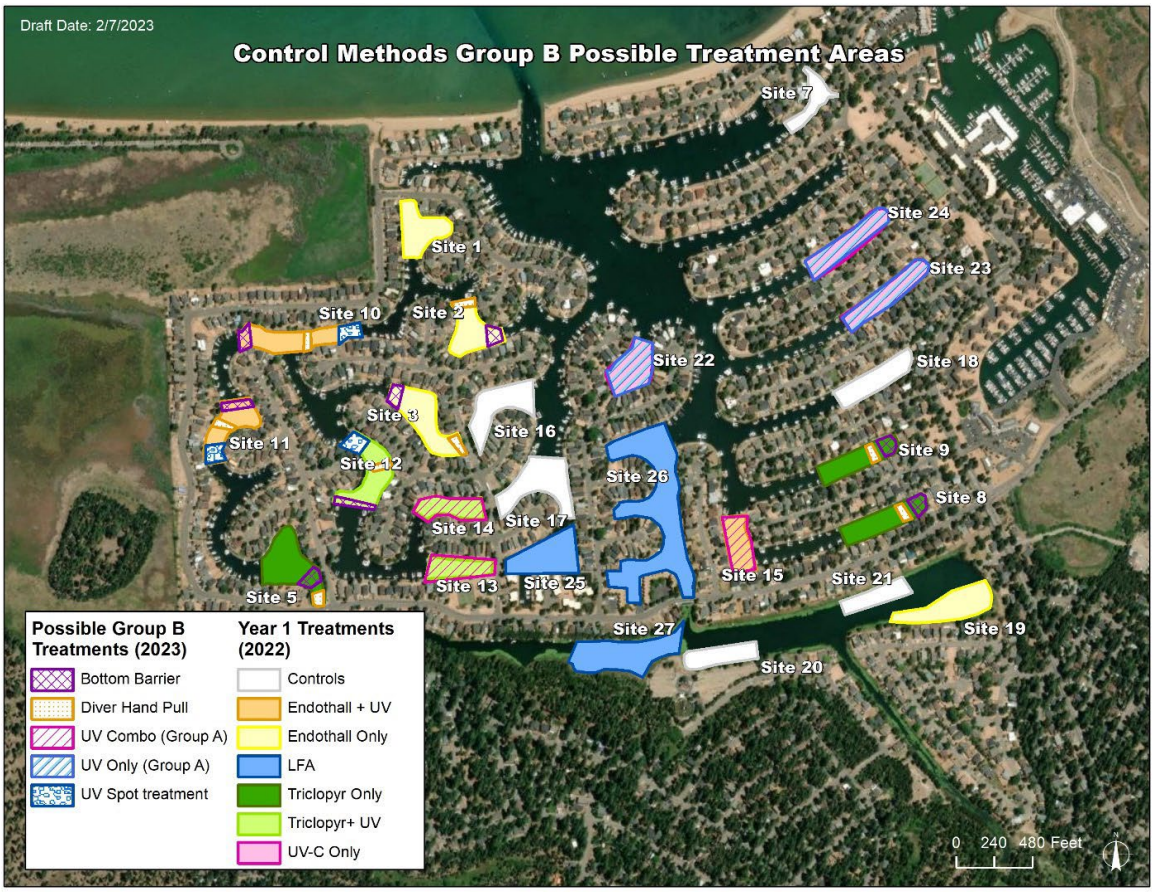
Water quality is an objective of the long-term solution in the lagoons, along with aquatic invasive plant management.

The efficacy of the Group A treatments is in the rake samples of plants in each test site. The sample schedule was 30 rakes at each site every two weeks. The samples were photographed to document species presence, the percent of samples comprised of each species, and the health of the plants. Graphs of relative plant abundance for each Group A treatment method are provided, compared to control sites. The following observations, not conclusions, were provided:

> "The rake sampling results above demonstrate that Endothall-only treatments greatly reduced target weed populations compared to Control sites (Figure 5). UV only treatments at Site 24 also reduced specific target weeds (Figure 6), as well as the total aquatic plant (native plants and target weeds) biovolume (Figure 9).
>
> Dramatic decreases in Eurasian watermilfoil can be seen in Figure 7 where Triclopyr treatments were applied at Sites 5, 8 and 9. Note that the relative abundance of the other target weed species compared to Control sites was not greatly reduced in Sites 5, 8 and 9 (since Triclopyr only targets Eurasian watermilfoil). Figure 7 also shows a substantial increase in the relative abundance of coontail at Sites 5, 8 and 9 compared to Control sites. No trends appear in Figure 8 for LFA Site 26 to date since LFA is designed as a long-term control method intended to reduce decaying biovolume and nutrients available for plant growth at the sediment layer." Page 11

The Next Steps for the CMT include Group B follow-up methods, including bottom barriers, diver-assisted suction/hand–pulling, UV-C spot treatments, UV-C treatment of UV-C-only sites, UV-C treatment of combination sites, and continued LFA at the LFA-only site.

Figure 10. Possible CMT Year 2 Group B Treatment Areas.



Staff questions regarding year one preliminary data.

What are the projections of reaching the 75% goal of the CMT?

> "Clear differences in biovolume densities can be seen between herbicide treated areas and Control sites, and also between UV light treated areas and Control sites.
> However, the objectives of the CMT are not to reduce total biovolume by 75%, but to reduce specific plant species biovolume, namely the target aquatic weed species Eurasian watermilfoil, curlyleaf pondweed, and coontail." Page 7

What are the reasons given for the incorrect projection of Triclopyr Degradation?

> "The turbidity curtains took significantly longer than anticipated to remove due to extended degradation times for one of the herbicides (Triclopyr). The longer herbicide degradation time presumably resulted from a combination of stagnant conditions behind the curtains, high water temperatures and related increases in turbidity which in turn reduced the light-driven breakdown of Triclopyr." Page 17

What are the next steps for full treatment/project implementation throughout the lagoons?

> "Once a large-scale plan is developed, additional rigorous public and scientific environmental review and permitting processes for the lagoons-wide plan will occur before any plan can be implemented. This process is projected to take 2-3 years to complete. As a result, TKPOA's application for a large-scale plan would likely be completed in 2024 or 2025 and implemented in the years after 2027. However, the urgency and threat of aquatic weeds to all of Lake Tahoe requires that action be taken as soon as possible to bring these aggressive weeds under control." Page 17

TAHOE KEYS LAGOONS AQUATIC WEED CONTROL METHODS TEST YEAR 1 PRELIMINARY RESULTS

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FEBRUARY 10, 2023

TAHOE KEYS LAGOONS AQUATIC WEED CONTROL METHODS TEST YEAR 1 PRELIMINARY RESULTS

FEBRUARY 10, 2023

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EXECUTIVE SUMMARY

The Aquatic Weed Control Methods Test (CMT) was initiated in Spring 2022 in the Tahoe Keys (Keys) West Lagoon and Lake Tallac Lagoon to evaluate new and improved approaches and methods to managing invasive aquatic weeds in the Keys. The CMT will specifically test which methods might achieve a large-scale knockback of invasive aquatic weeds to provide future management control, and which non-herbicide methods may be able to sustain control in the long-term. Ultimately, the results of the CMT will inform a large-scale aquatic weed control plan for the Keys.

