MINUTES OF THE ADJOURNED MEETING OF THE
BOARD OF DIRECTORS OF
VISTA IRRIGATION DISTRICT

March 15, 2023

An Adjourned Meeting of the Board of Directors of Vista Irrigation District was held on Wednesday, March 15, 2023, at the offices of the District, 1391 Engineer Street, Vista, California.

1. CALL TO ORDER

President MacKenzie called the meeting to order at 9:08 a.m.

2. ROLL CALL

Directors present: Miller, Vásquez, Kuchinsky, Sanchez, and MacKenzie.

Directors absent: None.

Staff present: Brett Hodgkiss, General Manager; Lisa Soto, Secretary of the Board; Don Smith, Director of Water Resources; and Shallako Goodrick, Director of Administration. Present via teleconference were Randy Whitmann, Director of Engineering; and Frank Wolinski, Director of Operations and Field Services. General Counsel Elizabeth Mitchell of Burke, Williams & Sorensen was also present.

Other attendees: Maia Singer, Stillwater Sciences; La Vonne Peck, La Jolla Band of Luiseño Indians; Stephanie Zehren, Special Counsel for the Rincon Band of Luiseño Indians; Don Lincoln, Special Counsel for the City of Escondido; and Holly Roberson, Special Counsel for Vista Irrigation District.

3. PLEDGE OF ALLEGIANCE

Director Kuchinsky led the Pledge of Allegiance.

4. APPROVAL OF AGENDA

23-03-29	***Upon motion by Director Vásquez, seconded by Director Kuchinsky and unanimously carried (5 ayes: Miller, Vásquez, Kuchinsky, Sanchez, and MacKenzie), the Board of Directors approved the agenda as presented.***

5. ORAL COMMUNICATIONS

No public comments were presented on items not appearing on the agenda.

6. CONSENT CALENDAR

23-03-30	***Upon motion by Director Miller, seconded by Director Vásquez and unanimously carried (5 ayes: Miller, Vásquez, Kuchinsky, Sanchez, and MacKenzie), the Board of Directors approved the Consent Calendar, including Resolution Nos. 23-07, 23-08, and 23-09, honoring the City of Vista, the Vista Chamber of Commerce, and approving disbursements, respectively.***

A. Resolutions recognizing the 60th Anniversary of the City of Vista and the 100th Anniversary of the Vista Chamber of Commerce

See staff report attached hereto.

The Board adopted Resolution Nos. 23-07 and 23-08 recognizing the 60th Anniversary of the City of Vista and the 100th Anniversary of the Vista Chamber of Commerce, respectively, by the following roll call vote:

AYES:	***Directors Vásquez, Kuchinsky, Sanchez, MacKenzie, and Miller***
NOES:	***None***
ABSTAIN:	***None***
ABSENT:	***None***

Resolution Nos. 23-07 and 23-08 are on file in the official Resolution book of the District.

B. Minutes of Board of Directors meeting on March 1, 2023

The minutes of March 1, 2023 were approved as presented.

C. Resolution ratifying check disbursements

RESOLUTION NO. 23-09

BE IT RESOLVED, that the Board of Directors of Vista Irrigation District does hereby approve checks numbered 71589 through 71688 drawn on Union Bank totaling $568,331.71.

FURTHER RESOLVED that the Board of Directors does hereby authorize the execution of the checks by the appropriate officers of the District.

PASSED AND ADOPTED unanimously by a roll call vote of the Board of Directors of Vista Irrigation District this 15th day of March 2023.

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7. LAKE HENSHAW TREATMENTS FOR HARMFUL ALGAL BLOOMS IN 2023

See staff report attached hereto.

Director of Water Resources Don Smith provided an overview of the item stating that at its January 4, 2023 meeting the Board approved an agreement with Stillwater Sciences for Phase II of the Harmful Algal Blooms (HABs) Management and Mitigation Plan for Lake Henshaw (lake). He said that staff and District consultants will present for consideration by the Board the technical team's recommendation for a treatment plan that will most likely facilitate releases from the lake this summer, and the costs associated with that plan. He introduced Maia Singer of Stillwater Sciences who, through the use of a PowerPoint Presentation (attached hereto as Exhibit A), presented the recommended lake treatment plan for HABs in 2023.

Ms. Singer discussed the treatment plan, which includes the use of peroxide-based and copper-based algaecides and lanthanum-modified clay. With regard to the copper-based algaecide, she noted that while the copper is applied to the lake as a water-soluble compound, the copper quickly interacts with other constituents in the lake water to form insoluble compounds which settle into the bottom sediments of the lake. Ms. Singer stated that the District's permit from the State prevents releases from the lake until the concentration of soluble copper in lake water falls below safe levels, usually within one to three weeks.

The Board discussed the cost of the treatment plan. General Manager Brett Hodgkiss stated that there is a funding committee researching grant opportunities. He said that staff, along with the City of Escondido (Escondido) and the San Luis Rey Indian Water Authority (SLRIWA), are looking for funding opportunities to offset the costs. President MacKenzie encouraged such collaboration, stating that she believes chances will be improved by applying for funding jointly. Mr. Smith said that most grants do not favor projects that are considered operations and maintenance, and the application of algaecides may not fare well in competing for funding.

Ms. Stephanie Zehren, Special Counsel for the Rincon Band of Luiseño Indians (Rincon Band) thanked the Board for supporting the efforts to develop a treatment plan to address HABs in Lake Henshaw. She stated that the SLRIWA met the previous week to review the proposed treatment schedule, and while it was not approved by the SLIWA Board, it was well received. Ms. Zehren advised that Tribal Water Quality Standards were recently adopted by the Rincon Band, which will make binding some of the California standards for cyanotoxins. These standards are currently in the approval process with the United States Environmental Protection Agency.

Mr. Don Lincoln, Special Counsel for Escondido, informed the Board that the Escondido City Council has been briefed on the matter and is in full support of the proposed treatment plan and schedule, as well as the adjustment of the budget amounts for Fiscal Years 2023 and 2024. He said that it is expected that the Escondido City Council will approve the appropriate changes to Escondido's budget to cover the treatment plan.

23-03-31	***Upon motion by Director Vásquez, seconded by Director Sanchez and unanimously carried (5 ayes: Miller, Vásquez, Kuchinsky, Sanchez, and MacKenzie), the Board of Directors authorized the General Manager to amend the as-needed services agreement with Aquatechnex LLC to add lanthanum-modified clay to the list of approved treatment chemicals and increase the not-to-exceed compensation under the agreement from $600,000 to $1,130,000 for Fiscal Year 2023.***

A brief break was taken from 10:50 a.m. until 11:00 a.m. Upon return from break, present in the Boardroom was Shallako Goodrick.

8. VISTA IRRIGATION DISTRICT 100TH ANNIVERSARY CELEBRATION UPDATE

See staff report attached hereto.

Director Sanchez, Chair of the 100th Anniversary ad hoc committee, stated that by adopting the draft resolution celebrating Vista Irrigation District's 100th Anniversary, the District would officially kick of its year of celebration and commemoration. He updated the Board regarding the plans that are underway, including seeking resolutions and proclamations from other agencies and organizations in recognition of the District's milestone. Director Sanchez reviewed outreach activities being planned, and the commemorative items that have been or will be ordered. He reported that the ad hoc committee selected the Bronze sponsorship level for the 2023 Association of California Water Agencies (ACWA) Spring Conference.

23-03-32	***Upon motion by Director Miller, seconded by Director Kuchinsky the Board of Directors adopted Resolution 23-10 celebrating the District's 100th Anniversary, by the following roll call vote:*** ***AYES: Directors Vásquez, Kuchinsky, Sanchez, Miller, and MacKenzie*** ***NOES: None*** ***ABSTAIN: None*** ***ABSENT: None*** ***A copy of Resolution 23-10 is on file in the official Resolution Book of the District.***

9. 2023 ASSOCIATION OF CALIFORNIA WATER AGENCIES JOINT POWERS INSURANCE AUTHORITY EXECUTIVE COMMITTEE ELECTION

See staff report attached hereto.

The Board discussed this matter briefly and took the following action.

23-03-33	***Upon motion by Director Miller, seconded by Director Kuchinsky the Board of Directors adopted Resolution 23-11 concurring in the nomination of James Pennock of the Vallecitos Water District to the ACWA Joint Powers Insurance Authority Executive Committee, by the following roll call vote:*** ***AYES: Directors Vásquez, Kuchinsky, Sanchez, Miller, and MacKenzie*** ***NOES: None*** ***ABSTAIN: None*** ***ABSENT: None*** ***A copy of Resolution 23-11 is on file in the official Resolution Book of the District.***

10. MATTERS PERTAINING TO THE ACTIVITIES OF THE SAN DIEGO COUNTY WATER AUTHORITY

See staff report attached hereto.

Director Miller reported that the San Diego County Water Authority (Water Authority) has published its draft budget for the next two years, which includes a potential rate increase of up to 14 percent. Director Miller reported that the Metropolitan Water District (MWD) is requesting information from all water agencies regarding shovel-ready or near-shovel-ready projects that can be added to a list of projects that either will create new water or will benefit the Colorado River to aid in its efforts to obtain funding from the Bureau of Reclamation to defray costs of new water initiatives for Southern California.

11. MEETINGS AND EVENTS

See staff report attached hereto.

Director Kuchinsky reported on his attendance at a meeting of the Vista Chamber of Commerce (Vista Chamber) Government Affairs Committee with the topic of discussion centering on the San Diego Association of Governments Draft North County Multimodal Corridor Plan. Director Kuchinsky noted that the District's legislative representatives are typically at these meetings and these contacts could potentially provide assistance in seeking funding for future District projects.

Director Kuchinsky reported on his attendance at a meeting of the Vista Historical Society Hall of Fame Nominating Committee. He said that a vote was taken on the slate of Hall of Fame nominees to be recommended for approval by the Historical Society Board of Directors. He noted that the Hall of Fame Annual Meeting and Induction luncheon would take place at the Shadowridge Country Club on Saturday, May 13, 2023 at 11:00 a.m.

Director Vásquez said that after the May 1, 2023 Board meeting he received notification regarding the Groundwater Awareness Week Kick-off and Interactive Workshop sponsored by the California Department of Water Resources, the Water Education Foundation, and the Groundwater Resources Association and others. He requested authorization (after the fact) for his virtual attendance on March 6, 2023.

Director Vásquez requested authorization to attend the Spring ACWA Conference in Monterey, May 9-11, 2023, and the ACWA Region 10 Event on June 29, 2023 at a location to be determined.

Director Miller reported on his attendance hosting a Water Authority/MWD sponsored tour of the State Water Project and Lake Oroville. Director Sanchez and President MacKenzie reported on their attendance on the tour and complimented Director Miller on a job well done hosting the tour.

President MacKenzie reported on her attendance at a meeting of the California Special Districts Association (CSDA) Legislative Committee in which proposed legislation was discussed including bills regarding drone cybersecurity and required financial training for board members, similar to the biennial ethics training requirement in California.

Director Kuchinsky reported on his attendance at the Vista Chamber's Heroes of Vista event where he received on behalf of the District an award for 50 years of membership with the Vista Chamber. He noted that the District also received a framed recognition from Assemblywoman Laurie Davies' office, and he suggested that the Board take a photo with the framed recognition and send the photo with a thank you note to the Vista Chamber and to Assemblywoman Davies' office.

Director Kuchinsky shared that the Vista Chamber is having a Meet the Leaders event on April 13, 2023, and the Vista Chamber's 100th Anniversary event will be on June 14, 2023. He said that he would provide the information to the Board Secretary for inclusion on the Schedule of Upcoming Meetings and Events staff report.

23-03-34	***Upon motion by Director Miller, seconded by Director Kuchinsky and unanimously carried (5 ayes: Miller, Vásquez, Kuchinsky, Sanchez, and MacKenzie), the Board of Directors authorized Director Vásquez to attend the Spring ACWA Conference in Monterey, May 9-11, 2023; the ACWA Region 10 Event on June 29; and the Groundwater Awareness Week Kick-off and Interactive workshop on March 6, 2023 (after the fact).***

12. ITEMS FOR FUTURE AGENDAS AND/OR PRESS RELEASES

See staff report attached hereto.

Mr. Hodgkiss noted that Andy Sells, Executive Director of ACWA Joint Powers Insurance Authority (JPIA) would be in attendance at the April 5, 2023 Board meeting to provide a general update on the activities ACWA JPIA and to discuss the refund process for 2023. It was noted that Adrienne Beatty, Assistant Executive Officer of ACWA JPIA, would also be in attendance.

13. COMMENTS BY DIRECTORS

Director Kuchinsky suggested adding a link to Director Sanchez's appearance on the Vista Chamber's "Velocity" podcast. Director Kuchinsky mentioned that Nancy Jones, Director of the Children's Garden at the Alta Vista Botanical Gardens (Gardens), made available a booth at the Earth Day event at the Gardens on April 22, 2023 for the District to conduct outreach activities, if desired.

Director Kuchinsky noted that the deadline to apply for ACWA JPIA Safety Awards is September 1, 2023, and he encouraged staff to apply.

Director Miller stated that he would be absent from the April 5, 2023 and July 5, 2023 Board meetings due to scheduling conflicts.

14. COMMENTS BY GENERAL COUNSEL

Ms. Mitchell presented a brief update on legislation including recent rulings regarding the California Environmental Quality Act and the Brown Act.

