

An aerial photograph of a lake with a residential area on the shore. The houses are mostly two-story buildings with dark roofs. The lake is blue and has a sandy beach. In the background, there are mountains under a clear blue sky.

Tahoe Keys Lagoons Aquatic Weed Control Methods Test Project Update

TRPA Governing Board

May 24, 2023

Dennis Zabaglo, TRPA

Pete Wolcott, TKPOA

Dr. Lars Anderson, TKPOA

Jesse Patterson, League to Save Lake Tahoe



LAKE TAHOE
INVASIVE SPECIES
PROGRAM

Tahoe Keys CMT Update



- Project Overview
 - *Dennis Zabaglo, TRPA*
- Tahoe Keys Property Owners Commitment
 - *Pete Wolcott, TKPOA*
- CMT Progress and Next Steps
 - *Dr. Lars Anderson, TKPOA Science Consultant*
- League Perspective
 - *Jesse Patterson, Keep Tahoe Blue*



Tahoe Keys Lagoons Aquatic Weed Control Methods Test

- Critical Need
 - *Find solutions to the largest infestation*
 - *Threat to Lake Tahoe*
- Innovative approach
 - *New tools for control*
 - *One time use of aquatic herbicides*
 - *Physical methods for long-term maintenance*



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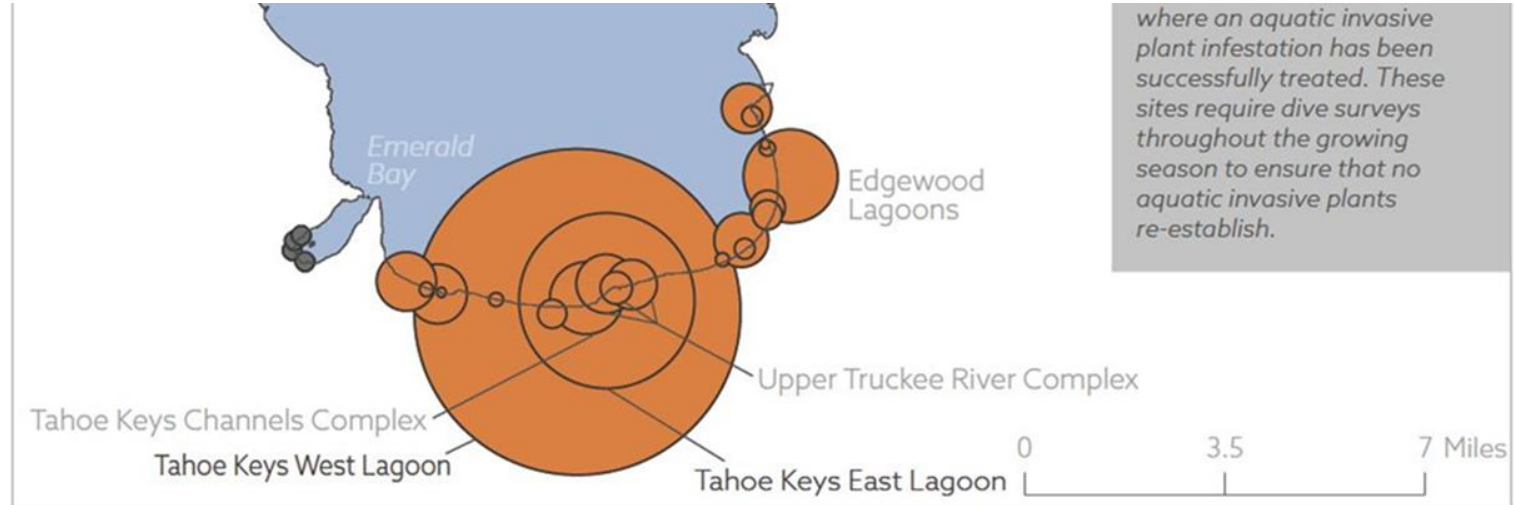
CMT Milestones

- AIS Program Success
 - *Prevention*
 - *Localized eradication*
 - *Funding*
 - *Tackle bigger infestations*
- TKPOA Commitment
 - *Collaboration*
 - *Funding*
- Stakeholder Committee
 - *Transparency*
 - *Public input*
 - *Start with a test*
- Comprehensive Environmental Analysis
 - *Alternatives*
 - *Doing nothing is not an option*
 - *CMT can be implemented safely*
- Redundant protections & mitigations
 - *Treat early*
 - *2X turbidity curtains*
 - *On-call divers*
 - *Tracer dye*
 - *Duplicate sampling*
 - *Aeration*
 - *Phoslock*
 - *Independent*
- Unanimous decisions
- Year 1 begins

- Regulatory
 - *EIP Permit & Thresholds*
- AIS Program Goals
 - *Localized eradication*
- Engage stakeholders and the public
 - *Public meetings & webinars*
- Independent monitoring
 - *Water quality*
 - *Mitigation triggers*
 - *Efficacy*



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The Tahoe Keys Challenge

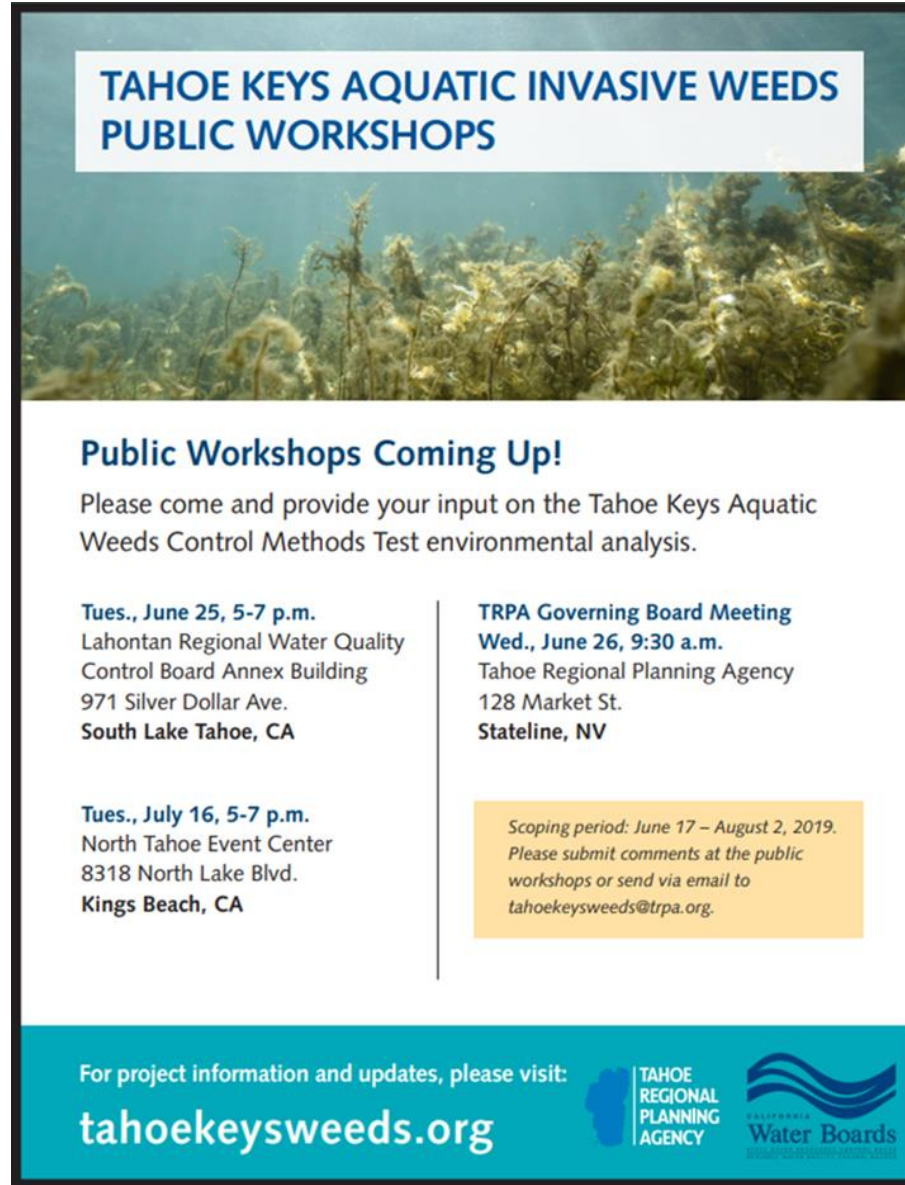
Based on acreage, the Tahoe Keys comprise 70 percent of all aquatic plant infestations in Lake Tahoe. The size of these infestations and the complexity associated with the geography of the Tahoe Keys make identifying and implementing control treatments a challenge. Although most marinas contain one or two embayments, the Tahoe Keys complex contains a myriad of connected waterways equalling approximately 170 acres.

Map produced by S. Matthews, Tahoe RCD 2019.