Aquatic weeds, particularly curlyleaf pondweed and Eurasian watermilfoil, pose near-term threats to the health and values of Lake Tahoe's ecosystem, water quality, recreation, and economy. These threats to Lake Tahoe galvanized many interested stakeholders to work together towards a sustainable solution. The planning, design, permitting, and initiation of the CMT was a 5-year, sustained collaboration among Tahoe Keys homeowners, regulatory agencies [Lahontan Regional Water Quality Control Board (Lahontan Water Board) and Tahoe Regional Planning Agency (TRPA)], the League to Save Lake Tahoe (League) and other stakeholders, with a high-level of public input and interest. Major funding for the CMT has been and continues to be provided by the Tahoe Keys Property Owners Association (TKPOA), as well as by TRPA for the independent monitoring. The League is supporting the Laminar Flow Aeration (LFA) study and participating in CMT evaluations. The 3-year CMT Project implementation costs are expected to range between $10 million and $12 million and are dominated primarily by the extensive environmental monitoring and data collection.

The Keys' unique environment and Lake Tahoe's strong regulatory protections required an innovative approach to finding solutions to control the lake's largest aquatic weed infestation. The CMT is both unique and complex not only in its highly collaborative approach, but also because the CMT was the first ever permitted use of aquatic herbicides in Lake Tahoe. While aquatic herbicides specifically target invasive weed species and have proven effective in other high elevation lakes, herbicides have never been tested as a tool for a one-time knockback followed by maintenance with non-chemical methods. The CMT is also unique in its approach and its first-time use of large-scale testing of ultraviolet (UV at the "C" wavelength) light treatment systems in the Keys for the same purpose.

Lake Tahoe is classified as one of the nation's Outstanding National Resource Waters (ONRW), which is a special designation with stringent anti-degradation rules under the federal Clean Water Act. To ensure protection of Lake Tahoe including the Tahoe Keys, the CMT included intensive monitoring of water quality for all test methods for the entire duration of the Project, and frequent and specific sampling for herbicides and their by-product degradants. To further protect Lake Tahoe, herbicide application areas were separated from the main West Lagoon and Lake Tallac by double turbidity curtains. These curtains were maintained until herbicides reached 'non-detect' levels in late September 2022.

For the long-term, removal of all three target invasive aquatic weeds from the Keys lagoons is unlikely. This includes both the non-native curlyleaf pondweed and Eurasian watermilfoil and the native coontail. However, the CMT is assessing what combination of control methods would be able to initially knockback these invasive weeds, allow native plants to increase in the lagoons, and then manage ("sustain control of") the regrowth of invasive weeds. The CMT success criteria of 75% or greater biovolume reduction for invasive aquatic weed species represents the target threshold for which native aquatic habitat conditions can be restored over time and unwanted and invasive aquatic weed populations can be feasibly controlled in perpetuity. Because the lagoons have a range of conditions (e.g., water depths and shorelines), variability is expected in achieving 75% biovolume reduction in target weeds across the test sites and ultimately throughout the lagoons.

Four types of tests were initiated in 2022: 1) herbicides only, 2) UV light only, 3) herbicides and UV light ("combination sites"), and 4) Laminar Flow Aeration only. All types of CMT Year 1 treatments began in 2022. However, the timing and full scale of all tests as proposed were not achieved. For example, extended deployment of the double turbidity curtains prevented the UV treatment vessels from accessing "combination sites." To help gather needed test data, additional UV treatments have been scheduled for 2023.

CMT monitoring of Year 1 treatments revealed four key outcomes thus far:

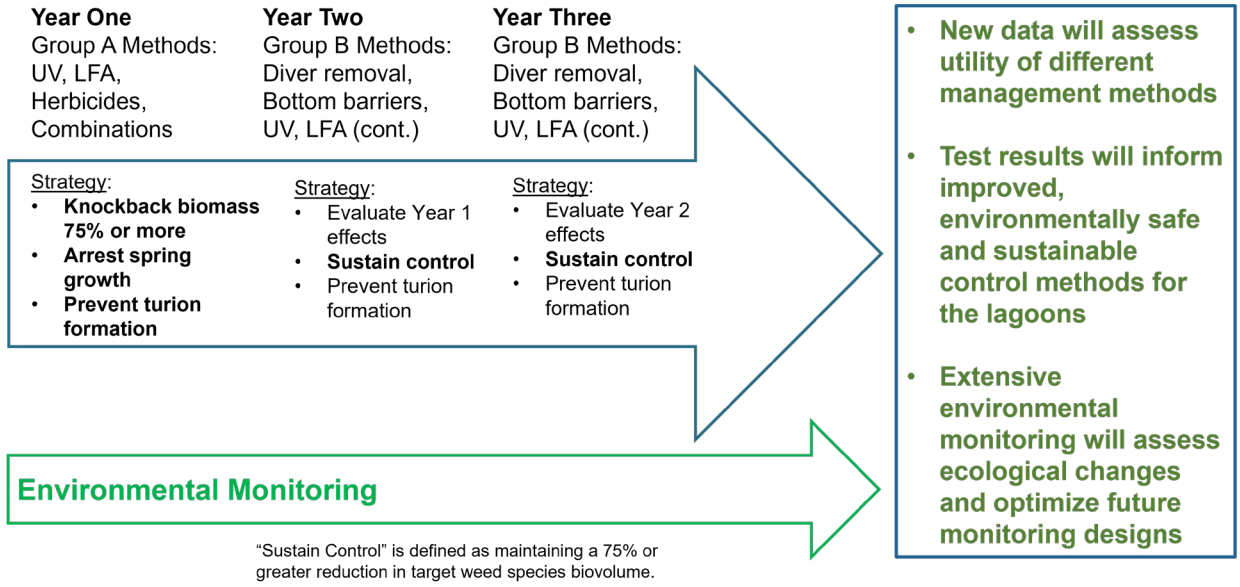
1. Although data from Year 1 are still being evaluated to determine if and where a 75% reduction in biovolume was achieved, the CMT herbicide and UV treatments reduced the prevalence of invasive target weed species and their biovolume. Certain herbicide (Endothall) treatments knocked back the invasive weeds, substantially increasing the relative presence of desirable and beneficial native plants.
2. Herbicides were successfully contained: No herbicides or degradants reached locations anywhere near the West Channel that connects with Lake Tahoe.
3. The CMT provided flexibility and adaptation to shifting environmental conditions.
4. LFA did not show reductions in target invasive weeds or total aquatic plant biovolume in Year 1, but will operate continuously through the entire 3-year CMT and be monitored for its long-term effectiveness in helping to control invasive aquatic weeds. For the CMT, LFA is being tested for its ability to reduce nutrients available for growth of invasive plants.

Year 2, which does not include herbicide applications, relies on the continuation of the UV stand-alone treatments at certain sites, continued and new implementation of UV treatments at Year 1 herbicide/UV combination sites, and the addition of site-specific treatments at multiple sites using bottom barriers and diver assisted suction hand-pulling. Selection of the Year 2 CMT sites will be based on the results of Year 1 treatments, 2022 aquatic plant data at those sites, and results of aquatic plant surveys planned for Spring 2023. (See Section 3 for details of Year 2 planning.)

1.0 PURPOSE OF THIS REPORT

This second progress report on the CMT serves as an update to the TKPOA members, public, and interested stakeholders on the CMT. This report focuses on preliminary results of Year 1 including examples of the effectiveness (or efficacy) of Year 1 CMT treatments. As described later in this report, over 75,000 data points were collected by TKPOA and TRPA in Year 1. These extensive data sets are being analyzed and the final results and analyses from Year 1 will be submitted in a separate detailed report to the Lahontan Water Board and TRPA in March 2023. This progress report also outlines the approach for Years 2 and 3 of the CMT, and highlights features of a possible long-term solution to the aquatic invasive weeds problem as well as long term management of the water quality in the lagoons. The CMT 3-year Project is outlined in Figure 1 below.