15. COMMENTS BY GENERAL MANAGER

Mr. Hodgkiss updated the Board regarding the annual inflationary adjustment to the District's water rates as detailed in the memo provided to the Board (attached hereto as Exhibit B). He noted that the rates were adjusted to reflect inflationary costs equal to the increase in the U.S. Department of Labor's Consumer Price Index for San Diego for the previous calendar year, which was 7.7 percent. He stated that messaging to District customers about the increase will begin in May 2023, and the increase will be effective July 1, 2023.

Mr. Hodgkiss informed the Board that he and Director of Engineering Randy Whitmann met with representatives from Encina Wastewater Authority (Encina) regarding a prospective direct/indirect potable reuse project for which they are seeking support. Mr. Hodgkiss indicated to the Encina representatives that it would not make sense for the District to participate as an individual taker of water from this project.

Mr. Hodgkiss reported that the water level of Lake Henshaw was currently at 16,528 acre feet which equates to about 30 percent full.

16. ADJOURNMENT

There being no further business to come before the Board, at 12:48 a.m., President MacKenzie adjourned the meeting.

Jo MacKenzie, President

ATTEST:

Lisa R. Soto, Secretary
Board of Directors
VISTA IRRIGATION DISTRICT

VISTA IRRIGATION DISTRICT **STAFF REPORT**	**Agenda Item: 6.A** **Board Meeting Date:** **March 15, 2023** **Prepared By:** **Lisa Soto** **Approved By:** **Brett Hodgkiss**

SUBJECT: RESOLUTIONS RECOGNIZING THE 60TH ANNIVERSARY OF THE CITY OF VISTA AND THE 100TH ANNIVERSARY OF THE VISTA CHAMBER OF COMMERCE

RECOMMENDATION: Adopt resolutions recognizing the 60th Anniversary of the City of Vista and the 100th Anniversary of the Vista Chamber of Commerce.

PRIOR BOARD ACTION: None.

FISCAL IMPACT: None.

SUMMARY: The Board of Directors of the Vista Irrigation District wishes to recognize the anniversaries of the City of Vista, celebrating its 60th Anniversary, and the Vista Chamber of Commerce (Vista Chamber), celebrating its 100th Anniversary.

DETAILED REPORT: The City of Vista, incorporated on January 28, 1963, celebrated its 60th Anniversary this year. Through the careful stewardship of its City Council and government, the City of Vista has grown from a population of over 19,000 in 1963 to a population of over 100,000 in 2023. Today, Vista is a thriving community that continues to grow and develop many new activities and attractions, adding dining, entertainment, shopping, parks and public amenities to a revitalized downtown area. The Vista Business Park is home to over 800 companies, with many global businesses relocating their headquarters, manufacturing, distribution and marketing facilities to the area, offering employment and supporting a robust local economy.

This year also marks the 100th Anniversary of the Vista Chamber. Originally formed on June 13, 1923, this diverse organization is focused on impacting the Vista community in powerful ways by advocating for businesses, planning for the community's future, giving back through non-profits, and partnering to make Vista a sought-after place to do business, raise families, shop, dine, and play. The Vista Chamber works with businesses, merchants, and industry to advance the civic, economic, industrial, professional, and cultural life of the City of Vista. The Vista Chamber works to promote Vista's business community through information resources and networking opportunities.

The District wishes to adopt resolutions recognizing the milestone anniversaries of the City of Vista and Vista Chamber.

ATTACHMENTS:

- Resolution No. 23-XX recognizing the 60th Anniversary of the City of Vista
- Resolution No. 23-XX recognizing the 100th Anniversary of the Vista Chamber of Commerce

RESOLUTION NO. 23-XX

RESOLUTION OF THE BOARD OF DIRECTORS OF
VISTA IRRIGATION DISTRICT
HONORING THE CITY OF VISTA
ON ITS 60TH ANNIVERSARY

WHEREAS, this year marks the 60th Anniversary of the City of Vista; and

WHEREAS, Vista, which was originally part of Rancho Buena Vista and Rancho Guajome Spanish land grants, was founded on October 9, 1882 with the establishment of an United States Post office, was incorporated on January 28, 1963, and became a charter city on June 13, 2007; and

WHEREAS, through the careful stewardship of its City Council and government, the City of Vista has grown from a population of over 19,000 in 1963 to a population of over 100,000 in 2023; and

WHEREAS, today, Vista is a thriving community that continues to grow and develop many new activities and attractions, adding dining, entertainment, shopping, parks and public amenities to a revitalized downtown area; and

WHEREAS, the Vista Business Park is home to over 800 companies, with many global businesses relocating their headquarters, manufacturing, distribution and marketing facilities to the area, offering employment and supporting a robust local economy, and

WHEREAS, the City of Vista is dedicated to maintaining a safe environment within the community by providing effective governance and the efficient and professional delivery of public services, and in the process of providing representative local government, the City of Vista identifies and anticipates concerns, problems and opportunities, and takes actions to address them; and

WHEREAS, the Board of Directors of the Vista Irrigation District desires to mark the occasion of this 60th Anniversary and join in the celebrations and special events in honor of the City of Vista history, culture, residents and community in being one of the "Best Places to Live."

NOW, THEREFORE, BE IT RESOLVED that the Board of Directors of the Vista Irrigation District recognizes and congratulates the City of Vista on its 60th Anniversary.

PASSED AND ADOPTED by the following roll call vote of the Board of Directors of Vista Irrigation District this 15th day of March 2023.

AYES:
NOES:
ABSTAIN:
ABSENT:

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Jo MacKenzie, President

ATTEST:

____
Lisa Soto, Secretary
Board of Directors
VISTA IRRIGATION DISTRICT

RESOLUTION NO. 23-XX

RESOLUTION OF THE BOARD OF DIRECTORS OF
VISTA IRRIGATION DISTRICT
HONORING THE VISTA CHAMBER OF COMMERCE
ON ITS 100^{TH} ANNIVERSARY

WHEREAS, this year marks the 100th Anniversary of the Vista Chamber of Commerce; and

WHEREAS, the Vista Chamber of Commerce was launched on June 6, 1923 with 18 representatives/citizens present, and all present agreed to become members; the first Vista Chamber of Commerce Board meeting was held on June 13, 1923; and

WHEREAS, on October 11, 1924, the Vista Chamber of Commerce hosted an event to celebrate the successful election to establish the Vista Irrigation District; and

WHEREAS, in the early 1960's, the Vista Chamber of Commerce established a committee to begin a study of the area's facilities with the idea of the community becoming a city; the City of Vista was incorporated on January 28, 1963; and

WHEREAS, on September 24, 1971, David Brinkley of "Brinkley's Journal", a nationally televised NBC program, joins the Vista Chamber of Commerce Board of Directors and says on air that "Vista is one of the best places in the United States to live"; and

WHEREAS, in 2009, the Vista Chamber of Commerce launched the Vista Strawberry Festival in celebration of Vista's agricultural roots, which has grown to one of the largest one-day festivals in the State of California; and

WHEREAS, the Vista Chamber of Commerce has represented our community by advocating for businesses, planning for our community's future, giving back through our nonprofits, and partnering to make Vista a sought-after place to do business, raise families, shop, dine, play; and

WHEREAS, the Vista Chamber of Commerce works with businesses, merchants, and industry to advance the civic, economic, industrial, professional, and cultural life of the City of Vista.

NOW, THEREFORE, BE IT RESOLVED that the Board of Directors of the Vista Irrigation District recognize the contributions of the Vista Chamber of Commerce on its 100^{th} Anniversary toward improving Vista's quality of life and promoting local businesses within the community.

PASSED AND ADOPTED by the following roll call vote of the Board of Directors of Vista Irrigation District this 15th day of March 2023.

AYES:
NOES:
ABSTAIN:
ABSENT:

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Jo MacKenzie, President

ATTEST:

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Lisa Soto, Secretary
Board of Directors
VISTA IRRIGATION DISTRICT

Cash Disbursement Report

Payment Dates 2/16/2023 - 3/1/2023

Payment Number	Payment Date	Vendor	Description	Amount
71589	02/22/2023	Refund Check 71589	Customer Refund	294.69
71590	02/22/2023	Airgas USA LLC	Welding Supplies	1,124.02
	02/22/2023		Trimix Gas, Wire Wheel, Deburring Pads	592.16
71591	02/22/2023	Amazon Capital Services	Dual Monitor Mount	51.47
	02/22/2023		Flag - Henshaw Dam	126.01
71592	02/22/2023	Asbury Environmental Services	Disposal of Non-Metal Used Filters	85.00
	02/22/2023		Disposal of Used Metal Filters	55.00
71593	02/22/2023	AT&T	3680/CALNET 01/13/23 - 02/12/23 Phones	437.71
	02/22/2023		0230/CALNET 01/13/23 - 02/12/23 Teleconference	20.35
71594	02/22/2023	BHA Inc	Survey of Henshaw Dam 01/2023	4,167.50
71595	02/22/2023	CAPPO	Membership Dues	140.00
71596	02/22/2023	CDW Government Inc	Acrobat Pro DC (2)	383.02
	02/22/2023		InDesign CC (2)	882.00
71597	02/22/2023	Cecilia's Safety Service Inc	Traffic Control Plan - Foothill Dr	35.00
	02/22/2023		Traffic Control - La Mirada Dr	1,520.00
	02/22/2023		Traffic Control - Huff St	2,992.50
	02/22/2023		Traffic Control - Alta Calle	855.00
	02/22/2023		Traffic Control - Buena Vista Dr/Mar Vista Dr	5,605.00
	02/22/2023		Traffic Control - E Vista Way/Vale Terrace Dr	1,282.50
	02/22/2023		Traffic Control - Phillips St	1,520.00
	02/22/2023		Traffic Control - Primrose Ave	1,567.50
	02/22/2023		Traffic Control - Buena Vista Dr/Mar Vista Dr	1,567.50
71598	02/22/2023	City Of Escondido	Bear Valley Reconciliation 10/2022 - 12/2022	7,414.30
	02/22/2023		Escondido Canal Operating Cost 10/2022 - 12/2022	121,226.81
	02/22/2023		Escondido Water Treatment Plant 11/2022 -12/2022	177,790.00
71599	02/22/2023	CleanCapital HC4 Borrower LLC	Solar Energy 01/2023	3,300.16
71600	02/22/2023	Core & Main	Lid 10" Slotted Valve (VID) (20)	1,691.53
	02/22/2023		Lid 8" Slotted Valve (VID) (700)	29,999.32
71601	02/22/2023	Cosco Fire Protection, Inc	Quarterly Fire Sprinkler & Annual Fire Extinguisher Inspections	2,095.00
71602	02/22/2023	Streamline	Website Hosting, Maintenance & Support 02/2023	300.00
71603	02/22/2023	Direct Energy	Electric 01/2023 - VID	2,211.99
71604	02/22/2023	Evoqua Water Technologies LLC	DI Bottle Services 02/01/22 - 04/30/23	389.77
71605	02/22/2023	FedEx	Express Shipping	20.94
71606	02/22/2023	Ferguson Waterworks	Ell 6" DI POxFL 22.5 Degree (1)	159.13

Payment Number	Payment Date	Vendor	Description	Amount
	02/22/2023		Wire 10 Copper (1500)	568.31
	02/22/2023		Lead Free Brass Parts	740.39
	02/22/2023		Brass Parts	7.60
	02/22/2023		Check Valve (1)	1,080.34
	02/22/2023		Meter 1" Gasket / 1/8" Thick (500)	189.44
	02/22/2023		Nipple 1" x 2" Brass (5)	24.79
	02/22/2023		Sigma 10" PWM-C10 - Pipe Restrainer w T-Bolts (5)	548.83
	02/22/2023		5/8" x 2.5" Brass Bolt (50)	324.75
	02/22/2023		Sigma 4" PWM-C4 - Pipe Restrainer w T-Bolts (4)	127.74
	02/22/2023		Threaded Weld Coupling 1" / Black (10)	44.38
	02/22/2023		Ell 1" / 90° Brass (10)	74.80
	02/22/2023		Nipple 1" x 6" Brass (5)	62.89
	02/22/2023		Nipple 1" x 4" Brass (5)	42.65
	02/22/2023		Nipple 1" x 2.5" Brass (5)	28.47
	02/22/2023		Coupling 1" PVC / S x S / Sch 40 (10)	8.44
	02/22/2023		Adapter 1" PVC / Male / Sch 40 (10)	9.31
	02/22/2023		Nipple 0.75" x CL Brass (5)	13.64
	02/22/2023		Slip Cap 1" Copper (5)	13.69
	02/22/2023		Ell 1" PVC / 45° / S x S / Sch 40 (10)	16.24
	02/22/2023		Ell 0.75" / 90° / C x C / Copper (10)	19.27
	02/22/2023		Calder Coupling / 4" Clay x 4" Clay (3)	21.47
	02/22/2023		5/8" Brass Nuts (50)	121.78
	02/22/2023		Threaded Weld Coupling 2" / Black (2)	23.84
	02/22/2023		Aquaphalt (36)	1,962.14
71607	02/22/2023	Fleet Pride	Zip Ties, Registration Packets	48.20
71608	02/22/2023	Grainger	Sump Pump	278.05
	02/22/2023		SCADA UPS (2) - Henshaw	514.99
71609	02/22/2023	Hawthorne Machinery Co	Quick Coupler Hydraulic Lines	735.43
	02/22/2023		Stabilizer Pads - B23	712.46
71610	02/22/2023	Hi-Line Inc	Supplies for Garage	88.50
71611	02/22/2023	Joe's Paving	Patch Paving - Santa Fe Drive	5,894.00
	02/22/2023		Patch Paving - various locations	3,390.70
71612	02/22/2023	Jan-Pro of San Diego	Janitorial Service 12/2022	4,497.00
71613	02/22/2023	Lanair Technology Group	Breach Prevention Platform 100 users 02/2023	180.00
71614	02/22/2023	Lawson Products	Drill Bit, Mini Fuse Holder	119.16
71615	02/22/2023	Leon Perrault Trucking & Materials	Trucking & Material 01/2023	20,571.00
71616	02/22/2023	Makelele Systems Landscape & Maintenance, Inc	Landscape Service 01/2023	1,650.00
71617	02/22/2023	Mallory Safety and Supply, LLC	Vest Lime Hi-Viz MED (6)	134.12
	02/22/2023		Vest Lime Hi-Viz LG (7)	156.48