- Regulatory
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TRPA Role



**TAHOE KEYS AQUATIC INVASIVE WEEDS
PUBLIC WORKSHOPS**

Public Workshops Coming Up!

Please come and provide your input on the Tahoe Keys Aquatic Weeds Control Methods Test environmental analysis.



Tues., June 25, 5-7 p.m.
Lahontan Regional Water Quality Control Board Annex Building
971 Silver Dollar Ave.
South Lake Tahoe, CA

**TRPA Governing Board Meeting
Wed., June 26, 9:30 a.m.**
Tahoe Regional Planning Agency
128 Market St.
Stateline, NV

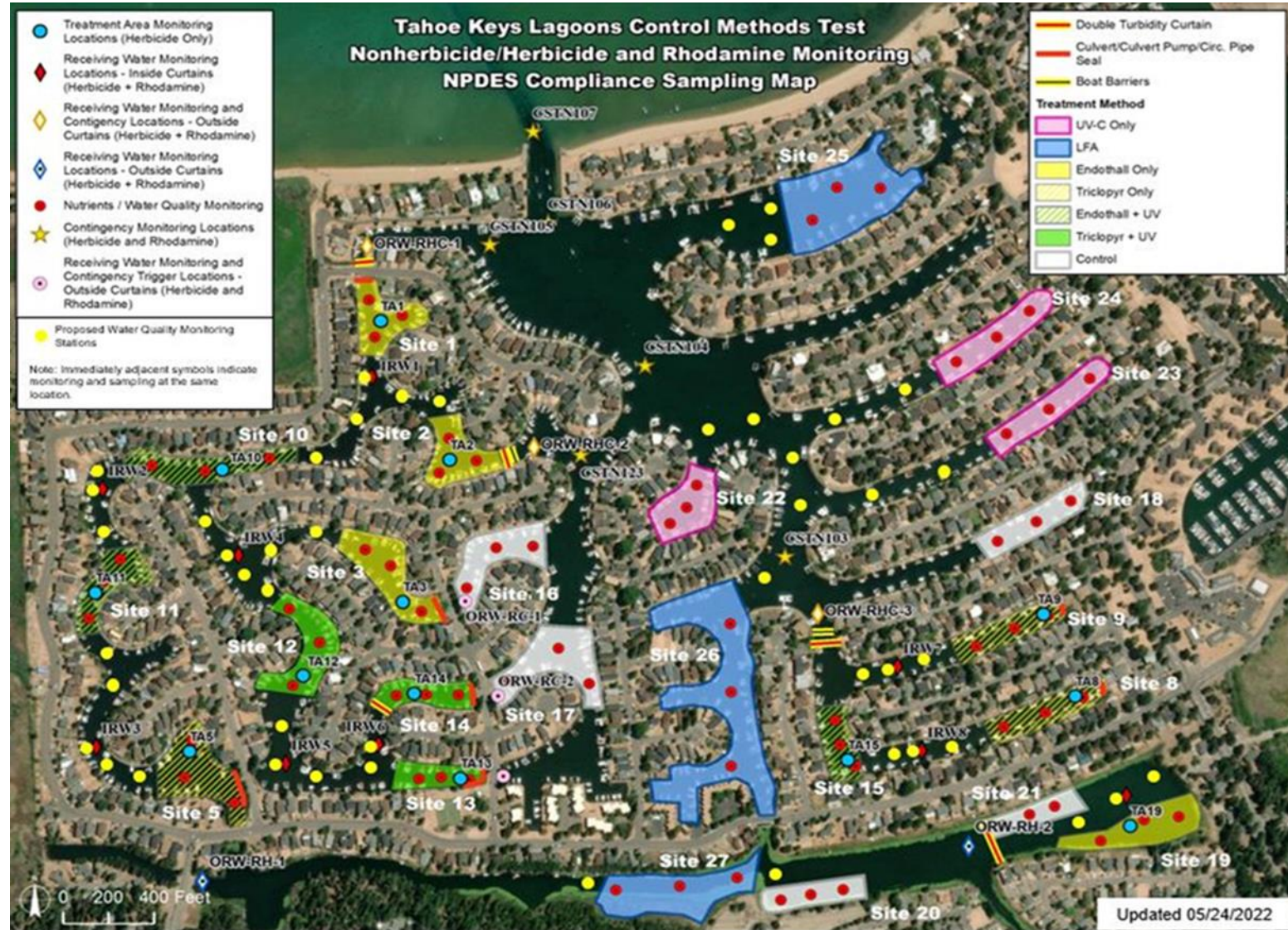
Tues., July 16, 5-7 p.m.
North Tahoe Event Center
8318 North Lake Blvd.
Kings Beach, CA

Scoping period: June 17 – August 2, 2019.
Please submit comments at the public workshops or send via email to tahoekeysweeds@trpa.org.

For project information and updates, please visit:
tahoekeysweeds.org



- Regulatory
 - *EIP Permit & Thresholds*
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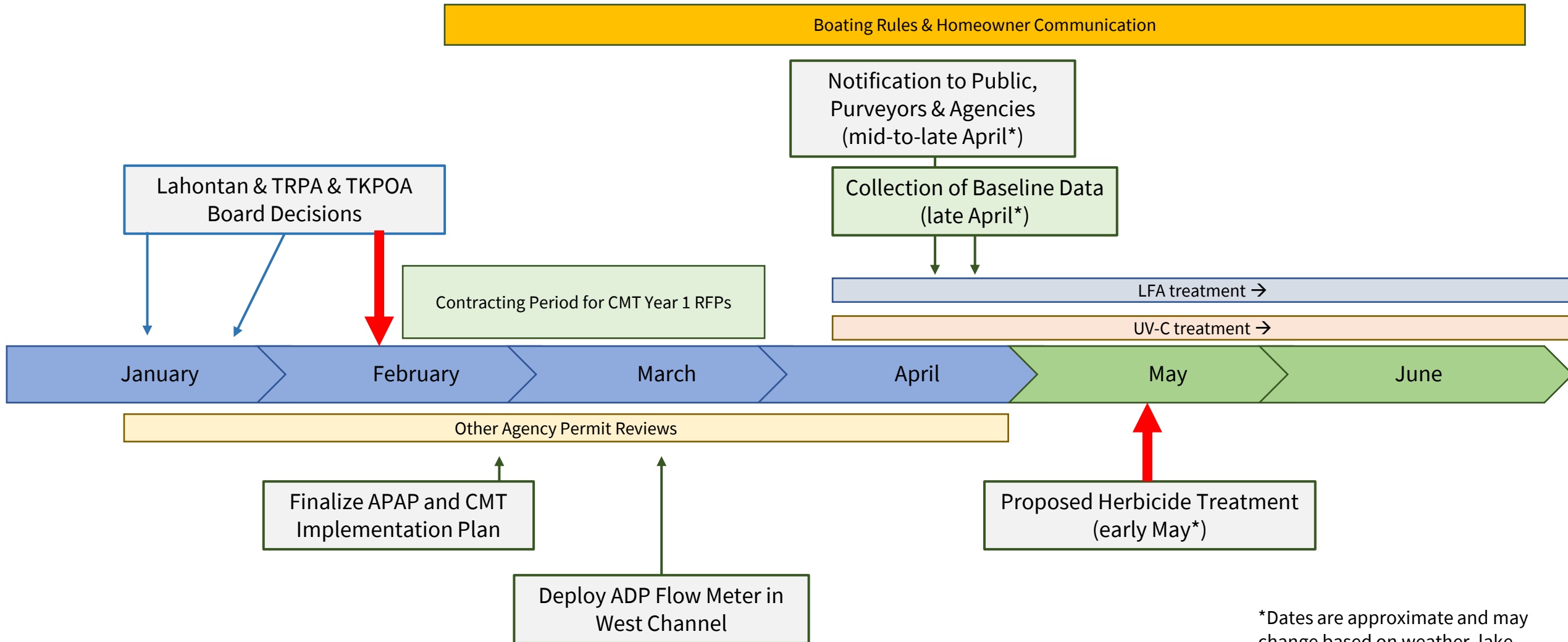
From Permit(s) to the Start Line for CMT

- **45 Years Battling Weeds**
 - **2 Decades of Advocacy**
 - **5 Years of Planning and Test Design**
 - **Only 12 Weeks to Implement?**
-
- 5 TKPOA Go/No Go's Feb thru May

Should we commit \$1-2M of our neighbors \$ on a 50-50 shot at 2022 implementation of the test?



Remaining Steps for CMT Implementation



From Permit(s) to the Start Line for CMT

- 2 Decades of advocacy
- 5 Years of Planning and Test Design
- 12 Weeks to Implement?
- **5 TKPOA “Go/No Go” Reviews Feb thru May**

Should we commit \$1-2M of our neighbors \$ on a 50-50 shot at 2022 implementation of the test?