Figure 1. 3-Year CMT Timeline



The first progress report for the CMT (September 2022 Special Report on CMT Project Implementation [Anderson 2022]) summarized the CMT's initiation of Year 1 control method testing. This second report on Year 1 presents preliminary results from the Year 1 Group control methods testing. A comprehensive report on Year 1 test results, permit compliance, and other analyses will be submitted to the Lahontan Water Board and TRPA by March 2023.

2.0 WHAT ARE THE PRELIMINARY RESULTS FROM YEAR 1 OF THE CMT?

Figure 2 shows the final CMT Year 1 treatment (termed "Group A" methods) test and Control (no treatment) sites. Figure 3 shows the water quality related monitoring and sample data

collection sites in relation to the test and Control sites for 2022. In addition to these monitoring locations for the test and Control sites, over 7,500 point samples of aquatic plants were collected with a rake that pulls existing plants from specific locations (rake samples). In addition to the rake pulls, hydroacoustic scans for aquatic plant biovolumes were gathered twice monthly. These groups of data together allow for a scientific comparison of changes in aquatic plant species populations and biovolume throughout Year 1 in both the CMT treatment and Control sites.

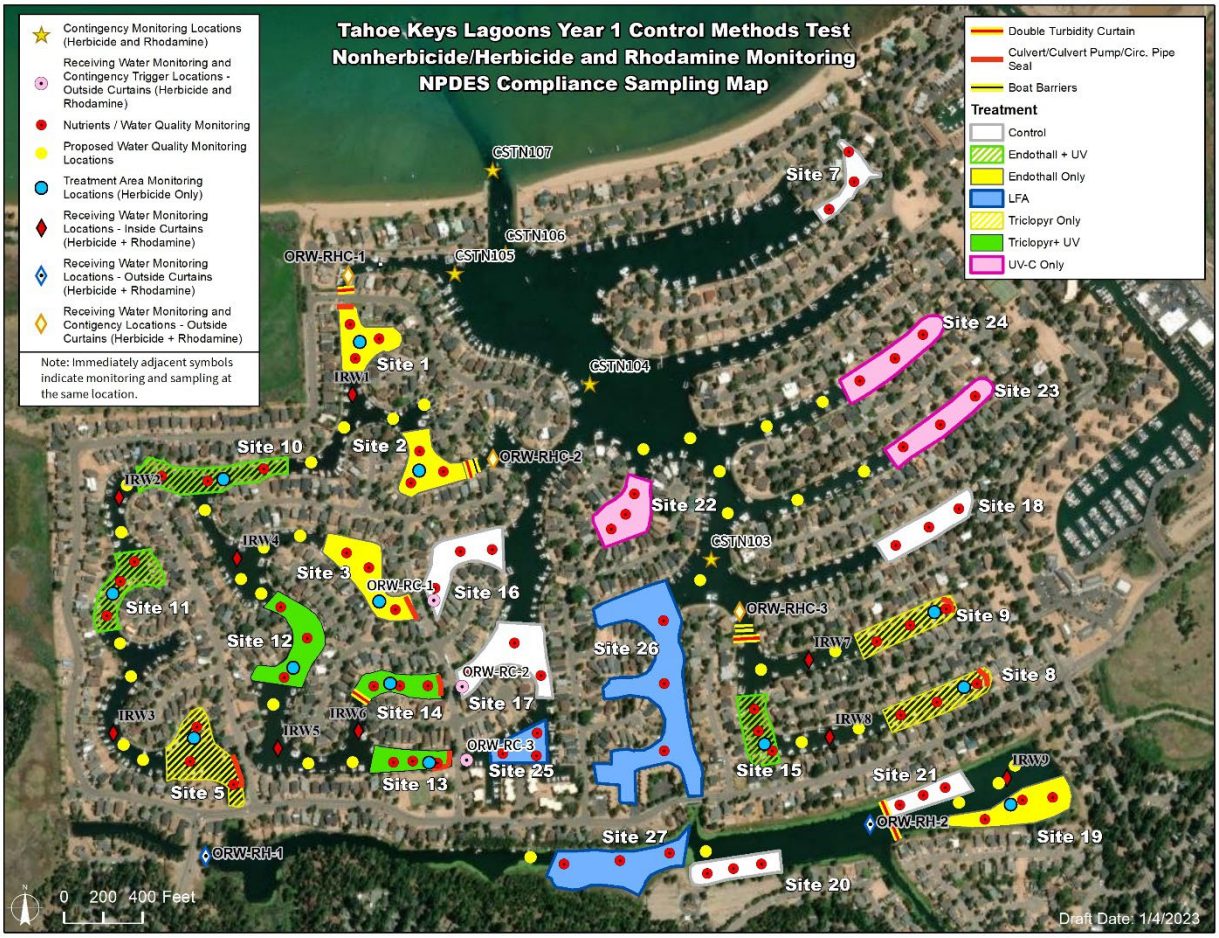
Figure 2. Year 1 CMT Final Treatment Sites

Figure 2 map depicts Year 1 restricted boating areas separated from the West Lagoon by sets of double turbidity curtains (A, B, and C) and boat barriers (A and B). The shaded zones also show where boating entrance and egress were prohibited from pre-herbicide applications (May 25, 2022) until removal of barrier curtains from each area.

The purpose of Year 1 of the CMT Project was to test the effectiveness of herbicides alone, UV alone, and herbicides in combination with UV to 'knockback' (by 75% or more) the biovolume of the targeted invasive weeds compared to "Control" (untreated) sites. Laminar Flow Aeration is being tested as a longer-term treatment method.

Two types of aquatic herbicides were tested in Year 1 of the CMT. Both types represent target-weed specific herbicides. The first herbicide, Endothall, is a contact herbicide that targets all three aquatic weed species (non-native Eurasian watermilfoil, non-native curlyleaf pondweed, and the nuisance native coontail). The second, Triclopyr, is a systemic herbicide that targets only Eurasian watermilfoil. UV light is a new technology using the "C" wavelength of light to break down the cellular structure of aquatic plants. UV light is not plant species specific and requires good water quality conditions to sufficiently transmit the light intensity needed to reach the plants from the boat light array. Two boats, one with a 20-foot long array and one with a 40-foot long array, were utilized in 2022. As noted earlier, Laminar Flow Aeration does not treat the plants directly, but rather oxygenates the water at the sediment layer to accelerate the breakdown of decaying biovolume and reduce nutrients available to aquatic plants.

Figure 3. Overview Map of Year 1 CMT Sites and Monitoring Locations



2.1 Categories and Completeness of Year 1 CMT Data Collection

Completed Year 1 CMT field monitoring, water quality sampling, and other data collection extended from April/May 2022 into November 2022. Sixteen categories of monitoring and sampling data plus daily field report forms and lab analysis reports on water and sediment samples were collected, compiled, and analyzed as Year 1 activities progressed. Table 1 presents a summary listing of the monitoring categories and number of data points collected for the CMT during Year 1. More than 92 percent of anticipated data collection was completed despite the challenges of extended Project duration and in-field data collection along with changing environmental conditions. These challenges included equipment malfunction, loss of sensors deployed in the water due to bears, and severe weather.