Payment Number	Payment Date	Vendor	Description	Amount
	02/22/2023		Jacket Rain XL (2)	216.39
71618	02/22/2023	McMaster-Carr Supply Company	Stainless Steel Hardware	409.74
71619	02/22/2023	MRC, Smart Technology Solutions	Managed Print Services	9.35
71620	02/22/2023	NAPA Auto Parts	Regulator for Hose Reel	75.22
	02/22/2023		Filters (4)	27.82
71621	02/22/2023	North County Auto Parts	Rear Brake Parts - Truck 20	437.50
	02/22/2023		Chemicals, Wiper Blades	84.59
71622	02/22/2023	North County Pool Center Inc	Chlorine - A Reservoir	41.12
71623	02/22/2023	Ramco Petroleum	Fuel 01/2023	3,012.48
71624	02/22/2023	Red Wing Shoe Store	Footwear Program (2)	360.00
71625	02/22/2023	Shallako Goodrick	CSMFO Conference	1,042.03
	02/22/2023		Boardroom Microphones (13)	4,021.41
	02/22/2023		Monthly Licenses to One Drive 12/2022 (3)	15.00
	02/22/2023		Monthly Licenses to One Drive 11/2022 (3)	15.00
71626	02/22/2023	Shred-it	Monthly Shredding Service	174.73
71627	02/22/2023	Bend Genetics, LLC	HABs Lab Analysis	2,479.00
71628	02/22/2023	Midas Service Experts	Tires (4) - Truck 47	1,126.68
71629	02/22/2023	The San Diego Union-Tribune LLC	Bid Advertisement- Deodar Reservoir Rehabilitation	995.20
71630	02/22/2023	TS Industrial Supply	Construction Marking Paint White #255 (12)	55.73
	02/22/2023		2" x 100ft Black Pipe Wrap Tape (18)	170.49
	02/22/2023		Wire Brush / 7 3/4" / Plastic Handle (10)	26.63
	02/22/2023		Marking Feather - Blue (25 per bundle) (4)	18.19
	02/22/2023		Maxi Flex Gloves / XL / Yellow Cuff (12)	66.77
	02/22/2023		Smart Fit Earplug / #SMF 30 (100 per box) (1)	116.91
	02/22/2023		Pyramex Safety Glasses Goliath-Blk Frm/Smk Lens(12)	113.66
	02/22/2023		Max earplug / Uncorded /#Max-1 (200 per box) (1)	38.97
	02/22/2023		Striping Paint White #710 (12)	99.37
	02/22/2023		Pyramex Goliath V2G / Amber Lens / Blk Frm (12)	228.62
	02/22/2023		Construction Marking Paint Blue #254 (12)	55.73
	02/22/2023		Maxi Flex Gloves / Large / Maroon Cuff (12)	66.77
	02/22/2023		Striping Paint Blue #750 (12)	99.37
	02/22/2023		Striping Paint Asphalt Black #770 (12)	99.37
	02/22/2023		Nemesis Safety Glasses / Smk Lens / Blk Frm (12)	73.00
	02/22/2023		Sea 1" Teflon Tape (20)	28.15
	02/22/2023		Regulators (2)	75.23
71631	02/22/2023	Tyler Technologies Inc	Maintenance 03/2023 - 06/2023	222.85
71632	02/22/2023	Underground Service Alert of Southern California	New DigAlert New Tickets 01/2023 (220)	393.25
	02/22/2023		Safe Evacuation Board Fees	147.15
71633	02/22/2023	White Cap Construction Supply	Premix 2 Stroke Fuel (25)	565.34

Payment Number	Payment Date	Vendor	Description	Amount
71634	02/22/2023	Zuza LLC	Daily Vehicle Inspection Forms	621.36
71635 - 71639	03/01/2023	Refund Checks 71635 - 71639	Customer Refunds	1,335.94
71640	03/01/2023	Refund Checks 71640	Customer Refund	115.47
71641	03/01/2023	A-1 Irrigation, Inc	Rope	137.38
71642	03/01/2023	Amazon Capital Services	Spare Monitors (2)	277.86
	03/01/2023		Binoculars - Warner Ranch	94.12
	03/01/2023		Torque Wrench - Truck 85	197.18
	03/01/2023		O-Ring Grease	50.88
	03/01/2023		Binoculars - Warner Ranch	(86.13)
	03/01/2023		Portable Water Supply Tank - Truck 21	115.93
71643	03/01/2023	TPC Training	Arc Flash Electrical Safety NFPA Training (1)	1,295.00
71644	03/01/2023	American Water Works Association	AWWA Renewal	1,725.00
71645	03/01/2023	Ando Pilve	Boardroom Audio Revamp	1,500.00
71646	03/01/2023	Asphalt Zipper Co	Cutting Bits - AZ2	5,195.19
71647	03/01/2023	AT&T	Voice & Data Service	1,157.19
71648	03/01/2023	Bryan and the Bee's	Live Bee Removal (1)	175.00
71649	03/01/2023	Burke, Williams & Sorensen, LLP	Legal 01/2023	4,156.00
71650	03/01/2023	Cecilia's Safety Service Inc	Traffic Control - E Vista Way/Washington St	2,850.00
	03/01/2023		Traffic Control - Crescent Dr	617.50
	03/01/2023		Traffic Control - Buena Vista Dr/Mar Vista Dr	3,040.00
71651	03/01/2023	Complete Office of California, Inc	Office Supplies	116.40
71652	03/01/2023	Consor North America, Inc	Deodar Reservoir Rehabilitation 12/2022	14,578.09
71653	03/01/2023	CoreLogic Solutions Inc	Real Online Services 01/2023	300.00
71654	03/01/2023	Cosco Fire Protection, Inc	Fire Extinguisher Inspection	645.00
71655	03/01/2023	Dell Awards	Name Badge - P Kuchinsky	17.85
71656	03/01/2023	Dennis Kessler	Reimburse - Damage to Vehicle	315.00
71657	03/01/2023	Diamond Environmental Services	Portable Restroom Service	137.56
	03/01/2023		Portable Restroom Service	85.69
71658	03/01/2023	Ferguson Waterworks	Threaded Weld Coupling 2" / Black (3)	35.75
	03/01/2023		Service Saddle 4x1 PVC (2)	299.42
	03/01/2023		Flange 6" SOW 8-hole (10)	239.99
	03/01/2023		Ell 2" Brass Street 90 Degree (5)	160.53
	03/01/2023		Flange 8" DI Blind (1)	154.80
	03/01/2023		Nut Bolt Gasket Kit 4" (4" gasket) (8)	109.55
	03/01/2023		Flange 4" SOW (5)	76.26
	03/01/2023		Gate Valve 4" FL R/W (1)	715.75
	03/01/2023		Sleeve 8"x12" Galvanized Top Sections (100)	1,185.34
	03/01/2023		Tee 2" Brass (2)	60.84
	03/01/2023		Coupling 1" CTSxCTS (1)	26.36

Payment Number	Payment Date	Vendor	Description	Amount
	03/01/2023		Nut Bolt Gasket Kit 6"-8"(6" gskt) 3/4 x 3 1/4 (25)	520.95
	03/01/2023		Sleeve 10"x12" Galvanized Top Sections (32)	502.28
	03/01/2023		Corp Stop 1" MIP X Flare (7)	545.13
	03/01/2023		Air Vent 2" ARI Combination Valve (9)	3,767.10
	03/01/2023		Fire Hydrant LB400 Check Valve (4)	8,248.65
	03/01/2023		Clow 2 1/2" O-Ring Gasket / Part T1630275 (10)	47.31
	03/01/2023		Clow 4" O-Ring Gasket / Part T1630276 (15)	230.90
71659	03/01/2023	Grainger	Intrusion Switches (4)	573.55
	03/01/2023		Safety Glasses	106.03
	03/01/2023		Wire Labels	187.54
71660	03/01/2023	Hach Company	Chlorine Buffers	667.07
71661	03/01/2023	Hawthorne Machinery Co	Broom Attachment Brushes, Skirt	1,053.64
	03/01/2023		Cutting Edge & Hardware - B16	291.99
	03/01/2023		Backhoe Pilot Control Tower Parts - B21	181.92
	03/01/2023		Service Call For DEF Codes - B24	468.51
71662	03/01/2023	Joe's Paving	Patch Paving - various locations	10,426.86
	03/01/2023		Patch Paving - various locations	12,074.70
71663	03/01/2023	Ken Grody Ford Carlsbad	Hub/Bearing Assemblies (2) - Truck 61	1,057.02
	03/01/2023		Electrical Harness Pigtail - Truck 61	37.32
	03/01/2023		ABS Repair Harness - Truck 61	37.32
71664	03/01/2023	Lightning Messenger Express	Messenger Service 02/10/23	88.00
71665	03/01/2023	McMaster-Carr Supply Company	Bolts (10)	113.08
	03/01/2023		Hardware - Pechstein Beam Repair Project	377.01
	03/01/2023		Hardware - Pechstein Beam Repair Project	2,027.58
	03/01/2023		Hardware - Pechstein Beam Repair Project	2,502.16
71666	03/01/2023	MRC, Smart Technology Solutions	Managed Print Services	529.34
71667	03/01/2023	Mutual of Omaha	LTD/STD/Life Insurance 03/2023	6,754.21
71668	03/01/2023	NAPA Auto Parts	Filters (2)	26.69
71669	03/01/2023	North County Auto Parts	Shocks (2) - Truck 61	180.52
	03/01/2023		Shocks (2) - Truck 61	180.52
	03/01/2023		Fuel Cap - Truck 1	13.13
	03/01/2023		Gas Cap - Truck 79	18.34
	03/01/2023		Oil & Wiper Blade	127.44
	03/01/2023		AC Blower Motor Part - Truck 1	24.43
71670	03/01/2023	North County Industrial Park	Association Fees 03/2023	936.60
71671	03/01/2023	North County Powder Coating Inc	Re-Finish Steel Entry Platform - MD Reservoir	522.93
71672	03/01/2023	One Source Distributors	Charging Stations (2)	680.48
71673	03/01/2023	Pacific Pipeline Supply	Couplers (5)	128.67
	03/01/2023		Air Vent Repair Kits (30)	1,143.51

Payment Number	Payment Date	Vendor	Description	Amount
	03/01/2023		Curb Stops (2)	461.51
	03/01/2023		Weld Reducer (1)	174.91
71674	03/01/2023	Pacific Safety Center	CPR/First Aid/AED Training (3)	195.00
71675	03/01/2023	San Diego Door Controls, Inc	Door Access Control Pad Repair	1,012.22
71676	03/01/2023	San Diego Gas & Electric	Electric 01/2023 - Cathodic Protection & TD	352.00
	03/01/2023		Electric 01/2023 - Reservoirs	156.02
	03/01/2023		Electric 01/2023 - Pump Stations	14,606.24
	03/01/2023		Electric 01/2023 - Plants	141.19
71677	03/01/2023	San Diego Water Board	Lanthanum Modified Clay NPDES Permit R9-2021-0056	3,274.00
71678	03/01/2023	SiteOne Landscape Supply, LLC	Ultraseal PTFE Thread Sealant, HP(RH-UST10-HP)(24)	369.61
	03/01/2023		Weld On 725 Wet Dry PVC Glue (12)	224.71
	03/01/2023		Primer Christy's Purple (12)	200.92
71679	03/01/2023	Steve Tester	Reimburse - Prescription Safety Glasses	200.00
71680	03/01/2023	Sunbelt Rentals	Scaffolding Rental - MD Reservoir	98.80
71681	03/01/2023	Tifco Industries	Shop Chemicals	257.01
71682	03/01/2023	Trench Shoring Company	Trench Shoring/Pump/Reservoir Assembly -Trk 65	1,440.28
71683	03/01/2023	TS Industrial Supply	Towel Wypall X80 (8)	394.90
	03/01/2023		Mirror 3.25" Diameter Telescopic (1)	25.71
	03/01/2023		Abrasive Mesh Roll 120G (3)	69.82
	03/01/2023		Goggles WR40 Cup (3)	90.93
	03/01/2023		Marking Paint Roller (2)	83.24
	03/01/2023		Gloves Welding LG (4)	105.00
	03/01/2023		Hat Hard Full Brim with Ratchet Head Gear (5)	151.55
	03/01/2023		Wire Wheel 4" (5)	100.13
71684	03/01/2023	UniFirst Corporation	Uniform Service	249.45
	03/01/2023		Uniform Service	1,540.58
	03/01/2023		Uniform Service	246.17
71685	03/01/2023	Verizon Wireless	Air Cards 01/13/23 - 02/12/23	152.04
	03/01/2023		Cell Phones 01/16/23 - 02/15/23	2,083.26
71686	03/01/2023	Vista Printing	Business Cards & Letterhead	1,395.58
71687	03/01/2023	Vulcan Materials Company and Affiliates	Cold MIx	2,479.19
71688	03/01/2023	YSI, Inc	Handheld Multi-parameter Sonde with GPS	809.97
			Grand Total:	**568,331.71**

VISTA IRRIGATION DISTRICT	Agenda Item: 7
STAFF REPORT	**Board Meeting Date:** March 15, 2023 **Prepared By:** Don Smith **Approved By:** Brett Hodgkiss

SUBJECT: LAKE HENSHAW TREATMENTS FOR HARMFUL ALGAL BLOOMS IN 2023

RECOMMENDATIONS:

1. Receive recommendations for the treatment of harmful algal blooms in Lake Henshaw for 2023; and
2. Authorize the General Manager to amend the as-needed services agreement with Aquatechnex LLC to add lanthanum-modified clay to the list of approved treatment chemicals and increase the not-to-exceed compensation under the agreement from $600,000 to $1,130,000 for Fiscal Year 2023.