- Last Minute Nudge from Joanne Marchetta

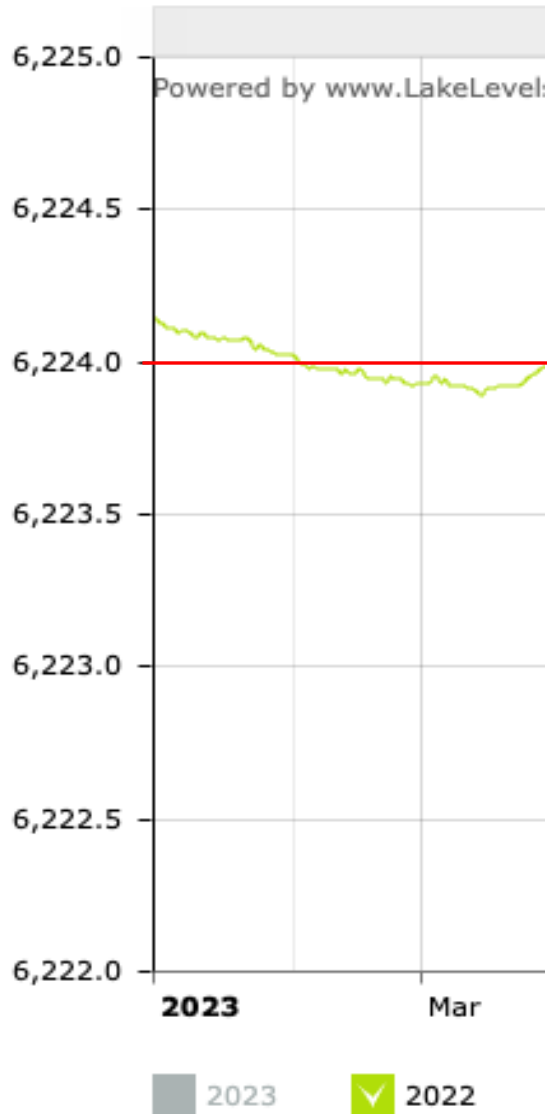


Getting to the Start Line: The 7 Miracles

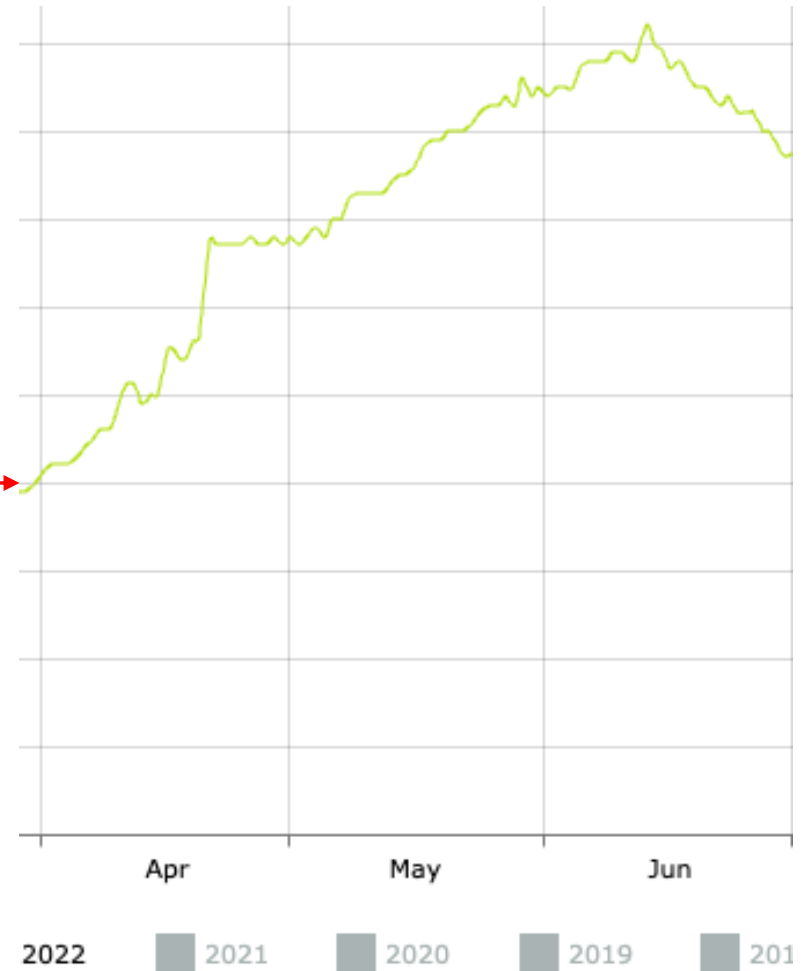
1. **Water Depth (Lake Height > 6224')**
2. Water Temperature > 16° C by early May
3. Lake water level is rising
4. Contractors are selected, briefed, and ready
5. Turbidity Curtains and Boat Barriers are Installed
6. Monitoring & Mitigation specs finalized
7. Proof of Flow into the Lagoons



#1: Lake Tahoe Water Level



Minimum Depth



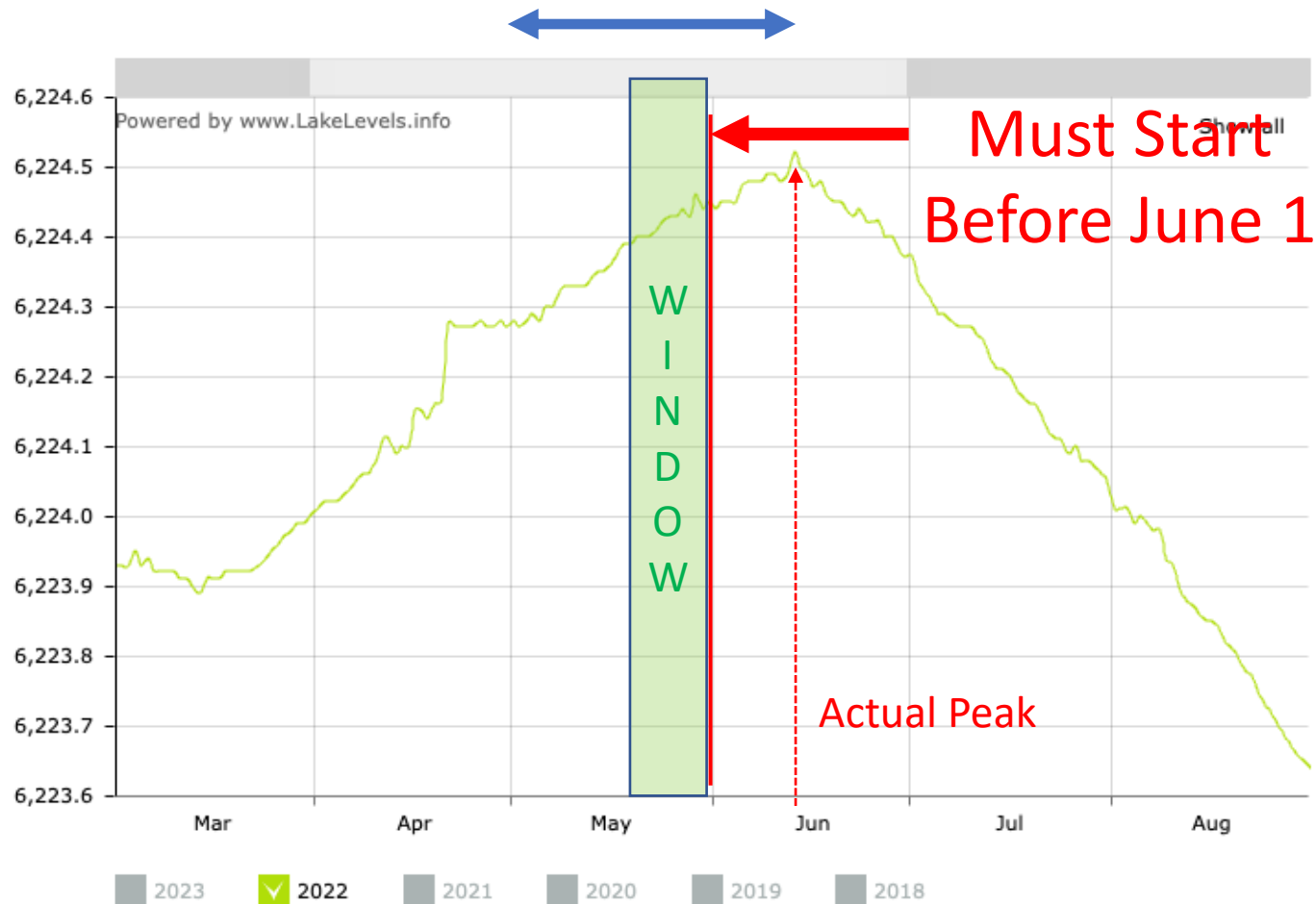
Getting to the Start Line: The 7 Miracles