Table 1. Summary of Monitoring Activities and Number of Data Points Collected During Year 1 CMT

Monitoring Activity	Number of Data Points
Continuous WQ (Temperature (Temp.) and Dissolved Oxygen (DO)) daily averages of 50 loggers at treatment and Control sites)	14,586
Standard WQ (Inside Test Areas) (Temp., DO, pH, Turbidity, (Oxygen Reduction Potential (ORP)and Specific Conductivity (SPC)) collected at 75 buoys at treatment and Control sites)	17,460
Standard WQ (Outside Test Areas) (Temp., DO, and pH) collected at 47 monitoring stations outside treatment areas)	3,321
Herbicide/RWT Dye monitoring (Samples analyzed for herbicides, degradants, RWT Dye) at 39 treatment and contingency stations	3,600
Nutrient Grab WQ Monitoring including forms of phosphorus and nitrogen) at 25 treatment and Control sites	1,088
Macrophyte Point Rake Samples (30 rake samples per site analyzed for species present) at 25 treatment and Control sites	7,799
Macrophyte Health Ratings (Ratings for each plant species present on rake)	18,129
Total Macrophyte Photos (with at least 1 photo per rake sample)	8,140
Turbidity Curtain Monitoring (Hourly measurements taken on 26 days of installation/ removal)	188
Cyanobacteria Grabs (Samples collected at all cyanotoxin triggered Control and treatment sites)	271
Hydroacoustic scans (Number of scans completed of the lagoons)	15
Benthic Macroinvertebrate (BMI) Sampling (Samples analyzed for BMI at 25 treatment and Control sites)	168
Well Water Monitoring (Samples analyzed for herbicides/ residues at all 3 wells)	66
Inspection of Culvert Plugs/ Curtains (Number of days Inspections were completed)	132
Spill Response/ Prevention (Number of treatment sites Spill Response/ Prevention was conducted)	13
West Lagoon Channel Hydrologic Monitoring	90
Total:	**75,066**

The September 2022 Special Report on CMT Project Implementation (Anderson 2022) described certain data collection categories and total data points that differ from Table 1. The differences are due to different time periods, different approaches used to compile the total number of data points (e.g., hourly daily v. daily data averages), and differences in the number of sites included in the counts.

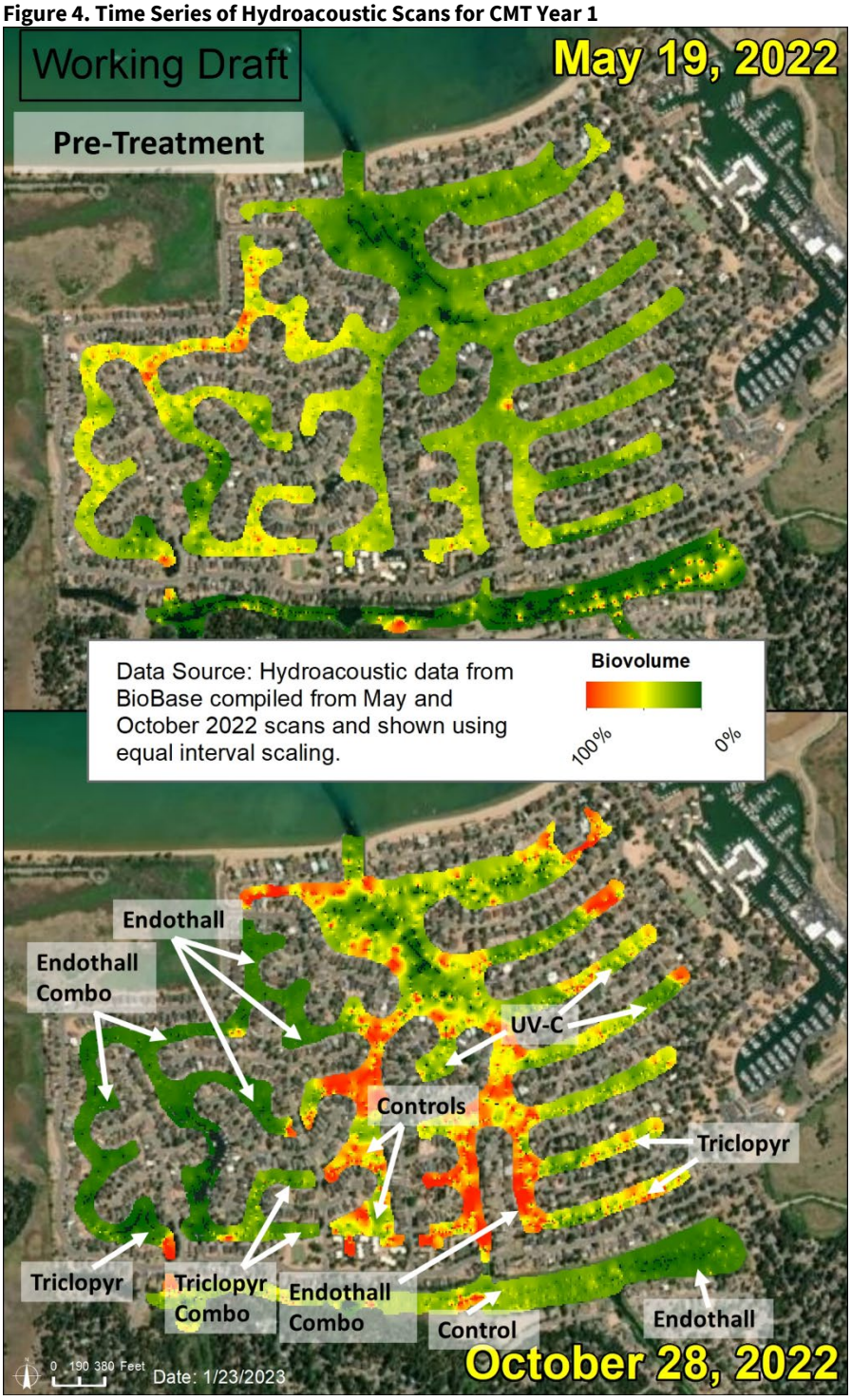
2.2 Comparison of Year 1 Group A Control Method Effects on Weeds

Preliminary analyses were completed on the effectiveness (or efficacy) of the four Group A treatments: herbicide only, UV light only, combination herbicide/UV light, and LFA. These initial analyses are preliminary, but are yielding some positive results from Year 1 treatments.

To assess changes in aquatic plant biovolume (without regard to plant species), pre- and post-CMT treatment hydroacoustic scans can be compared over time for treated and untreated (Control) areas. Figure 4 presents hydroacoustic scans for 2022 showing the overall changes in aquatic plant biovolume within the CMT Group A treatment, CMT Control, and non-CMT areas within the West Lagoon and the Lake Tallac Lagoon. Clear differences in biovolume densities can be seen between herbicide treated areas and Control sites, and also between UV light treated areas and Control sites.

However, the objectives of the CMT are not to reduce total biovolume by 75%, but to reduce specific plant species biovolume, namely the target aquatic weed species Eurasian watermilfoil, curlyleaf pondweed, and coontail. To assess the treatment effects on these specific targeted plants, over 7,500 point rake samples of aquatic plants within the test sites and photographs of the rake samples were collected by TRPA's monitoring consultant. Every two weeks, thirty rake samples and photographs of each rake sample were taken at each CMT site to record the species presence, the percent of the sample comprised of each species and the "condition" (health) of the plants.

Figure 4. Time Series of Hydroacoustic Scans for CMT Year 1



The preliminary example results for this report are limited to analyzing the effects of treatments during 2022 for the following: 1) Endothall treatment at herbicide-only Sites 1, 2 and 3; 2) UV only treatment at UV only Site 24; 3) Triclopyr only treatment at Sites 5, 8 and 9; and 4) LFA treatment at LFA only Site 26.

The figures below compare the relative abundance of plant species from rake pulls with the methods deployed in Year 1. Figure 5 compares the Endothall-only treatment sites (1, 2 and 3) to the three Control sites (16, 17 and 18). Figure 6 compares the UV only treatment site (24) to the three Control sites (16, 17 and 18). Figure 7 compares the Triclopyr only treatment sites (5, 8, and 9) to the three Control sites (16, 17 and 18). Figure 8 compares the LFA only site (26) to the three Control sites (16, 17 and 18).