PRIOR BOARD ACTION:

02/03/21 The Board authorized the execution of a professional services agreement with Stillwater Sciences to provide services related to the management and mitigation of harmful algal blooms (HABs) in Lake Henshaw and Lake Wohlford in an amount not to exceed $440,000.

04/06/22 The Board authorized the execution of an as-needed services agreement with Aquatechnex LLC (Aquatechnex) to provide services related to the treatment of HABs in Lake Henshaw in an amount not to exceed $600,000.

08/09/22 The Board received the findings and recommendations presented in the Lake Henshaw and Lake Wohlford Harmful Algal Blooms Management and Mitigation Plan (HABs Plan).

01/04/23 The Board authorized the execution of a professional services agreement with Stillwater Sciences for Phase II of the HABs Plan in an amount not to exceed $275,000.

FISCAL IMPACT: If authorized, the not-to-exceed compensation to Aquatechnex in Fiscal Year (FY) 2023 will increase by $530,000 (from $600,000) to $1,130,000. This cost will be shared equally by the District and the City of Escondido (Escondido), resulting in a net cost increase of $265,000 to the District. This would an unbudgeted expense.

To implement the recommended treatment approach, the District will need to budget $923,000 for lanthanum-modified clay and algaecide treatments in Lake Henshaw in FY 2024.

SUMMARY: In order to strike a reasonable balance between treatment effectiveness and the concerns expressed by La Jolla and Rincon Bands of Mission Indians over the use of copper-based algaecides in Lake Henshaw, staff recommends the treatment approach outlined below. The recommended treatment approach has been developed based on the District's experience using both peroxide- and copper-based algaecides in 2022, recommendations of the District's consultants and lake-treatment professionals, and discussions with Escondido staff. It is important to note that the recommended treatment approach will be discussed in consultation among the Parties to the San Luis Rey Indian Water Rights Implementing Agreement ("Implementing Agreement" and "Settlement Parties", which include the District; Escondido; the La Jolla, Rincon, San Pasqual, Pauma, and Pala Bands of Mission Indians; and the San Luis Rey River Indian Water Authority, or SLRIWA) scheduled for Monday, March 20, 2023.

Lake Treatments Prior to the Memorial Day Weekend (May 25 – 29, 2023)

- Two light-dose peroxide-based algaecide treatments (ideally spaced 7 to 10 days apart).
- One medium-dose copper-based algaecide treatment within 7 to 10 days of the last peroxide-based treatment.
- One treatment with lanthanum-modified clay within a couple days of completing the copper-based treatment and as soon as possible after receiving notice-of-applicability under the Regional Water Board's General National Pollutant Discharge Elimination System (NPDES) Permit. The goal of the lanthanum-modified clay treatment would be to strip free reactive phosphorus from the Lake Henshaw water column immediately after phosphorus is released from algae cells affected by the medium-dose copper-based treatment (a relatively light dose over the entire lake).

Remaining Lake Treatments in Fiscal Year 2023

- One or two light peroxide-based algaecide treatments as informed by monitoring of the Lake Henshaw cyanobacteria community. These would be scheduled to facilitate weekend releases, especially over the Father's Day (June 16 – 19, 2023) and Independence Day (June 30 – July 4, 2023) weekends.

Fiscal Year 2024 Lake Treatments Prior to Labor Day Weekend (August 31 – September 4, 2023)

- One or two light peroxide-based algaecide treatments as informed by monitoring of the Lake Henshaw cyanobacteria community. These would be scheduled to facilitate weekend releases.
- One medium-dose copper-based algaecide treatment in late July, unless cyanobacterial response to peroxide-based treatments dictates an early use.
- One treatment with lanthanum-modified clay within a couple days of completing the copper-based treatment. The goal of the lanthanum-modified clay treatment would be to sequester about 13% of the biologically available phosphorus within the deepest 400 acres of lake bottom sediments (sediment sealing) – a medium/heavy dose over 30-40% of the lake surface area.

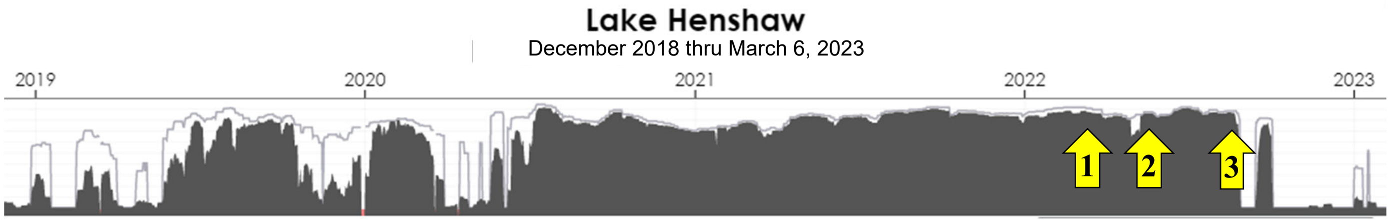
DETAILED REPORT: The goal of the treatment approach in 2023 is to ensure the timely deliveries of Local Water to Lake Wohlford and the Rincon Band of Indians are not interrupted by unacceptable levels of cyanotoxins. In particular, releases between the Memorial Day weekend (beginning Thursday May 25, 2023) through the Labor Day weekend (ending Monday, September 4, 2023) are important to support the recreational activities of the La Jolla Indian Campground. During this period, weekend flows through the campground are of primary importance with the holiday weekends surrounding Memorial Day, Father's Day (June 16), Independence Day (July 4) and Labor Day being of particular interest. Given the amount of water available for delivery in Lake Henshaw this year (in excess of 14,000 acre-feet at the writing of this report), deliveries may commence as soon as the San Pasqual Undergrounding Project is in a condition to support deliveries through the Escondido Canal (expected mid- to late-April) and proceed well past Labor Day (only limited by the quantity of Local Water that can be adequately treated at the Escondido-Vista Water Treatment Plant).

Other considerations include:

- The Indian Bands' environmental, traditional and cultural concerns over the use of copper-based algaecides in Lake Henshaw, as expressed in David Caron's December 12, 2022 letter to the SLRIWA.
- The cost of lake treatment options, which must be shared by the District and Escondido. These costs arise at a time of unusual financial stress for both agencies.
- The scientific assessment of the effectiveness of various treatment strategies.

In order to optimize the likelihood of timely Local Water delivery in light of these considerations, several strategies are incorporated into the recommended treatment approach.

Balanced Use of Peroxide- and Copper-based Algaecides. Until long-term management strategies are implemented, there is no viable alternative to the use of algaecides to manage HABs in Lake Henshaw. The scientific literature, supported by the District's experience in 2022, makes a compelling case for the greater effectiveness of copper-based algaecides in reducing cyanobacteria abundance and cyanotoxin concentrations as compared to peroxide-based algaecides. This effectiveness is documented in the Stillwater Sciences Technical Memorandum dated December 2, 2022; it is also graphically illustrated by the historical trend of "Modified Cyano Index" remotely sensed at Lake Henshaw as published by the San Francisco Estuary Institute. This index, designed to correlate to the abundance of cyanobacteria in a water body, shows a consistently high value from mid-2020 through the first use of copper-based algaecide in August 2022.



Historical trend of "Modified Cyano Index" remotely sensed at Lake Henshaw as published by the San Francisco Estuary Institute (https://fhab.sfei.org/?w=119&d=20230306). Numbered arrows indicate approximate dates of: 1) first treatment with peroxide-base algaecide (March 14 & 15, 2022); 2) second treatment with peroxide-based algaecide (May 16-19, 2022); 3) first treatment with copper-based algaecide (August 17 & 18, 2022).

It has been proposed that frequent low-dose treatments with peroxide-based algaecides may selectively reduce the abundance of cyanobacteria as compared to other algae, including diatoms and green algae, in a lake setting; however, there is little scientific documentation of this phenomenon or its effectiveness at limiting cyanotoxin production and no experience in lakes of a size or with cyanobacteria level comparable to Lake Henshaw. As a practical matter, the cost of a "peroxide-only" algaecide strategy (estimated at about $130,000 every 7 to 10 days) make the testing of this approach financially untenable without outside assistance. If this proposed approach should prove unsuccessful, a significant quantity of Local Water stored in Lake Henshaw this year would suffer evaporative loss, would not be delivered to offset more expensive imported water, would not be available to support the operations of the La Jolla Indian Campground, and may not be available for timely delivery to the Rincon Band of Indians.

As proposed, the initial use of peroxide-based algaecide is intended to keep the overall load of cyanobacteria at a low level until a medium-dose copper-based algaecide is used. It may also reduce the overall load of phytoplankton, including diatoms and green algae, in the lake this spring. In line with the recommendations of Stillwater's December 2022 Technical Memorandum, this strategy will minimize the likelihood of fish mortality due to oxygen depletion in conjunction with the subsequent use of a copper-based algaecide. Other recommendations of that Technical Memorandum will also be employed to further reduce the likelihood of fish mortality associated with the use of a copper-based algaecide.

The District will continue to monitor the level of copper in the bottom sediments of Lake Henshaw and will continue to ensure that water is not released from Lake Henshaw until dissolved copper concentrations meet State permit standards after using a copper-based algaecide. The compelling need to ensure timely releases from Lake Henshaw, the well-supported effectiveness of copper-based algaecide, and the District's careful attention to avoid adverse consequences from the use of copper will be discussed in upcoming consultation with the Indian Bands.

Proactive Treatments. Another strategy employed in the recommended treatment approach is to apply lake treatments proactively, before cyanotoxin levels reach a level of concern. This approach, supported by the Indian Bands in their letters and consultation sessions, is recommended because the process of testing lake waters, scheduling treatment, and monitoring water quality prior to resuming lake releases takes time that may not occur quickly enough to prevent unacceptable cyanotoxin levels or facilitate releases that target specific dates.

Limiting Phosphorus. A significant finding of the HABs Plan is that cyanobacterial growth in Lake Henshaw is limited by the availability of phosphorus, a nutrient essential for phytoplankton growth. While some phosphorus may be present at any given time within the water column, the release of phosphorus from accumulated organic matter in lake bottom sediments at times when lake bottom waters have low dissolved oxygen is a significant driver of cyanobacterial blooms. A key strategy recommended in the HABs Plan is the use of lanthanum-modified clay to bind phosphorus in the bottom sediments of the lake in a way that makes the phosphorus permanently unavailable to support phytoplankton growth.

The use of lanthanum-modified clay in the treatment of lake waters is regulated by the San Diego Regional Water Quality Control Board under the auspices of a General NPDES Permit. The District applied for that permit on February 28, 2023 and expects to receive a Notice of Applicability allowing treatment to commence by May 1, 2023.

The recommended treatment approach incorporates two treatments with lanthanum-modified clay in Lake Henshaw in 2023. The first, targeted at removing free reactive phosphorus from water column, is scheduled for April or May, as soon as coverage under the General NPDES permit is established. It is recommended that treatment with a copper-based algaecide immediately precede the lanthanum treatment, so that any phosphorus released from phytoplankton killed by the algaecide can be removed by the lanthanum-modified clay before it has an opportunity to support subsequent phytoplankton growth.

A second, heavier dose of lanthanum-modified clay is scheduled to take place in August, when water temperatures are more likely to create lake stratification. This condition is often associated with low-oxygen bottom waters, creating the chemical conditions conducive to the release of phosphorus from organic matter in lake bottom sediments. The goal of this second lanthanum-modified clay treatment is to bind a portion (calculated at about 13%) of the phosphorus available in the deepest 400 acres of lake bottom (which strategy is sometimes referred to as "sediment sealing"). It is recommended that this "sediment sealing" dose be repeated on an annual basis for several years. While more or less lanthanum-modified clay could be used for this second treatment, targeting 13% of the bioavailable phosphorus is a suitable target because 1) not all the bioavailable phosphorus in bottom sediments is actually released in any one year; 2) it is physically impractical to apply the quantity of lanthanum-modified clay necessary to bind all of the bioavailable phosphorus in bottom sediments in any one year; and 3) the cost of doing so would be excessive.

Increased Monitoring. The District is monitoring for more lake water quality parameters on a more frequent basis in 2023 than in previous years. In addition to the weekly monitoring of cyanotoxin, nutrient and chlorophyll levels, the District will also be quantifying total algae (including diatoms and green algae) and cyanobacteria cell counts on a weekly basis. The District has also recently acquired a multi-parameter sonde, which allows the real-time measurements of temperature, dissolved oxygen, conductivity, pH, chlorophyll-a and phycocyanin (a pigment associated with cyanobacteria) at depth throughout the water column. The increased level of monitoring will improve the assessment of lake water quality parameters and facilitate responsive actions when conditions warrant.