1. Lake Height > 6224'
- 2. Water Temperature > 16° C by early May**
- 3. Lake water level still rising in late May**
4. Contractors are selected, briefed, and ready
5. Turbidity Curtains and Boat Barriers are Installed
6. Monitoring & Mitigation specs finalized
7. Proof of Flow into the Lagoons

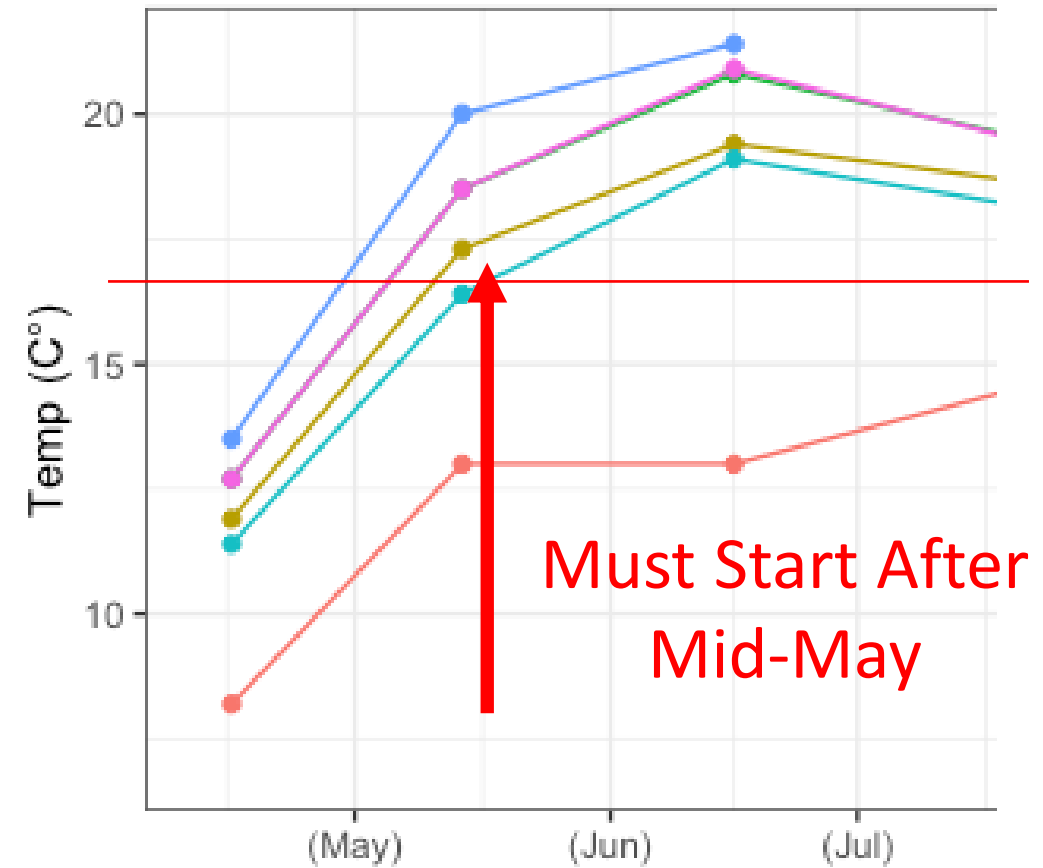


#2 & #3: Reach 16° C Before Lake Levels Fall

Permit window = May 1 to June 15



Surface Temperature During 2021



Note: Water Temp dropped ~ 10° F in April Storms

Getting to the Start Line: The 7 Miracles

1. Lake Height > 6224'
2. Water Temperature > 16° C
3. Lake water level is rising
- 4. Contractors are selected, briefed, and ready**
5. Turbidity Curtains and Boat Barriers are Installed
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#4: Contractors for CMT Project

TKPOA Contractors Selected

- Stratus Environmental Inc.
 - Well Water Monitoring
 - Environmental Program Manager for Spill Prevention and Response
- AquaTechnex
 - Herbicide and Rhodamine Water Tracer (RWT) Dye Application
 - Lanthanum Modified Clay (LMC) Application and Monitoring
- Mountain Pipeline/Pacific Built
 - Culvert Seals
 - Culvert Pump and Pipe Socks
- Hiuga Divers
 - Turbidity Curtain Install and Removal
- Shoreline Engineering
 - Installation of Boat Barriers
- Clean-Flo (Restorative Lake Sciences LLC)
 - Laminar Flow Aeration
- Sierra Ecosystem Associates (SEA)
 - CMT Project Management

TRPA Contractors Selected

- Blankinship & Associates, Inc.
 - Herbicide & RWT Dye Monitoring
 - Laboratory Services – Herbicide Residues/Degradants
- Environmental Science Associates (ESA)
 - Nutrient Grab Water Quality Monitoring
 - Benthic Macroinvertebrate (BMI)
 - Macrophyte Monitoring
 - Lab coordination if LMC samples are collected by AquaTechnex for lab analysis
- Stratus
 - Continuous Water Quality (miniDOTS)
- Inventive Resources, Inc (IRI)
 - UV-C Treatment Boats and Treatments
- Lahontan
 - Lab Services for TKPOA Cyanobacteria analyses

12 Contracts to Negotiate
> 100 Contractors on the Water

Getting to the Start Line: The 7 Miracles

1. Lake Height > 6224'
2. Water Temperature > 16° C
3. Lake water level is rising
4. Contractors are selected, briefed, and ready
- 5. Turbidity Curtains and Boat Barriers are Installed**
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7. Proof of Flow into the Lagoons



#5: Boating Restriction, Curtains, Barriers

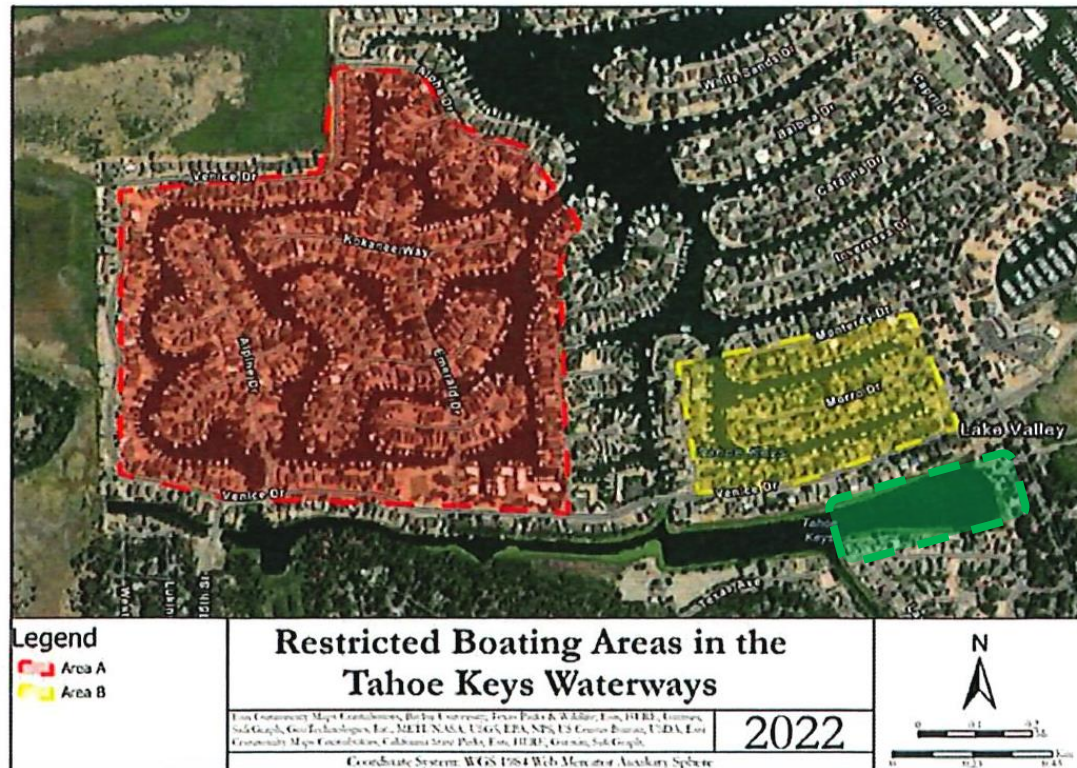
Boat Closure
from:

~~April 18~~

~~April 25~~

May 9

Restricted Boating Areas April 18-Latest Mid-July (Draft- 2022 Only)



Area A (Red)

Area B (Yellow)