Figure 5. Endothall Only Sites 1, 2, and 3: Changes in Relative Abundance of Plant Species Over Year 1

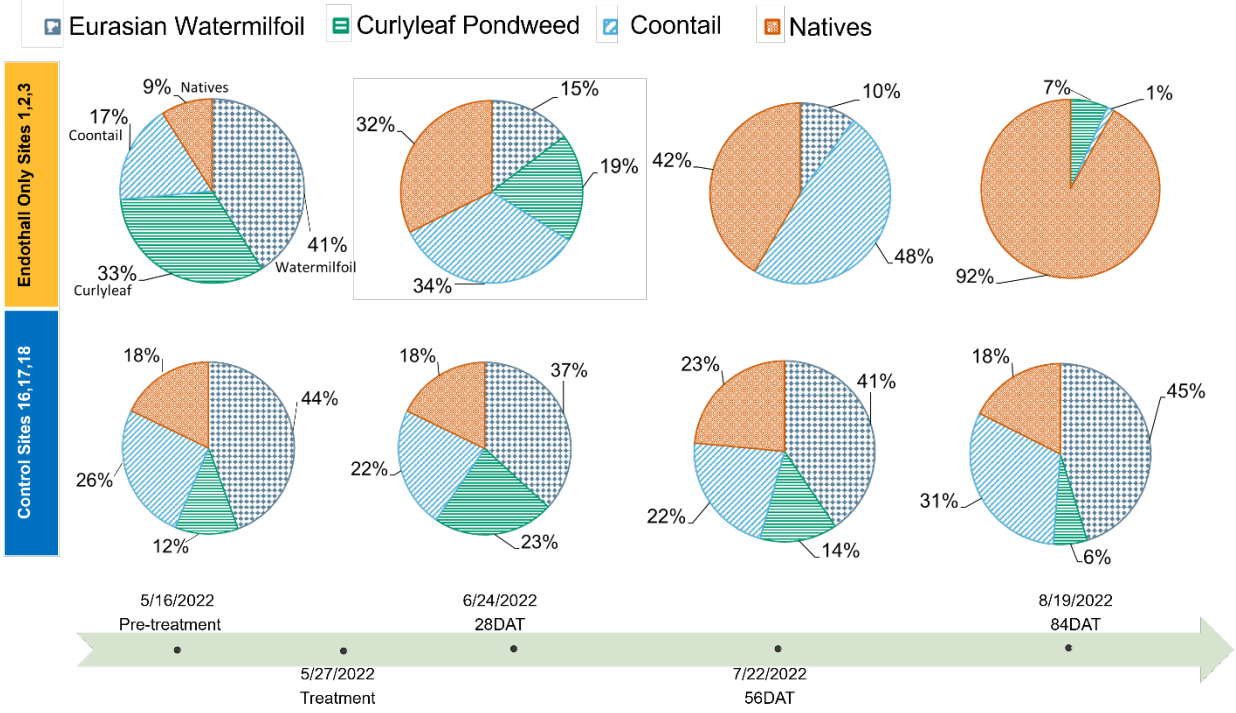


Figure 6. UV Only Site 24: Changes in Relative Abundance of Plant Species Over Year 1

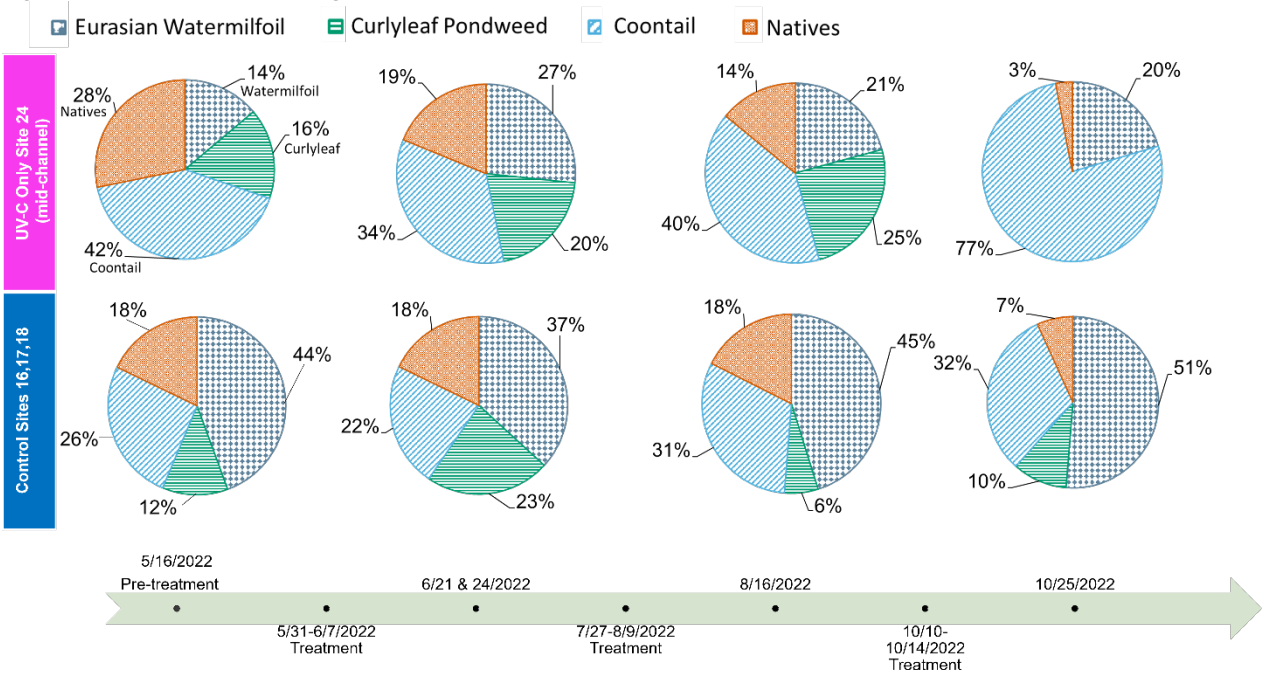


Figure 7. Triclopyr Only Sites 5, 8, and 9: Changes in Relative Abundance of Plant Species Over Year 1