Consultation. The Implementing Agreement makes multiple references to meetings, consultations and collaboration among the Settlement Parties. The leadership of the Indian Bands and Local Entities have agreed to consult regularly to discuss the status of Local Water in general and conditions at Lake Henshaw in particular, including both short- and long-term plans to manage HABs. The next consultation has been scheduled for the afternoon of Monday, March 20, 2023. It is anticipated that plans for the treatment of HABs at Lake Henshaw for 2023 will be a primary topic of discussion for that consultation.

As-Needed Agreement for Water Quality Treatments at Lake Henshaw. In April 2022, the District executed an as-needed services agreement with Aquatechnex to provide services related to the treatment of HABs in Lake Henshaw in an amount not to exceed $600,000. The unit cost of three algaecides (two copper formulations and one peroxide formulation) were established under the agreement. The treatments of May and August 2022 were performed under this contract (the March 2022 treatment being performed by another vendor under a contract with Escondido). In addition, 120,000 pounds of peroxide-based algaecide has been pre-purchased for use in 2023; $477,741 has been expended to date under the current not-to-exceed amount of $600,000.

If the recommended treatment plan is implemented, up to an additional $530,000 is estimated to be needed to pay for one lanthanum-modified clay treatment, one copper-based algaecide treatment, and up to four peroxide-based algaecide treatments in FY 2023. It is recommended that the not-to-exceed upper limit of the Aquatechnex agreement be increased to $1,130,000 to accommodate this outcome. In addition, the unit cost of $3.20 per pound for EutroSORB G (the trade name for a lanthanum-modified clay formulation) will be fixed under the as-needed services agreement.

ATTACHMENTS:

- Example Schedule of Treatments at Lake Henshaw
- David Caron's Letter dated December 12, 2022 to the SLRIWA
- Stillwater Sciences Technical Memorandum dated December 2, 2022

Example Schedule of Treatments at Lake Henshaw

Start Date	End Date	Duration (Days)	Description	Notes	Approx. Cost
Wed, 04/05/2023	Fri, 04/07/2023	3	Peroxide Treatment	85,000 lbs; 2 mg/l	$ 129,000.00
Sat, 04/08/2023	Sun, 04/16/2023	8	Resting Interval	Release unlikely due to SPUP	
Mon, 04/17/2023	Wed, 04/19/2023	3	Peroxide Treatment	85,000 lbs; 2 mg/l	$ 129,000.00
Thu, 04/20/2023	Thu, 04/27/2023	7	Resting Interval	Release depending on status of SPUP	
Fri, 04/28/2023	Sat, 04/29/2023	2	Copper Treatment	6,000 gal; 0.4-0.5 mg/l - no release	$ 102,000.00
Mon, 05/01/2023	Thu, 05/04/2023	4	Lanthanum Treatment	45,000 lbs; 0.04 mg/l P w/c removal	$ 181,000.00
Fri, 05/05/2023	Wed, 05/24/2023	19	Resting Interval	Release depending on dissolved Cu levels	
Thu, 05/25/2023	Mon, 05/29/2023	5	Memorial Day Release		
Tue, 05/30/2023	Thu, 06/15/2023	17	Resting Interval	possible peroxide if triggered	$ 129,000.00
Fri, 06/16/2023	Mon, 06/19/2023	4	Father's Day Release		
Mon, 06/26/2023	Wed, 06/28/2023	3	Peroxide Treatment	85,000 lbs; 2 mg/l	$ 129,000.00
Fri, 06/30/2023	Tue, 07/04/2023	5	Independence Day Release		
Thu, 07/06/2023	Sat, 07/08/2023	3	Peroxide Treatment	85,000 lbs; 2 mg/l	$ 129,000.00
Sat, 07/08/2023	Mon, 07/17/2023	9	Resting Interval		
Tue, 07/18/2023	Thu, 07/20/2023	3	Peroxide Treatment	85,000 lbs; 2 mg/l	$ 129,000.00
Fri, 07/21/2023	Sun, 07/30/2023	9	Resting Interval		
Mon, 07/31/2023	Tue, 08/01/2023	2	Copper Treatment	6,000 gal; 0.4-0.5 mg/l - no release	$ 102,000.00
Thu, 08/03/2023	Tue, 08/08/2023	6	Lanthanum Treatment	184,000 lbs; 13% of P in 400 ac of sediment	$ 687,000.00
Wed, 08/09/2023	Wed, 08/30/2023	21	Resting Interval	Release depending on dissolved Cu levels	
Thu, 08/31/2023	Mon, 09/04/2023	5	Labor Day Release		
				Total:	**$ 1,846,000.00**

December 12, 2022

President Bo Mazzetti
San Luis Rey Indian Water Authority
P.O. Box 428
Pauma Valley, CA 92061

Dear President Mazzetti,

Thank you for the opportunity to comment on the recent report "Assessment of August 2022 Algaecide Treatment Effectiveness for Lake Henshaw" provided to the San Luis Rey Indian Water Authority (SLRIWA) by Don Smith, Vista Irrigation District (VID) on December 2, 2022, as provided by their consultant on this matter, Stillwater Sciences. I have read the final report thoroughly. I have also read and provided comments (to Maia Singer, Stillwater Sciences) on the DRAFT report provided in October. As requested, I have the following assessment and comments on the final version.

<u>My overall assessment</u>: I strongly urge the SLRIWA to communicate directly with the Board of Directors of Vista Irrigation District to encourage them to direct their efforts towards a more thorough and continued investigation of effective ways to employ peroxide-based algaecides for future short-term mitigative efforts in Lake Henshaw. Most concerning in the Stillwater report is that it focuses on an apparently superior ability of copper to reduce algae and toxins in the lake relative to peroxide-based agents, based on only one addition of a copper-based product. While at the same time, the report tends to de-emphasize some of the serious and undesirable effects that occurred as a consequence of copper treatment. The current trajectory of VID's efforts, based on my evaluation of the Stillwater report, is that a priority for VID will be continued and indefinite use of copper as the mitigative strategy-of-choice in Lake Henshaw. Given the SLRIWA's health concerns, economic impacts and ethical stance on lake treatment and the desire for the application of eco-friendly mitigative approaches in Henshaw, VID's trajectory may be not in line with the SLRIWA's best interests.

<u>Report overview</u>: The report highlights the application of SeClear (an algaecide formulation whose active ingredient is copper sulfate pentahydrate) to Lake Henshaw on August 17 and 18, 2022. There is also a comparison of results with two previous treatments of the lake using a hydrogen peroxide-based algaecide. Overall, the conclusion of the report is that the SeClear treatment was more effective in reducing the algal bloom that was present in the lake at that time, and in reducing cyanotoxins (anatoxin-a and microcystins), relative to previous treatments using a peroxide-based compound. Overall, I do not disagree with that assessment (the effectiveness of the copper treatment). However, the report tends to downplay unwanted outcomes of the use of copper. Rather than an evenhanded consideration of both approaches, the report provides mostly

recommendations on how to better apply copper agents, and the tenor of the report implies that there will be emphasis on future applications of copper as the mitigative approach-of-choice (over application of hydrogen peroxide-based compounds). That viewpoint tends to dismiss several important considerations that the SLRIWA has raised from the beginning of this process. Below, I reiterate these issues, and comment on other aspects of the report.

Most significantly, as you are aware, there continues to be considerable and justifiable concern among the Bands within the SLRIWA on the continued use of copper as a long-term mitigative strategy. These concerns exist because of the varied and unique uses of the San Luis Rey River by the Bands. *Traditional and custom-related use* of the river and its waters raise undetermined risks for the safety and health of the Bands' members, creating the need for safety considerations that exceed normal State recreational recommendations for the use of aquatic resources. Additionally, the release of water from the lake following copper treatment has resulted, and may continue to result, in unwanted and unpredictable delays in the release of water from the lake. The inability to accurately predict post-treatment releases will continue to cause significant *economic hardship* for member Bands that are dependent on timely water delivery.

Beyond these *fundamental concerns* regarding the continued and repeated use of copper as an algaecide in Lake Henshaw, there are several aspects of the Stillwater report that I feel have not highlighted potential problems with the continued use of copper as a mitigative strategy.

<u>Specific issues with the report</u>: The Stillwater report noted the fish mortality that occurred following the copper treatment in August, 2022, but tended to minimize the magnitude of the incident and the direct and indirect roles that copper undoubtedly played in causing the fish kill.

1) No specific numbers were provided in the report for the fish mortality incident following copper treatment. Indeed, the mortality event was not acknowledged by VID until more than a month after the event. The Stillwater report states "Fish mortality was reported in Lake Henshaw on 8/19 and 8/20/22, two to three days following the copper-based algaecide treatment. An abundance of shad and several dozen individuals of bass, crappie, catfish, and carp were found dead at various locations in the lake on both dates." Significant numbers of fish, and multiple species, were affected, but the vagueness of this aspect of the report, and the tardiness of its acknowledgment, make the severity of the mortality event impossible to assess. It is also unclear to what extent the dead fish were removed. Allowing dead fish to remain in the lake would further increase the likelihood of reductions in dissolved oxygen as the fish biomass is decomposed, exacerbating the problem. Therefore, the response to the event also cannot be adequately judged.
2) The report states "it is not possible to completely rule out acute copper toxicity as a contributor to the Lake Henshaw fish mortality event on 8/19 and 8/20/22." Further text in the report pertains to the limited published information on acute (i.e. short-term) copper toxicity towards a few fish species, which in most cases is not

pertinent to the fish species affected by the mortality event in Lake Henshaw. As I noted in my comments on the DRAFT report (email sent to Maia Singer on Oct 31, 2022), my specific comment was not directed at the stand-alone, acute toxic effects of copper on fish, but to the potential for fish mortality at less-than-acute concentrations of copper because low dissolved oxygen concentrations (a consequence of killing too much algal biomass at one time) may have been exacerbated by stress created from high copper concentrations that remained in the water for several days after treatment. My specific comment was "fish already stressed by low dissolved oxygen may have succumbed to copper concentrations that were less than those concentrations known to be lethal from routine bioassays (which are generally not carried across a range of low DOs)". That being said, regardless of whether copper was a *direct* contributing factor to fish mortality or not, the low dissolved oxygen concentrations were indicative of overuse of copper, killing too much algal biomass at one time, and ultimately resulting in a significant mortality event. It is noteworthy that several fish species, including some very hardy species, were observed in the mortality event. That indicates a significant over-reach in algaecide application, a situation not clearly or adequately acknowledged in the report. It is worth noting that the potential for a fish kill from copper use was noted to the LEs at several times prior to the August treatment.

3) The Stillwater report notes that the length of time that SeClear was effective in maintaining lowered algal biomass and toxin concentrations was longer than that experienced following peroxide applications. It is also noted that the 'bounce back' of microcystin concentrations observed a few to several days after peroxide use was not observed when copper was applied. However, it is important to recognize that this is somewhat a case of comparing 'apples to oranges'. The copper treatment did reduce algal abundances more than observed for peroxide, but it is clear that the copper treatment was very strong (as evidenced by many fish dying). It is likely that a similarly high peroxide concentration would have greatly reduced algal biomass (similar to the effect of copper), but possibly without a fish kill because peroxide actually adds dissolved oxygen to the water. Additionally, the SeClear formulation contained a substance to bind phosphorus and sink that essential element to the bottom of the lake. Presumably the binding agent was in part responsible for the prolonged activity of the SeClear (i.e. it was not directly related to copper). Such a phosphorus-binding agent might be used in conjunction with, or following a hydrogen peroxide-based treatment to achieve the same longevity of effect as observed in August, without the adverse effects observed for the recent SeClear application (i.e. the fish kill and delayed water release), as well as the unwanted legacy of copper in the lake.

<u>Broader issues covered by the report</u>: The Stillwater report offers 10 recommendations for the future use of algaecides in Lake Henshaw (page 40 of the report). Six (6) of these provide general recommendations for how to improve and optimize future algaecide applications in Lake Henshaw. Most of these recommendations were excellent in my opinion and I agree with all of them. They include:

- Maintain better control of algal biomass in the lake (i.e. avoid having to treat a massive bloom).
- Use phosphorus-binding agents to reduce algal growth (i.e. sediment sealing).
- Monitor total algal as well as cyanobacterial abundance to better gauge the magnitude of the algaecide treatment needed, and predict its effects.
- Increase monitoring of dissolved oxygen concentrations throughout the lake in order to prevent dangerously low dissolved oxygen concentrations.
- Assess lake conditions (i.e. algal abundance, dissolved oxygen concentrations, etc) *prior to*, *during* and *following* mitigative treatments to better inform the mitigative plan.
- Develop an adaptive treatment plan (based on approach immediately above) to avoid over-dosing.

These excellent recommendations aside, four (4) of the ten recommendations related exclusively (or almost exclusively) to future copper treatments of the lake. While those recommendations are appropriate if copper is to be used, they imply that future applications will indeed be focused on more copper applications, which is *contrary to all communications of the SLRIWA to VID on this topic*. It would appear that VID has gained relatively little knowledge from the two applications of peroxide-based product to the lake, and this report emphasizes a future of algaecide applications focused on copper-based products. In part this appears to be a financial decision, and in part because there is still much to be learned about optimizing the use of peroxide for controlling algal blooms and cyanotoxins in Lake Henshaw. However, given that (1) peroxide leaves no copper residual or legacy in the lake and thus circumvents health and safety concerns for the Bands, (2) peroxide may lessen the impact on fish and other aquatic species by adding oxygen to the lake, and (3) peroxide decomposes rapidly allowing more accurate prediction of the timing of water release following treatment, it seems unwarranted at this time to sentence Lake Henshaw to interminable applications of copper-based products for short-term mitigation of harmful algal blooms.