Lake Tallac (Green)

not connected to Lake Tahoe



**Test Area B:
Turbidity Curtains and Boat Barrier Installed 5/16**

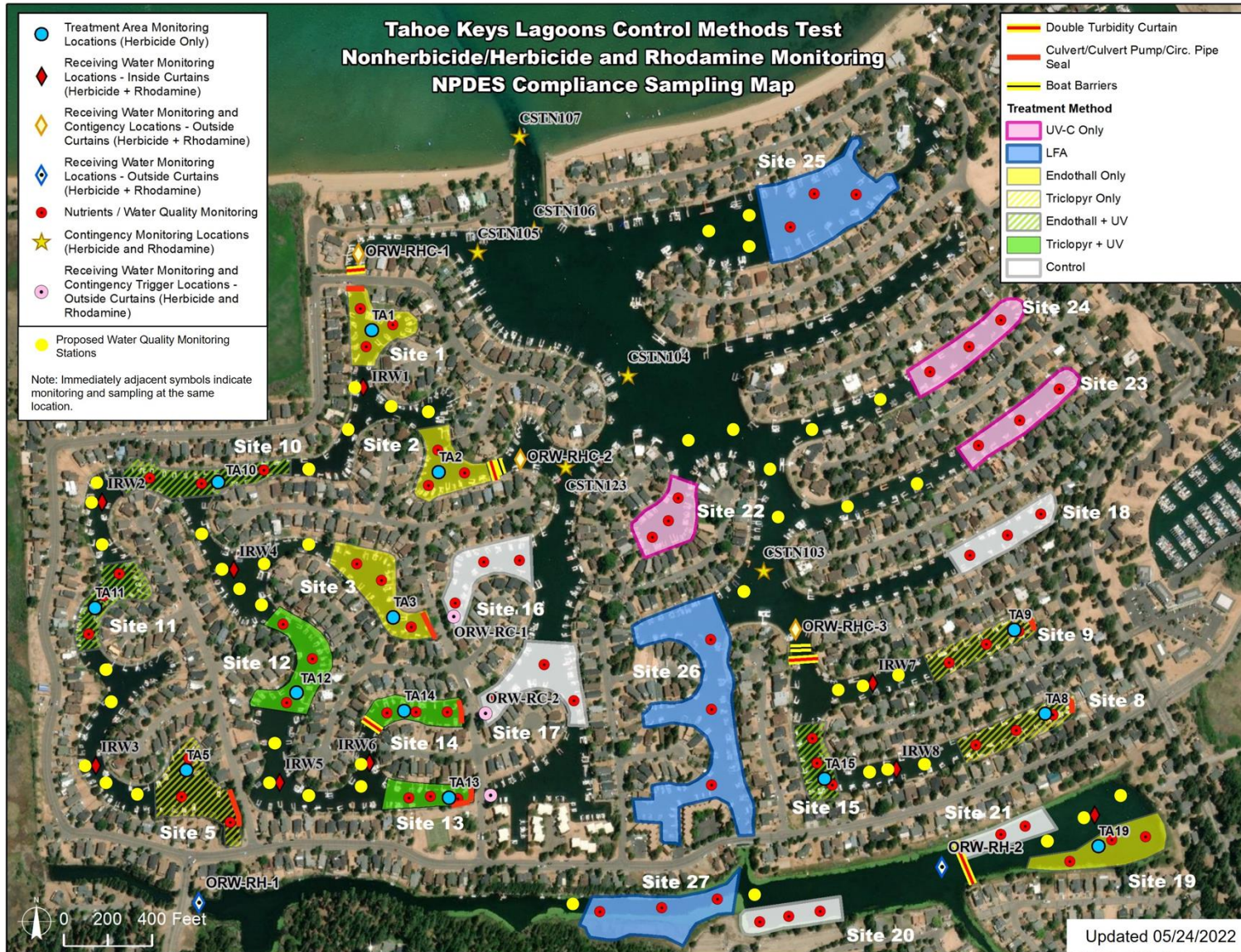
One week before Scheduled Start of Test

Getting to the Start Line: The 7 Miracles

1. Lake Height > 6224'
2. Water Temperature > 16° C
3. Lake water level is rising
4. Contractors are selected, briefed, and ready
5. Turbidity Curtains and Boat Barriers are Installed
- 6. Monitoring & Mitigation specs finalized**
7. Proof of Flow into the Lagoons



#6: Final Monitoring Spec Finalized 5/24 (T-1)



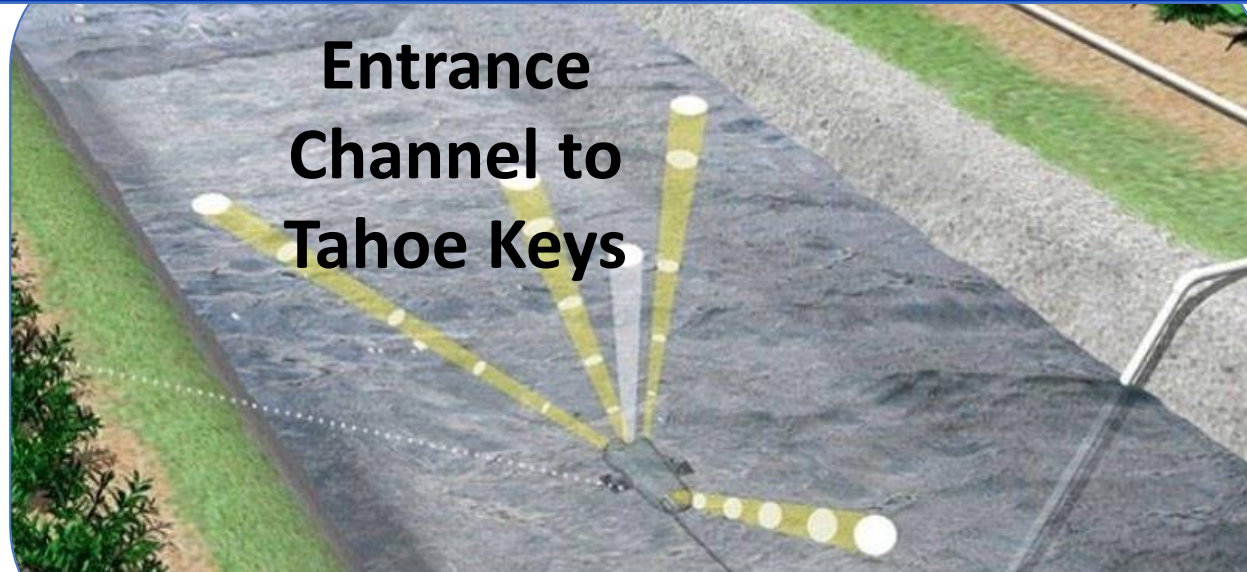
Getting to the Start Line: The 7 Miracles

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- 7. Proof of Flow into the Lagoons**



5/23 Doppler Flow Meter Not Working

The Lake – cold, clean and clear



The Lagoon – warm, turbid, sediment-laden

#7: Revised Flow Monitoring Spec @ 11th Hour

Simple Fix:

- Manual Meter (in stock)
- Mounted on a pole to the bottom
- Measuring @ 3 depths
- From Anchored Barge

Bonus: Learned a lot more about Flow



CMT – How did we do?

- We successfully navigated the 7 Miracles to the starting line
- Monitoring: 75K data points compiled, > 90% of target
- Mitigation: No Herbicides detected anywhere near the lake

We Met Important Commitments to Stakeholders & the Public



CMT – How did we do?

- We successfully navigated the 7 Miracles to the starting line

Meteorological Good Fortune	Hard Work Perseverance Teamwork Solid Science
• Water Depth (Lake @ 6224.5')	• Contractors selected & ready to go
• Lake Rising until June 14th	• Curtains & Barriers installed
• Water Temperature > 16°C by May 15th	• Monitoring Specifications Agreed
	• Proof of Flow into Lagoons

A Job Well Done by CMT Project Team!



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CMT Year 1 Problems/Challenges:

- 5 Wind Events in the first 3 weeks of the test
- 3-Year Cost @ ~4X TKPOA's Original Funding Level
- Non-detect for Triclopyr set @ 1PPB, a high bar
 - Turbidity Curtains remain in place until late September
 - Water Quality behind the curtains erodes markedly in August



60% of TKPOA Boaters lose entire season

Boat Closure to:

~~3-5 weeks~~

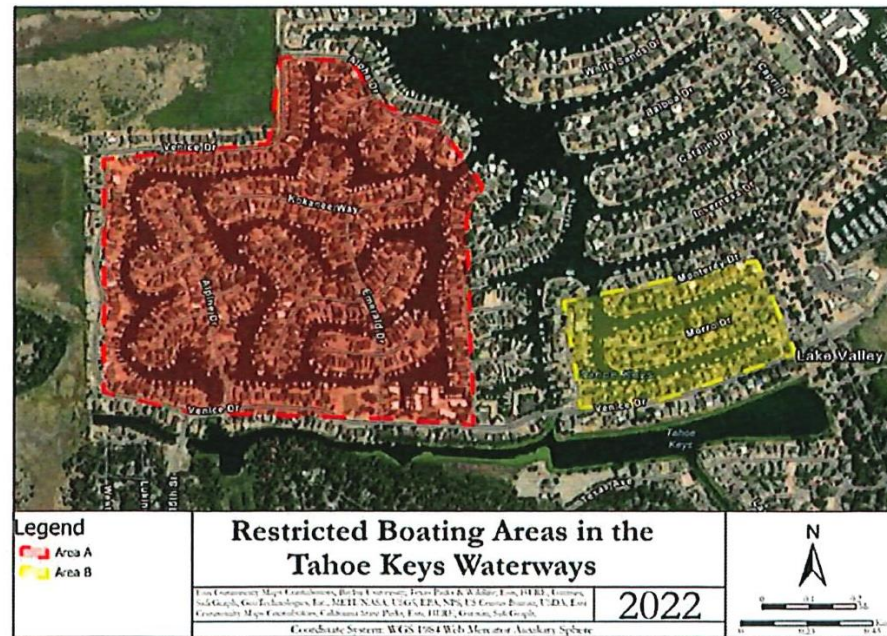
~~Mid-July~~

~~August 19~~

Sept 2 for Area B

Sept 23 for Area A

Restricted Boating Areas April 18-Latest Mid-July (Draft- 2022 Only)