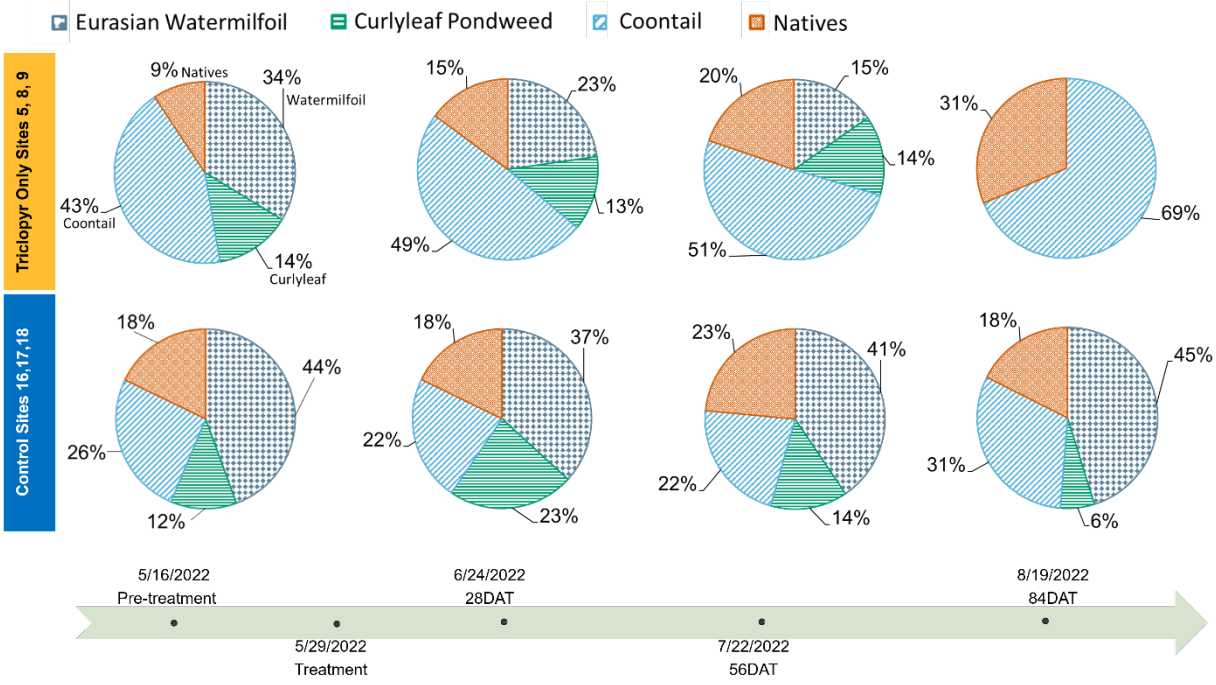
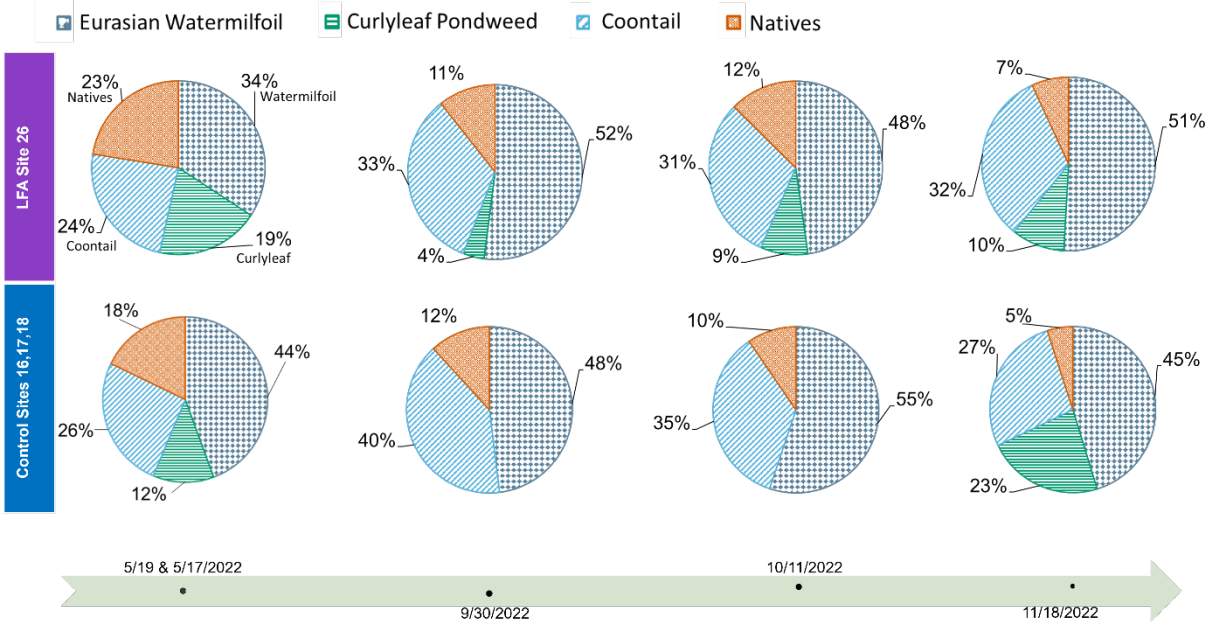


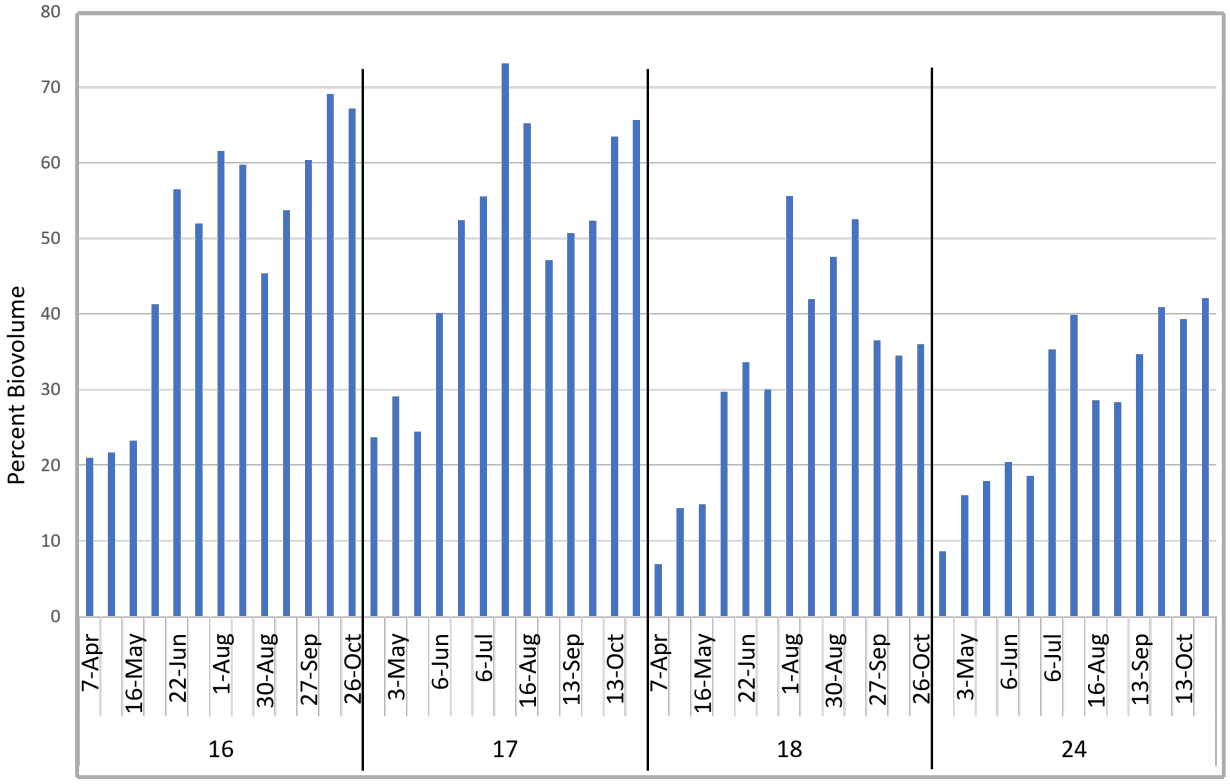
Figure 8. LFA Site 26: Changes in Relative Abundance of Plant Species Over Year 1



The rake sampling results above demonstrate that Endothall-only treatments greatly reduced target weed populations compared to Control sites (Figure 5). UV only treatments at Site 24 also reduced specific target weeds (Figure 6), as well as the total aquatic plant (native plants and target weeds) biovolume (Figure 9).

Dramatic decreases in Eurasian watermilfoil can be seen in Figure 7 where Triclopyr treatments were applied at Sites 5, 8 and 9. Note that the relative abundance of the other target weed species compared to Control sites was not greatly reduced in Sites 5, 8 and 9 (since Triclopyr only targets Eurasian watermilfoil). Figure 7 also shows a substantial increase in the relative abundance of coontail at Sites 5, 8 and 9 compared to Control sites. No trends appear in Figure 8 for LFA Site 26 to date since LFA is designed as a long-term control method intended to reduce decaying biovolume and nutrients available for plant growth at the sediment layer.