Respectfully,

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Stillwater Sciences
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phone 510.848.8098

TECHNICAL MEMORANDUM

DATE: December 2, 2022

TO: Don Smith, Vista Irrigation District

FROM: Maia Singer, Avi Kertesz, and Peter Baker, Stillwater Sciences

SUBJECT: Assessment of August 2022 Algaecide Treatment Effectiveness for Lake Henshaw

EXECUTIVE SUMMARY

The application of SeClear (a non-chelated copper sulfate algaecide including a phosphorus binding agent) in Lake Henshaw on August 17 and 18, 2022 appears to have been more effective at controlling harmful algal blooms (HABs) than the application of peroxide-based algaecides in Lake Henshaw in March and May of that same year. This conclusion is supported by:

- Significantly greater reduction in cyanobacterial cell counts after treatment with copper as compared to treatment with peroxide;
- The significant reduction in the concentration of anatoxin-a from a range of 1.09–7.15 µg/L prior to treatment to non-detect (<0.15 µg/L) within 4 days of treatment with copper;
- The absence of a rebound in microcystin concentrations 2 weeks following treatment with copper, as observed in March and May when treated with peroxide;
- Greater percentage reduction in chlorophyll-*a* after treatment with copper compared with treatment with peroxide.

A significant concern with the August 2022 treatment of Lake Henshaw with copper was the limited fish mortality event observed on August 19 and 20, 2022. While it is not possible to completely rule out acute copper toxicity as a contributor to the Lake Henshaw fish mortality, a review of the observed copper and dissolved oxygen concentrations post-treatment strongly suggests the fish mortality was caused by oxygen depletion brought on by decaying algae killed by the copper. A number of recommendations to prevent this outcome with future use of copper are presented in the Conclusions and Recommendations section of this memorandum.

Finally, the resumption of releases from Lake Henshaw after treatment with copper in August of 2022 was delayed due to the combined effect of persistent dissolved copper in the water column and the historically low hardness of Lake Henshaw lake water. The most likely cause of the low hardness was the chemical precipitation of natural hardness causing chemicals, notably calcium and magnesium, brought on by high pH conditions, measured in excess of 10 s.u. These high pH conditions, in turn, were likely caused by excessive photosynthesis in lake waters during the summer of 2022. Recommendations to facilitate timely releases from Lake Henshaw include both more frequent monitoring of lake water hardness as well as more proactive assessment and management of total algal activity.

1 INTRODUCTION

In March 2020, the Vista Irrigation District (District) began monitoring for the presence of cyanobacteria and cyanotoxins in Lake Henshaw after being alerted to the potential presence of HABs in the lake by remote sensing data. Since then, routine monitoring and laboratory analysis have confirmed the presence of elevated levels of the cyanotoxins microcystin and anatoxin-a at multiple sites in the lake and in water released to the downstream San Luis Rey River.

The District is currently developing a Draft HABs Management and Mitigation Plan, which outlines protocols for identifying early HAB development and actions that can be taken to minimize cyanotoxin production and associated delays to water deliveries in the short term, while longer-term alternatives are developed and implemented to prevent future blooms. As part of Draft HABs Management and Mitigation Plan development, application of copper- and/or peroxide-based algaecides has been identified as the most feasible short-term HABs control method for Lake Henshaw for the following reasons:

- Algaecide application is a well-proven mitigation method for HABs. Approved algaecide chemicals act quickly (i.e., minutes to hours) and can prevent the formation of and interrupt an ongoing HAB and stop cyanotoxin production.
- Little to no capital investment is required for algaecide application, since licensed applicators can be hired by the District to apply the chemicals and undertake monitoring needed to meet permit requirements.
- Costs are generally predictable and there are multiple algaecide products available on the market.

In June 2021, the District obtained a Statewide Aquatic Weed Control Permit for application of copper sulfate, chelated copper, and sodium carbonate peroxyhydrate (peroxide) to control HABs in Lake Henshaw. The District desires to obtain experience with the use of both copper- and peroxide-based algaecides in the lake over time.

Throughout 2021, persistent cyanotoxin concentrations above the California Cyanobacteria Harmful Algal Bloom (CCHAB) Network "caution" thresholds (i.e., 0.8 µg/L and detection for microcystin and anatoxin-a, respectively) in Lake Henshaw hindered the District's ability to deliver water on behalf of itself, Bands represented by the San Luis Rey Indian Water Authority (SLRIWA), including the La Jolla Band of Luiseno Indians (La Jolla) and Rincon Band of Luiseno Indians (Rincon), and the City of Escondido. Cyanotoxin concentrations in the lake dropped below the CCHAB caution thresholds in early 2022 and the District subsequently released water from Henshaw Dam. However, persistent low-level microcystin concentrations (<0.5 µg/L) and several subsequent anatoxin-a detections both in Lake Henshaw and at downstream sampling sites in the San Luis Rey River prompted the District and Escondido, in consultation with the SLRIWA, to initiate the first algaecide treatment of Lake Henshaw to assess lake response.

In accordance with the State Water Board approved *Aquatic Pesticide Application Plan for Lake Henshaw and the Warner Ranch* (Marine Biochemists 2021), the District applied 40,000 pounds of SePRO PAK 27 (active ingredient sodium carbonate peroxyhydrate 85%) to Lake Henshaw on March 14 and 15, 2022. The resulting dose of hydrogen peroxide in the 40% of lake surface area that was treated, assuming an average 5-foot water depth, was approximately 2.9 mg/L (ppm). Averaged across the entire lake surface, the hydrogen peroxide dose was 1.1 mg/L, although the latter estimate assumes complete mixing immediately following dosing, which is unlikely to have occurred. The March 2022 algaecide treatment in Lake Henshaw appeared to have a minor effect on HABs, with variable and modest changes in chl-*a*, the ratio of phe-*a* to chl-*a*, total cyanobacteria cell densities, and nutrient concentrations depending on the amount of time elapsed since treatment. Microcystin concentrations doubled at shoreline sites following treatment, and either increased or decreased slightly at other sites following treatment (Stillwater Sciences 2022a).

In order to support the release of recreational water to the San Luis Rey River over Memorial Day weekend, the District implemented a second algaecide treatment in Lake Henshaw beginning on May 16, 2022, with the goal of minimizing cyanotoxin concentrations in the lake leading up to the holiday weekend. Due to the current SLRIWA preference for peroxide-based treatment products, the District applied SePRO PAK 27, consistent with the March 2022 application. Over the course of four days, from May 16 to May 19, approximately 80–90% lake surface area (approximately 771 acres) was treated with 120,000 pounds of SePRO PAK 27. The May treatment corresponded to a concentration of approximately 2.2 to 4.3 mg/L (ppm) on any given day, or 3.3 mg/L on average, assuming an average 5-foot water depth. Averaged across the entire lake surface, the hydrogen peroxide dose was 1.6 mg/L on any given day, although the latter estimate assumes complete mixing immediately following dosing, which is unlikely to have occurred. The May 2022 algaecide treatment in Lake Henshaw also appeared to have a minor effect on HABs, with variable and modest changes in chl-*a*, the ratio of phe-*a* to chl-*a*, total cyanobacteria cell densities, and nutrient concentrations following treatment. The exception to the observed modest changes was *Dolichospermum*, a cyanobacteria genus that exhibited an order of magnitude increase in cell densities over the course of the May post-treatment sampling period. Microcystin concentrations generally increased approximately two weeks following treatment, with a return to pre-treatment levels at the deep open water sites by three weeks post-treatment (Stillwater Sciences 2022b).

A third algaecide treatment was undertaken by the District in August 2022 to support the release of recreational water from Lake Henshaw to the San Luis Rey River over Labor Day weekend. Cyanotoxin concentrations had increased in Lake Henshaw in July 2022, ranging 0.6 – 0.93 ug/L microcystin and 3.6 – 4.4 ug/L anatoxin-a on August 1, such that the goal of the third algaecide treatment was to minimize cyanotoxin concentrations in the lake leading up to the holiday weekend. Consultations between the District, Escondido, and the SLRIWA indicated that a copper-based treatment would be acceptable so long as baseline levels of copper could be established in lake water and sediments, as well as San Luis Rey River water, prior to treatment. Background lake water and sediment samples were collected by the District on August 1, 2022, and background river water samples were collected by the La Jolla Band on June 9 and 16, 2022. The results of these analyses were shared among the District, Escondido and the SLRIWA shortly after they were performed. The District plans to collect and analyze post-treatment lake sediment samples for copper and share those data as well.

For the third algaecide treatment, the District hired AquaTechnex, an applicator with extensive experience with algaecide application in western lakes, to apply SeClear, a non-chelated copper sulfate product including a phosphorus binding agent. Recommendations for algaecide dosing concentration were made by the algaecide manufacturer in July of 2022 and reviewed by the District, Stillwater, and AquaTechnex. On August 17 and 18, approximately 45% of the lake surface area (approximately 45% of 710 acres or 320 acres) was treated with 9,075 gallons of SeClear. The original treatment area was intended to be 50% of lake surface area as estimated in July 2022, where the SeClear total volume was to be applied in strips or blocks running along a south-west to north-east axis. However, on the dates of treatment, the applicator’s boats were unable to access the full width of each planned treatment strip/block due to insufficient water depth. Thus, more shallow areas on the northern, eastern, and southern sides of the lake were not treated directly and less than 50% of the lake area was treated. Based on 320 acres of treatment area and an average 5-foot water depth, the August treatment corresponded to a total copper concentration of approximately 0.87 mg/L (870 ug/L). Averaged across the entire lake surface, the copper dose was 0.39 mg/L, although the latter estimate assumes complete mixing immediately following dosing, which is unlikely to have occurred.

This technical memorandum provides an assessment of the effectiveness of the third algaecide treatment in Lake Henshaw in August. The methodology, results, and conclusions of the water quality monitoring effort associated with the August algaecide treatment are described below, including comparisons to the March and May treatment results where applicable.

2 METHODS

To inform the assessment of algaecide treatment effectiveness in August, the District re-occupied water quality monitoring sites used for the March and May treatment effectiveness monitoring, including four routine monitoring sites (H-S, H-FD, H-BL, H-BLS) and seven additional open water and shoreline sites (Table 1). The District also included monitoring of *in situ* water quality parameters and additional analytical constituents before and after the August treatment event, with monitoring on 7/25, 8/1, 8/26, and 8/29 conducted as part of routine monitoring activities and monitoring on 8/16, 8/19, and 8/22 conducted as part of algaecide effectiveness monitoring activities. To provide a more comprehensive time series analysis of algaecide effectiveness, monitoring data collected as part of routine monitoring activities are also presented in this technical memorandum. Lastly, AquaTechnex, the algaecide applicator, collected *in situ* data at one foot depth intervals at multiple locations in the lake on 8/17 and 8/18 between 7:00 and 8:30 am and between 3:30 and 5:00 pm, and these data were also reviewed in a general sense (rather than on a site-specific basis) to inform the assessment of treatment effectiveness.

In situ water quality parameters included water temperature, dissolved oxygen (DO), conductivity, total dissolved solids, pH (standard units [s.u.]), oxidation reduction potential (ORP), and turbidity (formazin nephelometric units [FNU]). *In situ* measurements were taken in the morning (between approximately 8:00 am and noon) and the afternoon (between approximately 12:00 pm and 2:00 pm) at five deep water sites (H-BL, H-FD, H-ML, H-NL, H-SL) on 8/16, 8/19, 8/22, 8/24, and 8/29/2022 and were made with a calibrated YSI DSS multiprobe.

Chlorophyll-a, pheophytin-a, and nutrients (total nitrogen, nitrate, ammonia, total phosphorus, orthophosphate), microcystin, and anatoxin-a, were sampled in the morning (between approximately 7 am and 11 am) at designated monitoring sites on 7/25, 8/1, 8/8, 8/18, 8/22, and 8/26/2022. Samples were shipped overnight to the analytical laboratory (Bend Genetics, Sacramento, California) and analyzed using the fluorometric (acidification) method (EPA 445) for chlorophyll-a and pheophytin-a; persulfate digestion and spectrophotometric methods 10208 (total nitrogen) and 10210 (total phosphorus); spectrophotometric methods 10209 (orthophosphate), 10205 (ammonia), and 10206 (nitrate); and enzyme linked immunosorbent assay (ELISA) for total anatoxin-a and total microcystin/nodularin concentrations.

Cyanobacterial counts by genus were sampled in the morning (between approximately 8 am and 12 pm) on 8/1, 8/8, 8/18, 8/22, and 8/26/2022 at H-S, H-FD, H-BLS, and H-ML. Grab samples were shipped overnight to the analytical laboratory (Bend Genetics, Sacramento, California) and analyzed using microscopy for identification of potentially toxigenic cyanobacteria (PTOX).

The District also collected samples from Lake Henshaw on 8/8/2022 to establish background concentrations of total copper in surface waters and sediments prior to application of the copper-based algaecide later in August. Total and dissolved copper samples were collected from Lake Henshaw before and after the 8/17–8/18/22 application of copper-based algaecide. Copper samples were shipped to the analytical laboratory (Sierra Analytical Labs, Inc., Laguna Hills, California) and analyzed using EPA 6010B for copper in sediments and EPA 200.8 for total and dissolved copper in water. Dissolved organic carbon was analyzed for a subset of samples using SM 5310B.

Table 1. Lake Henshaw water quality monitoring sites for algaecide effectiveness monitoring associated with the August 2022 treatment event.