Treatment Area A (Red) Barrier Placement will impact all homeowners on the following streets:

- All streets off Emerald Drive (Garmish Court, Marconi Way, Lido Way, Kokanee Drive)
- Southern side of Aloha Drive (Aloha Drive, Daggett Court, Carson Court)
- All streets off Alpine Drive (Alpine Drive, Cascade Court, Cathedral Court, Genevieve Court)
- Waterway side of Venice Drive from Lighthouse Shores to Christie Drive
- West Side of Christie Drive and Wedeln Court

Treatment Area B (Yellow) Barrier Placement will impact all homeowners on the following streets:

- Eastern side of Lucerne Way
- Northern side of Venice Drive from the Corner of Lucerne Way and Ala Wai Blvd
- All of Morro Drive
- Southern side of Monterey Drive
- Western side of Danube Drive from the corner of Venice to Monterey

Significant Algae Bloom behind curtains



TKPOA Commitment to CMT

Goal of CMT is long-term management solution for invasive weeds

- **Environmentally Sound**
- **Economically Viable**
- **Permittable**

- Despite rough summer, members approve Year 2 funding > 4:1
- Pursuing 2nd collaborative effort to address water quality in lagoons



Toughest Question from Homeowners

***What guarantee is there that
this Test will lead to a solution?***

Failure is not an option

“Progress Runs at the Speed of Trust”

- TRPA Support & Leadership
- Acknowledgement of Staff

<https://www.keysweedsmanagement.org/>



Summary of CMT Year One Results

- Effectiveness of CMT Treatments
- Monitoring: Nutrients and Water Quality
- Permit Compliance and Reporting
- Year Two Planning:
“Group B”
non-herbicide methods



Summary of Year- One CMT Treatment Effectiveness

Metric (Goal)	Vessel Hull Clearance (3 feet)	Biovolume (Reduce by 75%)	Encourage Desirable Native Plants (Increase Occurrence)
Treatment 			
Endothall Only (Controls all 3 target weeds)	100% 	Near or above 75% throughout season <u>All target plants controlled!</u>	>No consistent increase in native plants > Native Elodea healthy
Triclopyr Only (Very selective against Eurasian Watermilfoil)	50% 	For all target plants: Highest reduction was 50% <u>>90% Control of Eurasium watermilfoil !</u>	>Native plant community similar to controls > Native Elodea healthy
UV (mid-Site/deep)	100% 	Highest reduction was 66%; greater following treatments (near 75%)	Native plant community generally reduced compared to controls
Endothall (+ UV) (Combination)	66% 	2/3 sites had ≥75% reduction	Response of native plant community inconsistent between sites
Triclopyr (+ UV) (Combination)	83% 	1/3 sites had ≥75% reduction	Native plant community similar to controls in 2/3 sites



Triclopyr 14 days after treatment:
Only Eurasian watermilfoil is affected



Controls (untreated) (July 6, 2022)
All plants are robustly growing



Endothall only 6 weeks after treatment
(July 6 2022): **Only native Elodea is thriving**

Examples of Year 1 Herbicide Effects



Endothall only 6 weeks after
treatment (July 6, 2022):
Native Elodea is growing well

Double Curtain Installations



Spill Response Team



Temporary Launch Ramp

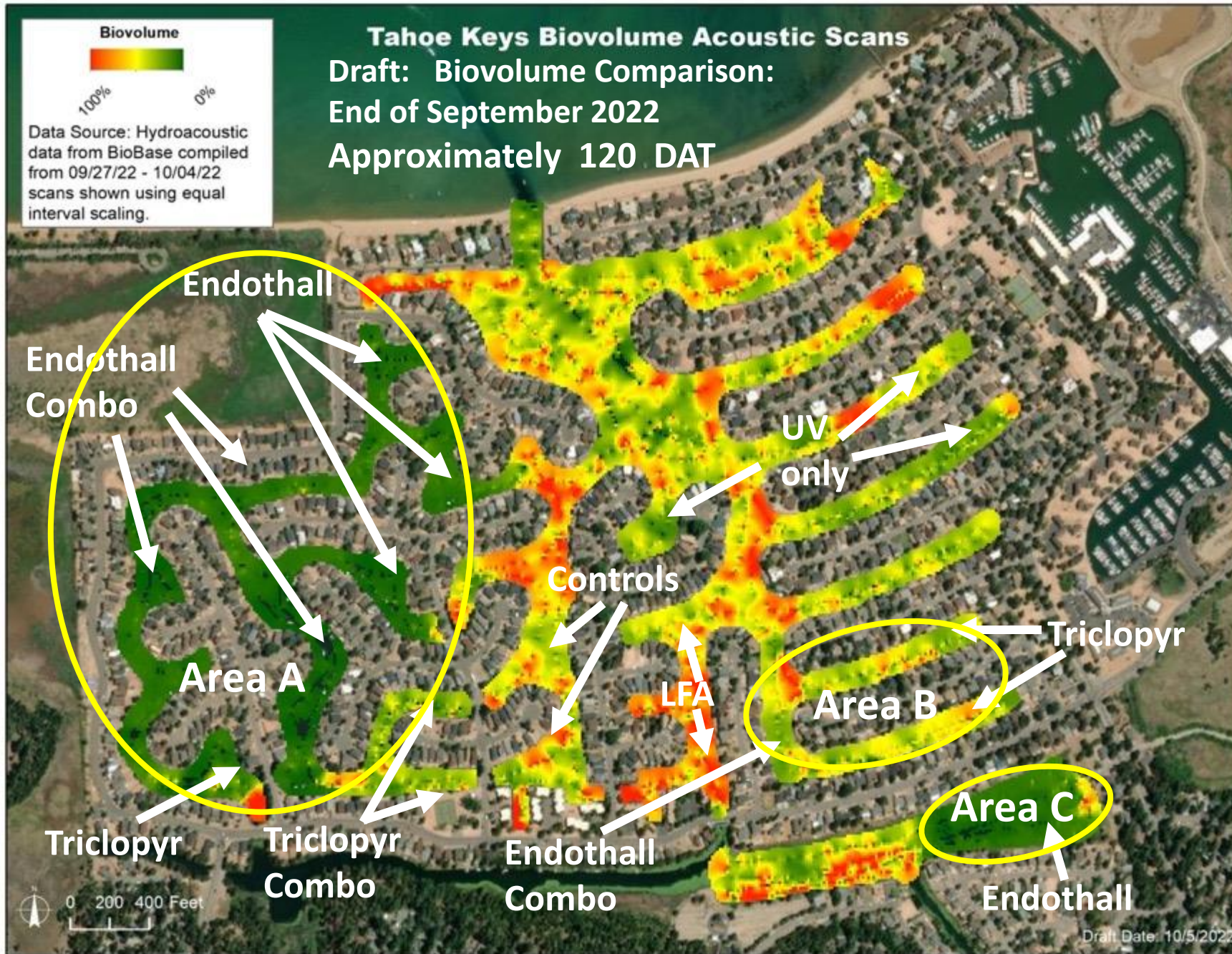


Pumped /Dropline Application of Liquid Endothall Herbicide
Mixed with Rhodamine Dye Tracer
May, 2022



Blower Application of Pelleted Triclopyr Herbicide
Rhodamine Dye Was Applied Immediately afterword
May 2022





CMT Year One Treatments:
Note: All treatments were replicated three times

- Controls (No treatments)
- Endothall herbicide- alone
- Triclopyr herbicide- alone
- UV light- alone
- Combinations:
 Endothall/UV Light
 Triclopyr/UV Light
- Laminar Flow Aeration ("LFA")
Note: Effects expected to take multiple seasons:
Sediment "muck" reduction
Reduced available nutrients

Monitoring: Herbicide Levels Summary

- **Herbicides never entered Lake Tahoe and never reached the West Channel.**
- Rhodamine dye worked well to indicate likely presence of herbicides.
- Endothall became “non-detect” (5 µg/L) by 45 Days after treatment.
- Triclopyr was above “non-detect” levels (1 µg/L) until >100 DAT.
> *This prevented removal of turbidity curtains until September.*

NOTE: Triclopyr is photo-degraded (light dependent) and high turbidity in Area A probably greatly impeded normal photodegradation.