Figure 9. UV Only Site 24 Changes in Average Biovolume Comparison to Control Sites 16,17, and 18



While Endothall as a contact herbicide controlled all three invasive aquatic weeds, Triclopyr is a systemic herbicide that shows promise for longer-term control of Eurasian watermilfoil over the course of a season and potentially longer in a one-time application. Eurasian watermilfoil inhabits shallow areas of the lagoons where UV light treatment from boats is difficult to apply, so Triclopyr may prove to be an effective combination tool for control of Eurasian watermilfoil in the near-shore areas of lagoons with UV light treatment in the deeper zones of the lagoons.

Other preliminary conclusions can be derived from Figures 5 through 8. First, there were increases in the relative abundance of native plants in both the Endothall and Triclopyr treated sites (Figures 5 and 7). This can be contrasted with the relatively unchanged abundance of desired native plants in the Control sites (16, 17 and 18). Also of interest for long-term control of curlyleaf pondweed are: 1) the reduction in pondweed's occurrence for most treated and Control sites at 84 days after treatment (DAT), likely due to that plant's normal decline in the late Fall; and 2) the return (small increase) of curlyleaf pondweed in the Endothall sites in late August/early September, most likely due to turions in the sediment layer sprouting from the current year's plant production, as well as some turions produced in previous years.

2.3 Schedule and Scope for Year 1 Final Report

Data collection during CMT Year 1 activities included three primary purposes: 1) to track compliance with conditions of the Lahontan Water Board and TRPA permits; 2) to generally monitor environmental conditions and potential impact issues identified in the EIR/EIS; and 3) to evaluate the success and effectiveness of the four Year 1 (Group A) treatment methods for knocking back the target weeds (i.e., which sites/methodologies achieved a 75% or greater reduction) for subsequent years testing of Group B methods to sustain the knockback.

The preliminary results presented above for CMT Year 1 Group A treatment effectiveness represent a small subset of the data collected. These results are still subject to revision based on additional independent analyses underway as part of the Year 1 Final Report preparation. After the comprehensive CMT Year 1 Final Report is submitted to the Lahontan Water Board and TRPA in March 2023, summaries of that report will be released to the public and the stakeholder group that helped shape the final CMT Project design. TKPOA will summarize the results for its homeowners via Town Hall forums and other homeowner communications.

3.0 WHAT WILL BE DONE IN YEARS 2 AND 3 OF THE CMT?

Year 2 of the CMT will include: 1) testing of small-scale, site-specific Group B treatments at multiple sites using bottom barriers, diver assisted suction hand-pulling, and UV spot treatments; 2) continuation of Group A UV only treatment at the UV only Year 1 test sites; 3) continuation of the LFA systems operations; and 4) starting and in some cases continuing UV treatment in the mid-channels of the previous combination UV/herbicide treatment sites (see Figure 2). No herbicides will be applied in Year 2.

3.1 Year 1 Results to Inform Scope and Location of Year 2 Tests

The selection of the Year 2 CMT Group B method test locations will be based on the results of Year 1 treatments, a comparison of 2022 aquatic invasive plant data at those sites, and results of aquatic plant surveys to be performed in Spring 2023. The continuation and restarting of Group A UV treatments will be at the same locations as the Year 1 Group A UV sites. LFA treatments will continue at the same sites as during CMT Year 1 operations.

3.2 Scale of Years 2 and 3 Control Methods Testing

The scale of the Year 2 Group B methods to test the ability to “sustain control” of reduced target weed biovolume cannot be determined until the aquatic plant survey data is collected in the Spring of 2023. This data will identify where the target aquatic weeds are regrowing, and to what extent. This adaptive management approach was anticipated as part of the design and

strategy of the CMT (Figure 1) and is necessary because it is difficult to predict where and how widespread the target species may reappear within the CMT Year 1 Group A treatment sites. The same adaptive management approach will be used to identify the scale and location of Group B method testing for Year 3. The Year 2 testing results and Spring 2024 surveys will help inform the locations for Group B method testing in Year 3.

Table 2 presents a preliminary breakdown of the approximate acreages for Group A and Group B treatments anticipated for Year 2 of the CMT. With Table 2, Group B site treatments and testing will be achieved per CMT design goals while meeting CMT funding and budget objectives. All Group A continuing and Group B new treatments in Year 2 will occur within the Year 1 Group A treatment sites, however, not all Group A treatment areas will include Group B testing in 2023.

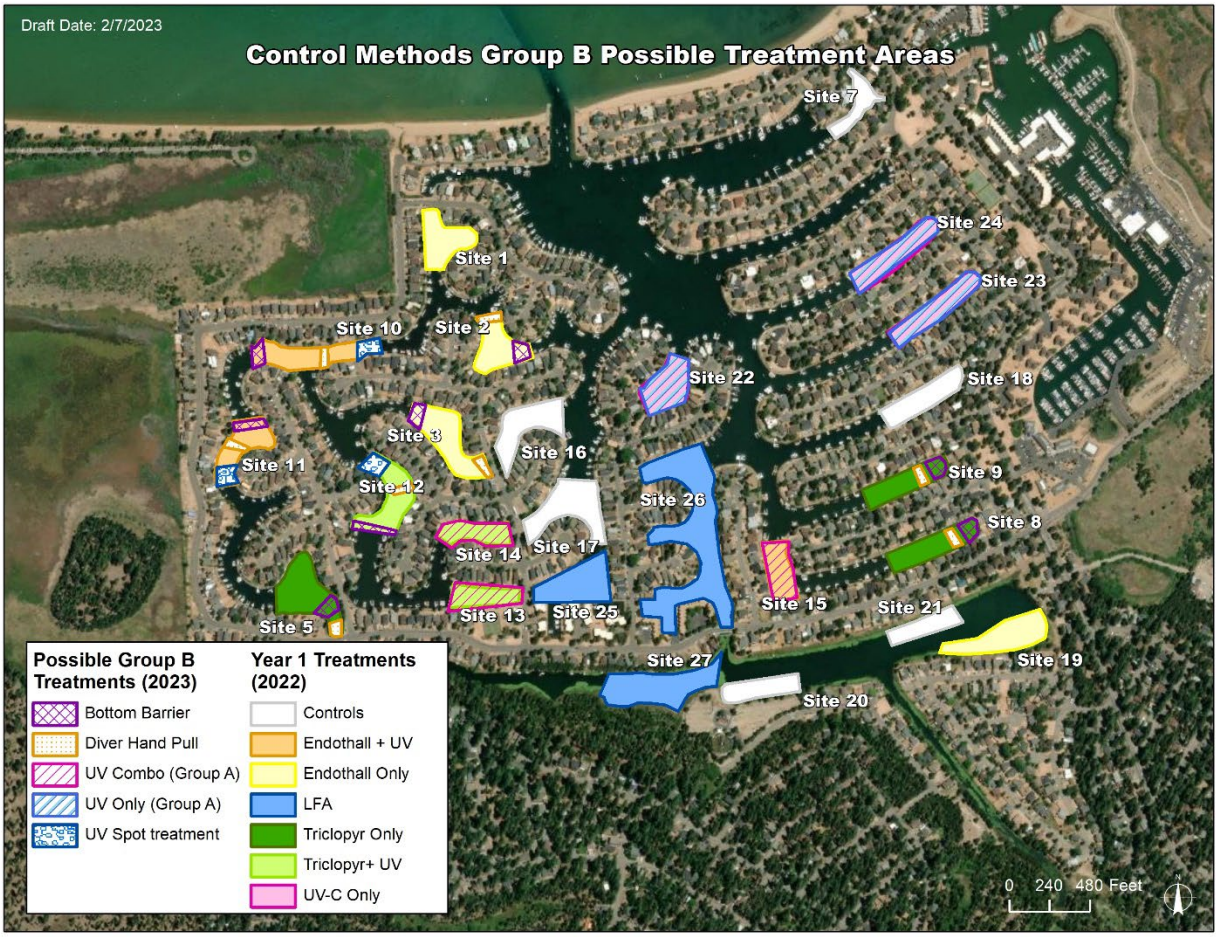
Figure 10 shows a conceptual layout of possible Group B treatment testing within CMT Year 1 (Group A) test sites. Group B test sites will be smaller, subset areas of Year 1 test sites. The Control sites for Year 2 will remain the same as Year 1 Control sites.