Site ID	Location	Latitude	Longitude
H-S	Southwestern shoreline at beach adjacent to fishing dock	33.23496°N	116.75617°W
H-FD	Southwestern shoreline at the in-water end of the fishing dock in surface waters	33.23544°N	116.75568°W
H-FDD	Southwestern shoreline at the in-water end of the fishing dock in bottom waters	33.23544°N	116.75568°W
H-BLS	Buoy line at dam in surface waters	33.23963°N	116.76174°W
H-BL	Buoy line at dam in bottom waters	33.23963°N	116.76174°W
H-NL	Northern portion of lake in surface waters	33.24600°N	116.75300°W
H-ML	Mid-lake in surface waters	33.23890°N	116.75275°W
H-MLD	Mid-lake in bottom waters	33.23890°N	116.75275°W
H-SL	Southern portion of lake in surface waters	33.23000°N	116.74400°W
H-NS	Northern shoreline at beach	33.24729°N	116.75414°W
H-ES	Eastern shoreline at beach	33.23546°N	116.73801°W
H-SS	Southern shoreline at beach	33.22659°N	116.74316°W

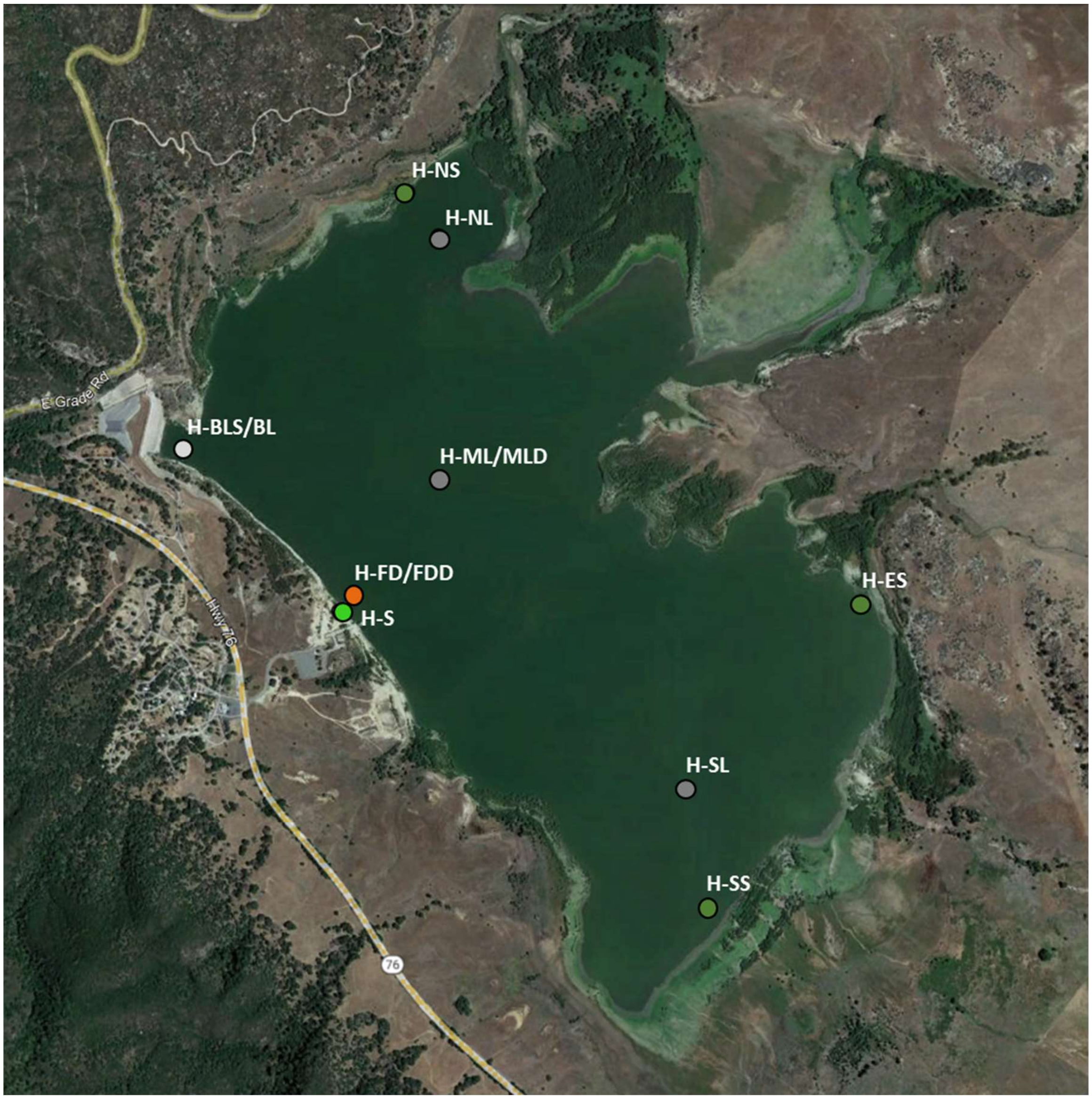


Figure 1. Lake Henshaw water quality monitoring sites for algaecide effectiveness monitoring associated with the August 2022 treatment event.

3 RESULTS

3.1 *In situ* Water Quality

Water quality results for a subset of the *in situ* measurements are summarized below. While AquaTechnex performed monitoring required by the NPDES permit (pre-, during and post-algaecide application), the District performed significant additional monitoring to better understand the lake response to the treatment event.

3.1.1 Water temperature

Water temperatures at all monitoring sites remained relatively stable throughout the water column across all sampling dates and for both morning and afternoon *in situ* measurements in August 2022, ranging 24–28°C, with some slight increases in the upper water column, particularly during the afternoon (Figure 2). There were no apparent differences between water temperatures measured prior to algaecide treatment (8/16) and those measured after treatment (8/19 – 8/29) While water temperatures measured in August 2022 were several degrees higher than values measured during March 2022 (12–15°C) and May (17–23°C; Figure 3), similar to March and May there was no evidence of a persistent and defined thermocline at the open water sites during August (Figure 3). For the August dataset, all sites except Site H-ML in the afternoon (PM) exhibited surface water temperatures that were 1–4°C greater than bottom water temperatures, although changes in temperature at these sites occurred gradually with depth throughout the water column (Figure 2, Figure 3). Water temperatures measured by AquaTechnex on 8/17 and 8/18 were generally consistent with the District's measurements, with a minimum value of 24°C occurring in surface waters in the morning and a maximum value of 29°C occurring in surface waters in the afternoon.

3.1.2 Dissolved oxygen

Across all August sampling dates, DO readings were variable, ranging 1.5–13.7 mg/L (11–170% saturation) with an average of 5.4 mg/L (66% saturation) (Figure 2). Prior to algaecide treatment, at the deeper open water sites (H-BL, H-NL, H-ML), concentrations in surface waters on the morning of 8/16 (between approximately 10:00 and 10:45 am) were supersaturated (10.6 mg/L and 133% saturation; 8.7 mg/L and 109% saturation; and 10.1 mg/L and 126% saturation, respectively), while concentrations in bottom waters decreased to near or below 5 mg/L (4.9 mg/L and 60% saturation; 5.6 and 69% saturation; and 6.0 mg/L and 72% saturation, respectively). The lower bottom water concentrations in the morning suggest that a fair amount of water column and/or sediment oxygen demand was present prior to algaecide treatment.

During algaecide treatment, DO measurements collected by the applicator (AquaTechnex) exhibited a minimum value of 0.95 mg/L (12.6% saturation) in shallow bottom waters (approximately 4 feet) in the southern portion of the lake at approximately 7:45 am on 8/18. DO values throughout the water column at this location on 8/18 in the morning ranged 2.4–3.0 mg/L (32–39% saturation). DO values also were less than 4 mg/L in some deeper waters in the northern and central open water sections of the lake on both 8/17 and 8/18 during treatment. During treatment, the maximum DO measurement of 8.6 mg/L (115% saturation) occurred in the surface waters on 8/17 at approximately 8:30 am.

On 8/19, one to two days following algaecide treatment, DO concentrations during both the morning and afternoon were generally low in Lake Henshaw (Figure 2), with 96% of measurements below 5 mg/L, 87% of measurements below 4 mg/L, 62% of measurements below 3 mg/L, and 32% of measurements below 2 mg/L (Table 2). There were no measurements below 1 mg/L on 8/19 (Table 2). Values below 3 mg/L occurred at multiple depths in the morning and afternoon on 8/19 at all sites except H-NL (Figure 2), suggesting that the lake experienced a third consecutive day of low DO at multiple sites throughout the water column and that there was an effect of algaecide treatment on the bloom (e.g., oxidative stress, cell death).

By 8/22, four to five days following treatment, DO concentrations in surface waters had largely recovered to pre-treatment concentrations, although concentrations in deeper waters at sites H-BL, H-FD, H-ML, and H-NL remained below 5 mg/L (Figure 2).

Table 2. Lake Henshaw dissolved oxygen (DO) water column measurements relative to thresholds in the morning and afternoon of August 19, 2022, one to two days following a copper-based algaecide treatment event.

	DO < 5 mg/L and 60% saturation	DO < 4 mg/L and 48% saturation	DO < 3 mg/L and 37% saturation	DO < 2 mg/L and 25% saturation	DO < 1 mg/L and 15% saturation
Number of measurements below the threshold	76	69	49	25	0
Percent of measurements below the threshold	96%	87%	62%	32%	0%

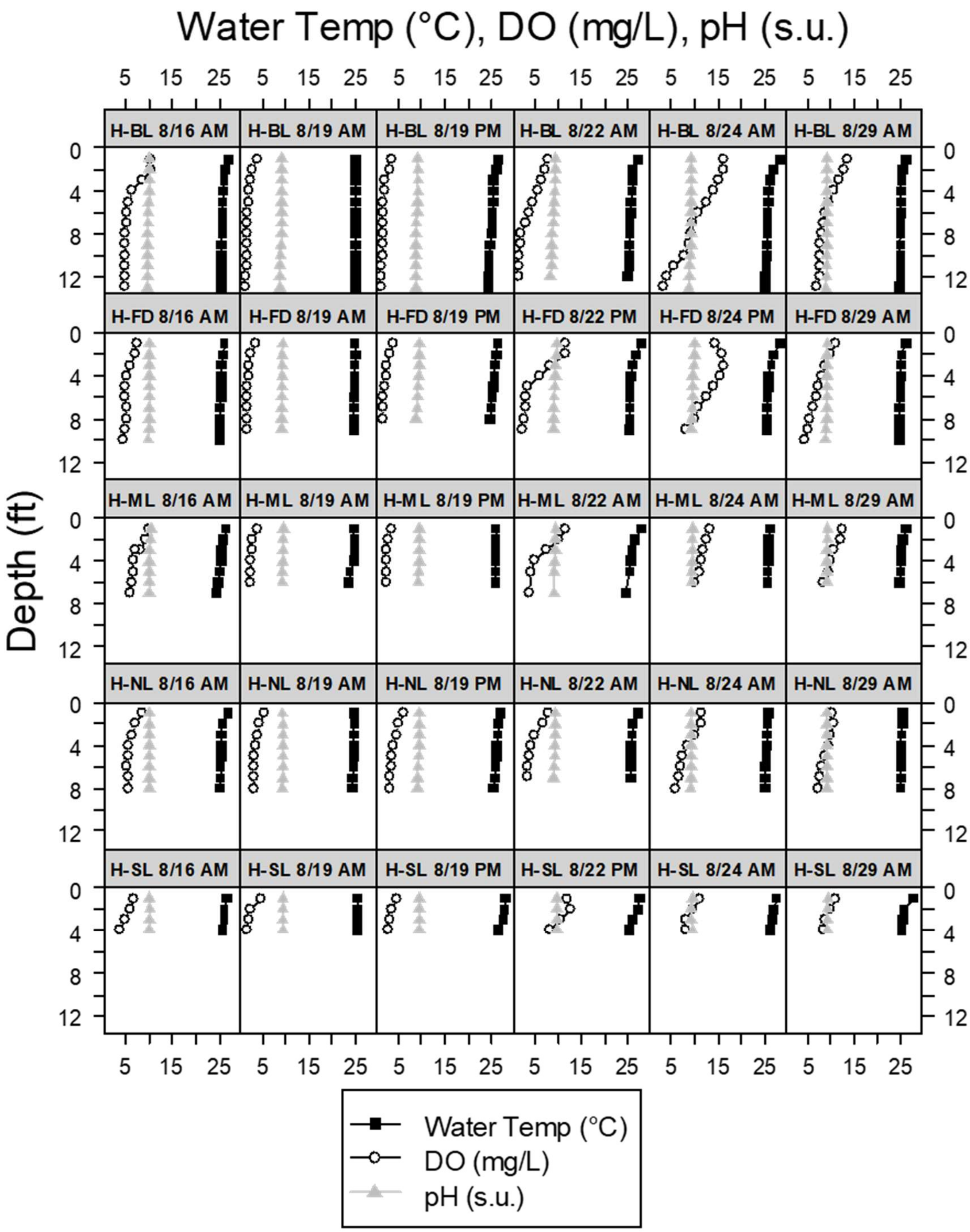


Figure 2. Lake Henshaw *in situ* water temperature (°C), dissolved oxygen (mg/L), and pH (standard units [s.u.]) during algaecide effectiveness monitoring associated with the August 2022 treatment event.

Notes: Algaecide treatment occurred on 8/17 and 8/18/22, such that data collected on 8/16/22 in the morning (AM) were collected prior to algaecide treatment. Data collected on other dates in the morning (AM) or afternoon (PM) were collected after treatment. Site locations provided in Table 1 and Figure 1.