Year Two: Strategy of the CMT

Year One

Group A Methods:
UV-C, LFA,
Herbicides,
Combinations

Goal/Strategy:

- **Knock down biomass**
- **Arrest spring growth**
- **Prevent turion formation**
- *Do this Selectively!*

Year Two

Group B Methods:
Diver removal
UV-C
Bottom barriers

Goal/Strategy:

- Evaluate Year 1 effects
- Select Group B sites
- **Sustain control**
- Prevent turion formation

Year Three

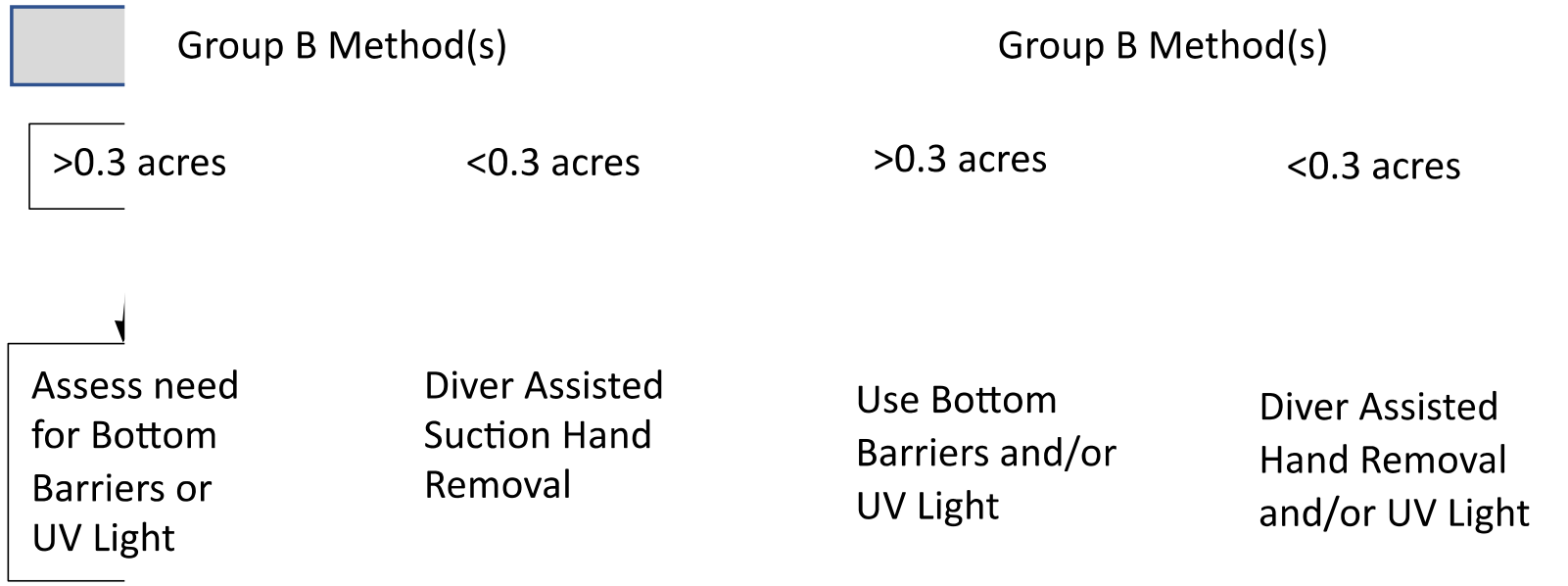
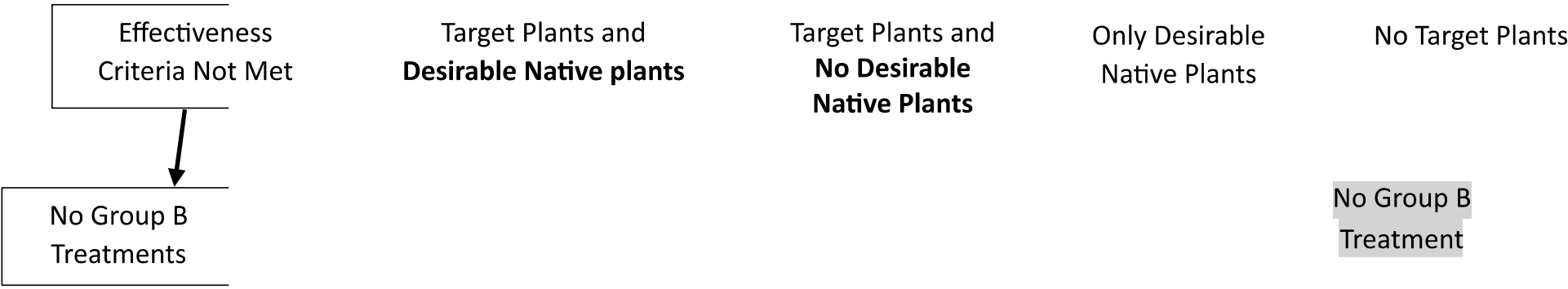
Group B Methods:
Diver removal
UV-C
Bottom barriers

Goal/Strategy:

- Evaluate Year 2 effects
- Select Group B sites
- **Sustain control**
- Prevent turion formation

Environmental Monitoring: TKPOA Staff and Contractors, TRPA Staff and Contractors

Decision Framework for CMT Year-One Group A Methods Results

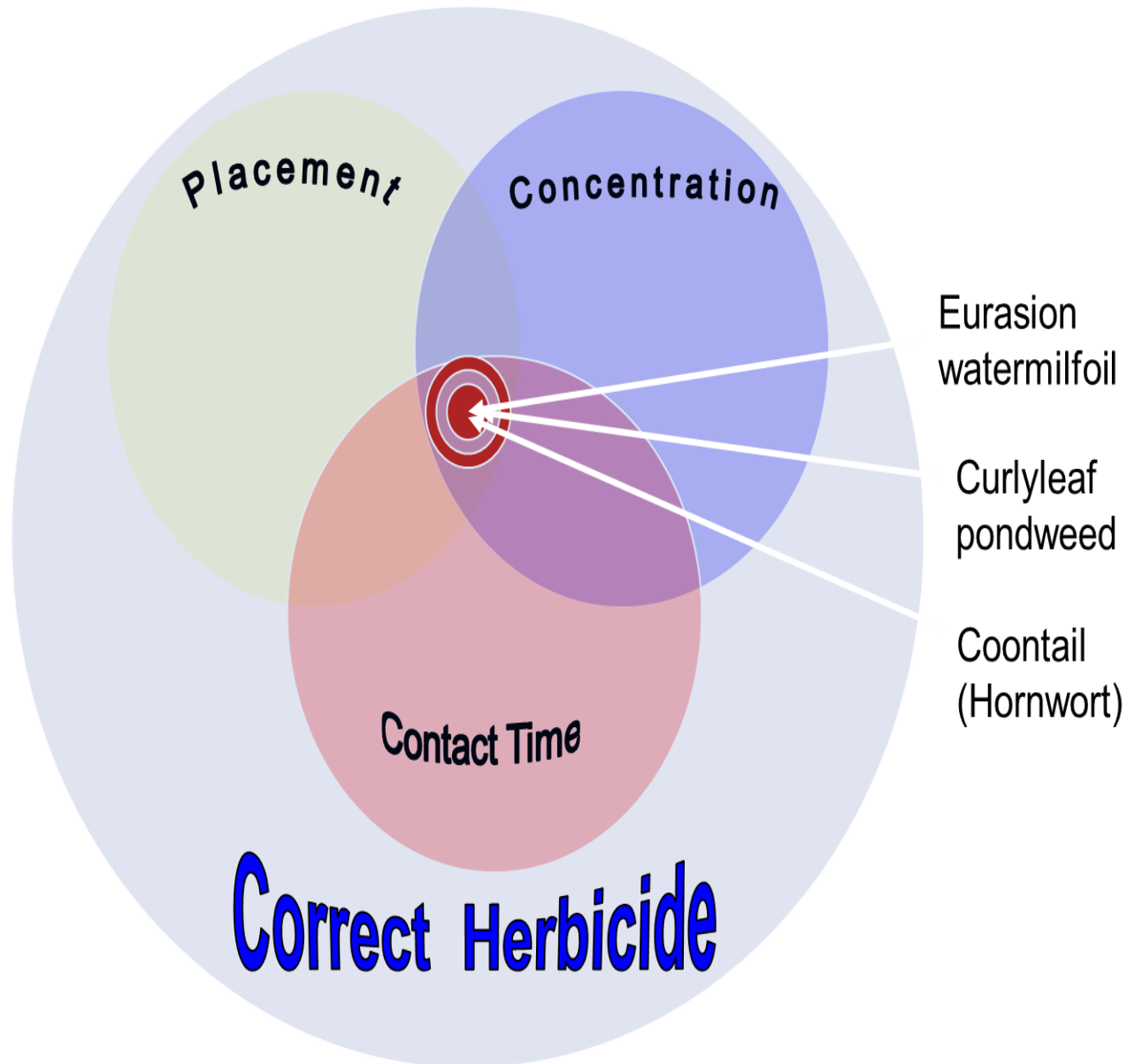


Next Steps- Implement CMT Year Two

- Contractor Orientations and Coordination
- Prep equipment and finalize monitoring schedules
- Spring (baseline) surveys for site selection
- Identify Group B test site locations (late-May/Early June)
- Contractors start work (mid-June)