Table 2. Year 2 CMT Group B Treatment Preliminary Estimates

Methods:	Number of Sites	Approx. Acreage per Site	Total Acreage	Potential Locations	Type of CMT Year 1 Test Sites	Contractor
UV Only (Group A)	3	1.5	4.7	22,23,24	UV Only	Inventive Resources, Inc.
UV Combo (Group A)	6	0.5	3.0	10,11,12	Combo	Inventive Resources, Inc.
UV (Spot Treatments)	6	0.5	3.0	1,2,3	Endothall	Inventive Resources, Inc.
Diver Hand Pull*	8	0.13	1	2,3 10,11,12* 5,8,9	Endothall Combo Triclopyr	TBD
Bottom Barrier*	8	0.23	1.8	2,3 10,11,12* 5,8,9	Endothall Combo Triclopyr	TBD
LFA	3	4.3	12.9	25,26,27	LFA	CleanFlo
Control	5	0.9	5.5	7,16,17, 18, 20	Control	N/A

*Sites 1 & 19 also represent options for Year 2 testing of diver hand pull and bottom barrier
*Diver hand pull and bottom barrier to be used on Site 26 per Lahontan Water Board approval

Figure 10. Possible CMT Year 2 Group B Treatment Areas



4.0 WHEN WILL THE CMT BE COMPLETED AND WHAT HAPPENS AFTERWARDS?

The CMT is projected to be a 3-year project with Group A (knockback) method testing in Year 1 and Group B (follow-up) method testing in Year 2 and Year 3. Some repeated treatments of Group A UV only and UV mid-channel applications in combination sites are planned for Year 2 and could be carried into Year 3 depending on the locations and extent of aquatic weed regrowth. LFA will operate continuously during all three years.

4.1 CMT Project 3-Year Timeline

Figure 1 shows a general timeline of the 3-year CMT Project. The approach and strategy for the Year 1 (Group A) and the Years 2 and 3 (Group B) control method testing are summarized in the timeline, along with the expected outcomes from the CMT.

4.2 Long-Term Goals for a Long-Term Solution

Removal of all target aquatic weeds from the Keys lagoons is unlikely. However, the CMT is assessing what combination of (Group A) control methods would be able to initially knockback the invasive weeds, allow native plants to increase in the lagoons, and then manage ("sustain control of") the remaining invasive weeds with (Group B) control methods. The CMT success criteria of 75% or greater biovolume reduction for aquatic weed species represents the target threshold for which native aquatic habitat conditions can be restored over time and unwanted and invasive aquatic weed populations can be feasibly controlled in perpetuity.

Water quality is another key consideration for sustaining improved ecologic health of the Keys lagoons. For several decades, scientists (e.g., Oswald 1990 and Green 1998), engineers (e.g., RO Anderson 2016, and Domenichelli and Associates 2018), and TKPOA's Water Quality Committee have recognized the need to renovate the Keys' circulation and nutrient removal treatment system. Since the late 1990s, the large-scale circulation and treatment system has not operated properly and has not operated at all since the early 2000s. Key design and operational issues include the need to lower the circulation system intake elevations due to drought cycles, modify the nutrients removal and turbidity reduction process, add lagoons fragment management, and consider restoring the hydrology and wetland functions of Pope Marsh (that was hydrologically isolated when the Keys were developed). Based on the past five years of water quality studies for the CMT, additional issues that need to be addressed include mitigating harmful algae blooms, exploring potential synergies with clean-up of regional groundwater contamination, addressing stormwater nutrient runoff into Lake Tallac Lagoon, and evaluating renewable energy options to operate the system.

The CMT will inform the preparation of a large-scale, lagoons-wide plan to knockback and then maintain aquatic weeds at manageable levels. As the large-scale plan is developed and implemented, overhaul of the circulation and treatment system to improve water quality in the lagoons should also be pursued to support the long-term success of the aquatic weed management program as well as support the overall restoration of the lagoons for maintaining the multiple public, private, and environmental beneficial uses of the Keys and Lake Tahoe.

4.3 Possible Long-Term Solution

After the comprehensive CMT Year 1 report is completed and submitted to the Lahontan Water Board and TRPA in March 2023, TKPOA along with partner agencies and stakeholders will begin reviewing the success of the CMT Group A ("knockback") methods to begin developing options for the large-scale plan to bring the aquatic weeds under control throughout the Keys. That plan will be adapted as CMT testing continues into Years 2 and 3. Group A method success means achieving an initial 75% or greater biovolume reduction for the invasive weed species within the test sites. Technical, economic, environmental, and feasibility considerations for large-scale use of each of the Group A (as well as Group B) CMT methods will be important in designing the Keys-wide plan.

Planning using the results of CMT Year 1 activities will move ahead because of the continued, growing threat of curlyleaf pondweed and Eurasian watermilfoil in the Keys and the survey evidence of these highly invasive weeds infesting the near-shore areas of Lake Tahoe. The Tahoe Keys Marina in the East Lagoon is the largest public boat launch on the lake, and future public, commercial, institutional, and private boating from the East and West lagoons will continue to threaten aquatic invasive plant spread to the lake.

The September 2022 Special Report on CMT Project Implementation (Anderson 2022) details 'lessons learned' that must be considered in the large-scale plan. In particular, the turbidity curtains took significantly longer than anticipated to remove due to extended degradation times for one of the herbicides (Triclopyr). The longer herbicide degradation time presumably resulted from a combination of stagnant conditions behind the curtains, high water temperatures and related increases in turbidity which in turn reduced the light-driven breakdown of Triclopyr.

Once a large-scale plan is developed, additional rigorous public and scientific environmental review and permitting processes for the lagoons-wide plan will occur before any plan can be implemented. This process is projected to take 2-3 years to complete. As a result, TKPOA's application for a large-scale plan would likely be completed in 2024 or 2025 and implemented in the years after 2027. However, the urgency and threat of aquatic weeds to all of Lake Tahoe requires that action be taken as soon as possible to bring these aggressive weeds under control.

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REFERENCES

Anderson, Lars. 2022. Summer 2022 CMT Implementation Special Report. September, 2022.

Domenichelli & Associates. 2019. Tahoe Keys - Potential Cost v. Benefit and Condition Assessment Approach of the Existing Hydraulic Circulation System. Draft May, 2018.

Green, Christopher T. 1998. Integrated Studies of Hydrogeology and Ecology of Pope Marsh, Lake Tahoe. March, 1998.

Oswald, William J. 1990. The Origin and Recommendations for Mitigation of Weed Problems in Tahoe Keys. July, 1990.

R.O. Anderson (ROA). 2016. Treatment Options and Engineering Controls for Aquatic Invasive Plant Mitigation. Prepared for TKPOA. December, 2016.