Extra Slides/ follow up if needed

Obtaining Optimal Effectiveness of Aquatic Herbicides



CMT Used "Selective" Aquatic Herbicides:

>They do not harm desirable native plant *Elodea canadensis*

Endothall (2 ppm): Controls All three target plants
("Mainly Contact" = shorter control)

Triclopyr (1 ppm): Controls Eurasian watermilfoil
("Systemic" = longer control)

Monitoring: Nutrient Results Summary

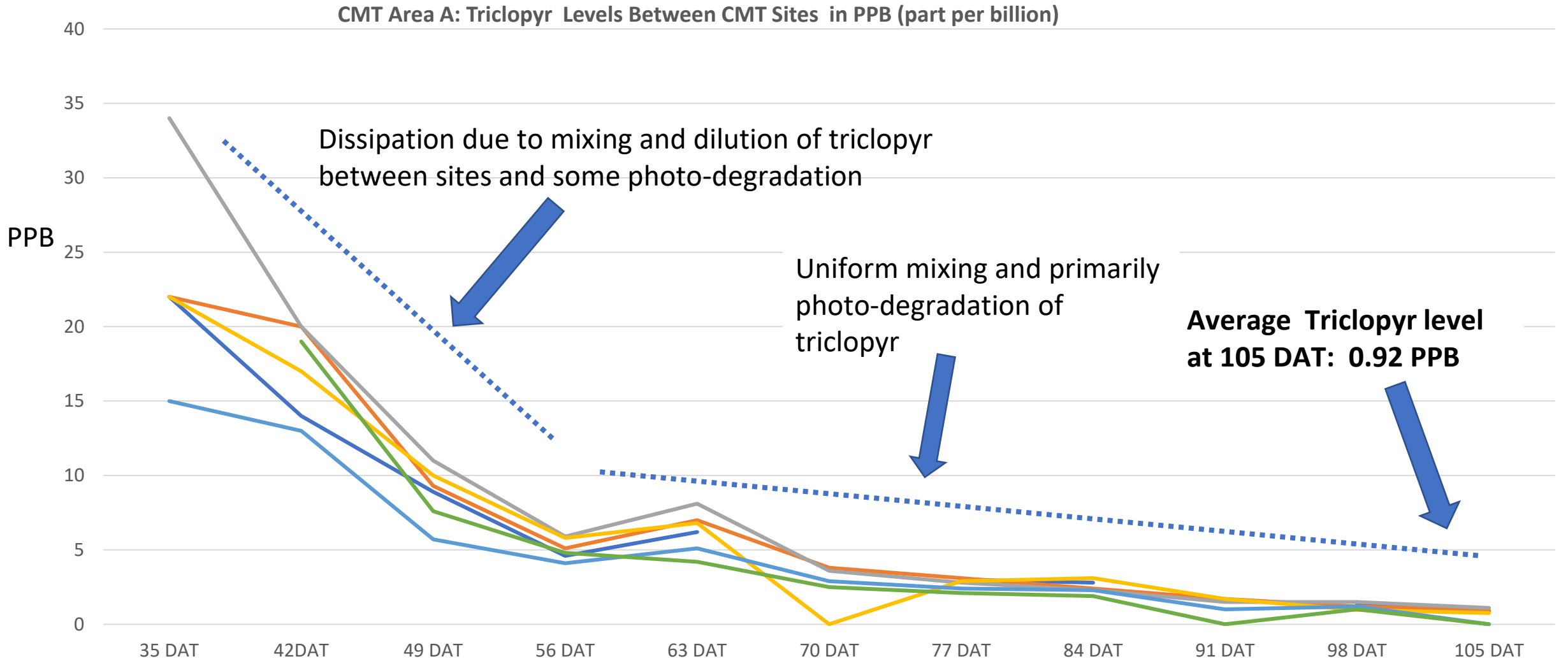
- Nutrients (nitrogen and phosphorous) in all CMT sites and Untreated Control sites were above regulatory levels
- Some nutrients were elevated in Endothall-only sites and Triclopyr-only sites
- Nutrients were lower in LFA site compared to controls
- UV treatments had less effects on nutrient levels

Monitoring: Quality Results Summary

- pH was above regulatory ranges in Controls
- Herbicide treatments brought pH into regulatory range in many sites.
- Dissolved oxygen was depressed in all sites near the bottom and in mid-depth in Endothall and some Triclopyr sites
- Turbidity was very high in Endothall only sites
(generally in all of "Area A")
>This probably slowed degradation of Triclopyr
- Temperature was not affected by UV treatments.

Triclopyr Degradation in Area A

(Different lines are from separate monitoring stations in Area A)





A Control Methods Test to Keep Tahoe Blue

Jesse Patterson
Chief Strategy Officer
May 25, 2023



Mission

To protect and restore the environmental health, sustainability and scenic beauty of the Lake Tahoe Basin. We focus on water quality and its clarity for the preservation of a pristine Lake for future generations.



League to Save Lake Tahoe

65 years of protecting
Lake Tahoe

A decade long journey to the Control Methods Test

- 2012: Learn about the Tahoe Keys through LTAIS Program
- 2013: Eyes on the Lake + Pipe Keepers @ the Tahoe Keys
- 2017: League financial commitment to non-chemical control methods, containment, WQ improvements, monitoring
- 2017-present: HABs in Tahoe Keys lagoons







A decade long journey to the Control Methods Test

- 2018: Stakeholder Committee for CMT
- 2018: Bubble curtain and hydroacoustic scanning (\$)

Bubble Curtain

September 2018





A decade long journey to the Control Methods Test

- 2018: Stakeholder Committee for CMT
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- 2019: Laminar Flow Aeration in Tahoe Keys (\$)





A decade long journey to the Control Methods Test

- 2018: Stakeholder Committee for CMT
- 2018: Bubble curtain and hydroacoustic scanning (\$)
- 2019: Laminar Flow Aeration in Tahoe Keys (\$)
- 2020: Control of Tahoe Keys Offshore / West Channel LFA (\$)

Tahoe Keys Offshore

August 2020






Tahoe Keys Offshore



0 250 500 1,000 Feet



Infestation Characteristics

-  High Density EWM & CLP (approximately 16 acres)
-  Patchy EWM & CLP (approximately 35 acres)
-  Sparse EWM (approximately 53 acres)



A decade long journey to the Control Methods Test

- 2018: Stakeholder Committee for CMT
- 2018: Bubble curtain and hydroacoustic scanning (\$)
- 2019: Laminar Flow Aeration in Tahoe Keys (\$)
- 2020: Control of Tahoe Keys Complex / West Channel LFA (\$)
- 2021: Double bubble curtain in East Channel / Complex (\$)

Containment



Bubble Curtain 2.0



East Channel Bubble Curtain

April 2021





A decade long journey to the Control Methods Test

- 2018: Stakeholder Committee for CMT
- 2018: Bubble curtain and hydroacoustic scanning (\$)
- 2019: Laminar Flow Aeration in Tahoe Keys (\$)
- 2020: Control of Tahoe Keys Complex / West Channel LFA (\$)
- 2021: Double bubble curtain in East Channel / Complex (\$)
- 2022: CMT year-1 implementation

We SUPPORT the Control Methods Test

- Status quo is destroying the Lake
- Current methods are not effective/enough
 - No silver bullet
- Conditions in Keys and Lake are getting worse – No ACTION Alternative
- CMT poses no significant threat to the Lake and is a science-based 3-year test to learn
 - Adaptive management
- League will continue to focus on other complimentary projects, but...
- CMT is essential to a long-term solution
- League remains committed

Tahoe Keys Complex - East Channel Containment

Complete AIP removal, maintenance and monitoring with improved fragment control

- Legend**
- Bottom Barriers / Hand-pulling
 - Bubble Curtain
 - CollectThor
 - Pixie Drone
 - Suction / Hand-pulling
 - UV-C Treatment






Jesse Patterson
Chief Strategy Officer
jesse@keptahoeblue.org



- Urgency
- Epic collaboration & coordination
- Comprehensive monitoring and protections
- Encouraging results from the first year
- Next steps
- Complementing efforts
- Finding a solution is critical



Thank you
www.TahoeKeysWeeds.org

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