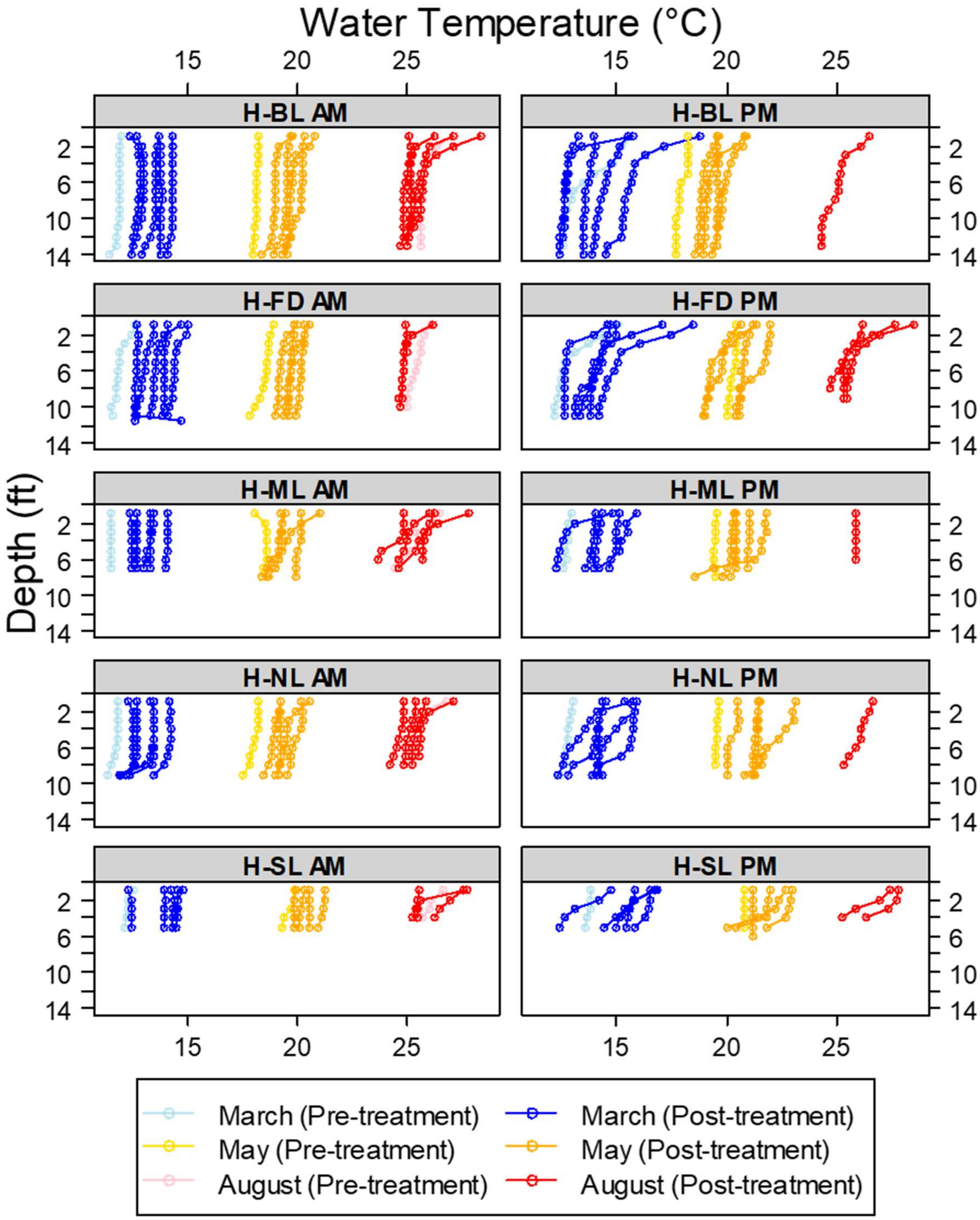


Figure 3. Lake Henshaw water temperature during algaecide effectiveness monitoring associated with the March, May, and August 2022 treatment events.

Notes: Algaecide treatment occurred on 8/17 and 8/18/22, such that data collected on 8/16/22 in the morning (AM) were collected prior to algaecide treatment. Data collected on other dates in the morning (AM) or afternoon (PM) were collected after treatment. Site locations provided in Table 1 and Figure 1.

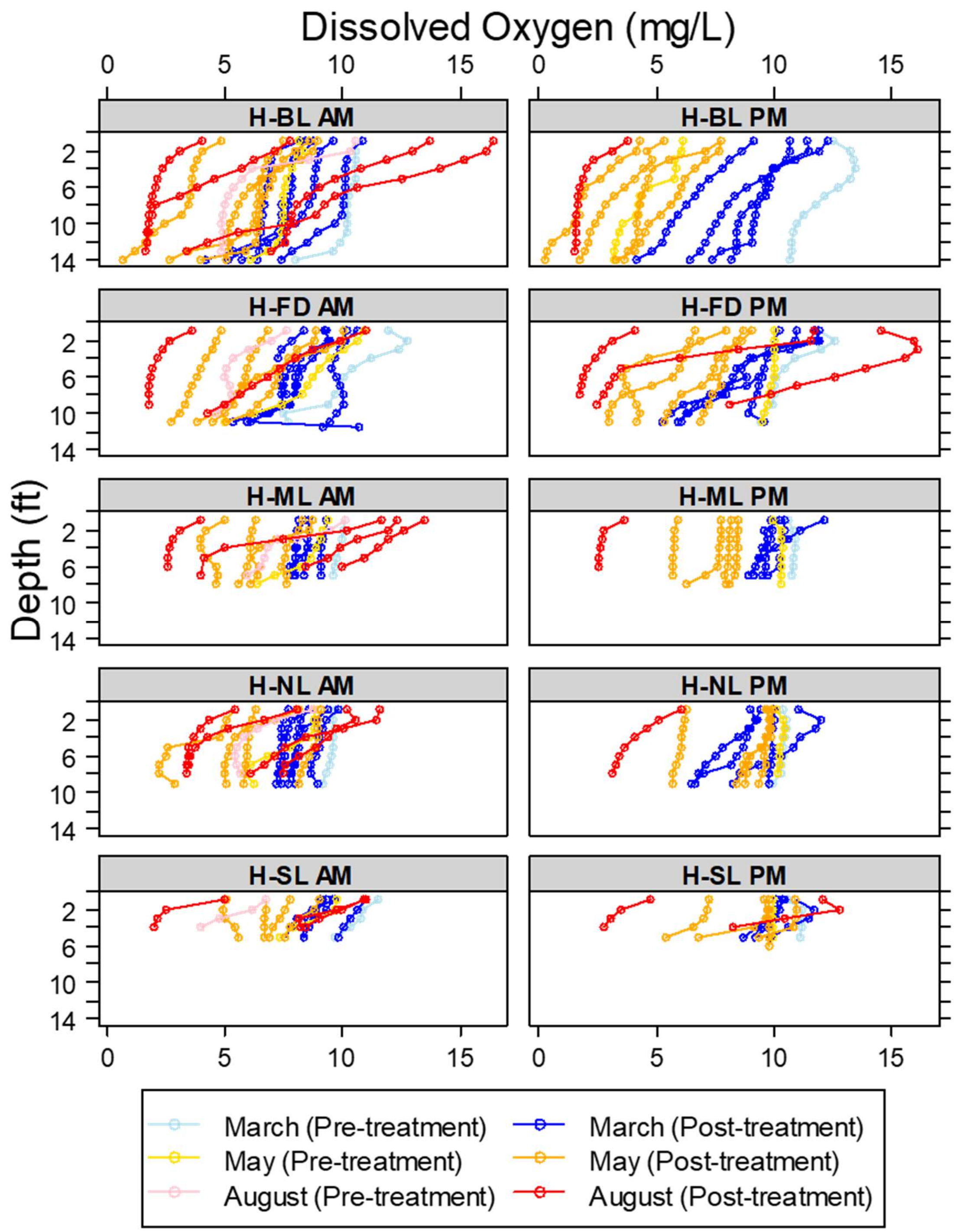


Figure 4. Lake Henshaw dissolved oxygen (milligrams per liter [mg/l]) during algaecide effectiveness monitoring associated with the March, May, and August 2022 treatment events.

Notes: Algaecide treatment occurred on 8/17 and 8/18/22, such that data collected on 8/16/22 in the morning (AM) were collected prior to algaecide treatment. Data collected on other dates in the morning (AM) or afternoon (PM) were collected after treatment. Site locations provided in Table 1 and Figure 1.

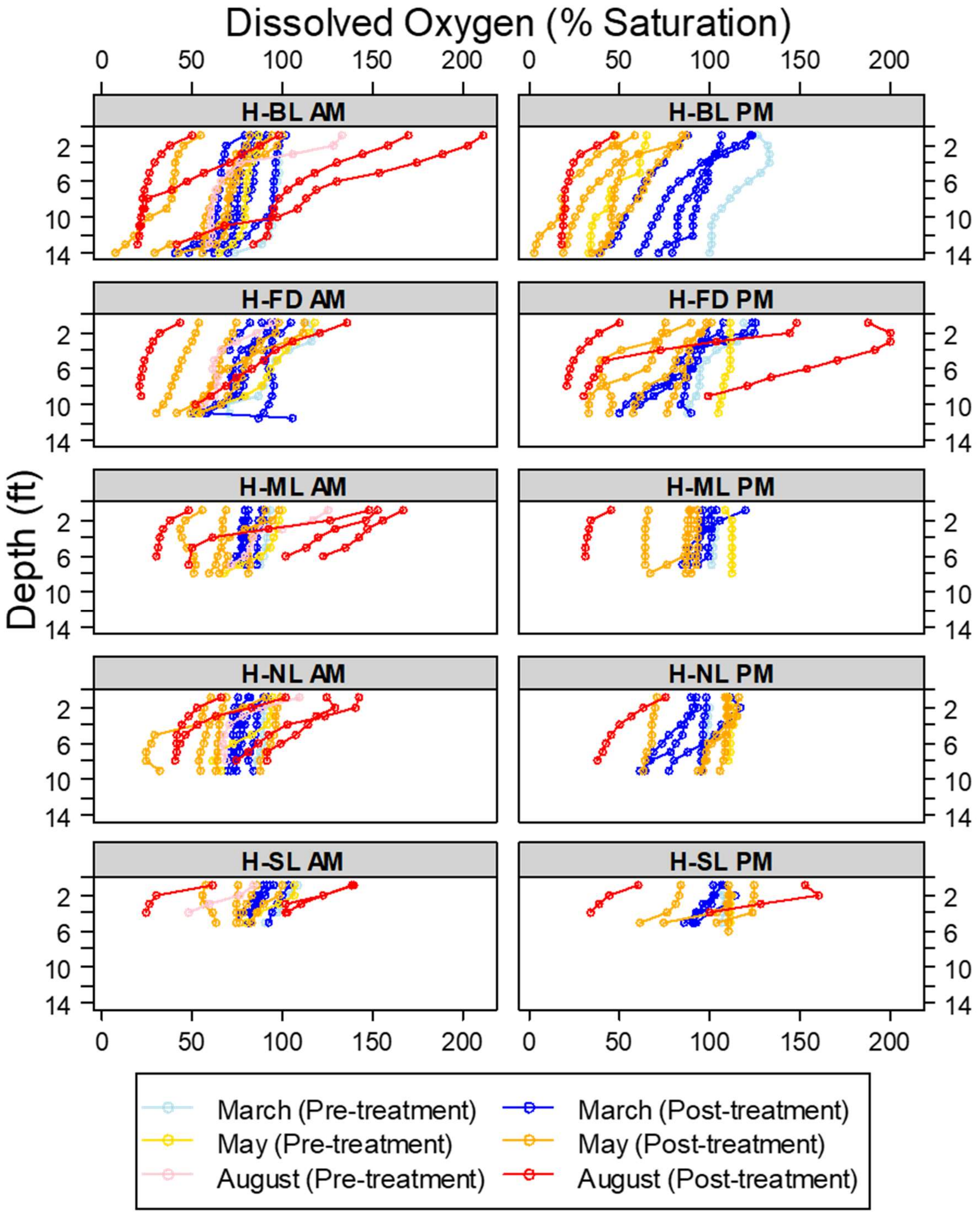


Figure 5. Lake Henshaw dissolved oxygen (percent [%] of saturation) during algaecide effectiveness monitoring associated with the March, May, and August 2022 treatment events.

Notes: Algaecide treatment occurred on 8/17 and 8/18/22, such that data collected on 8/16/22 in the morning (AM) were collected prior to algaecide treatment. Data collected on other dates in the morning (AM) or afternoon (PM) were collected after treatment. Site locations provided in Table 1 and Figure 1.

3.1.3 Turbidity

Pre-algaecide treatment turbidity (8/16) in the morning ranged 35–68 FNU (Figure 6), which was generally lower than March 2022 pre- and post-treatment turbidity (50–100 FNU), similar to or slightly lower than May 2022 pre- and post-treatment turbidity (30–90 FNU), and greater than August 2022 post-treatment turbidity (12–56 FNU; Figure 7). In general, turbidity readings were variable throughout the water column prior to treatment on the morning of 8/16.

August post-algaecide treatment turbidity exhibited the lowest values measured in Lake Henshaw in 2022 (Figure 7). Following treatment, turbidity readings were similar regardless of depth, with the exception of a sharp increase in turbidity at Site H-FD on 8/24 in the afternoon and increases in bottom water turbidity at Site H-NL on 8/19 in the afternoon and Site H-SL on 8/22 in the afternoon and 8/29 in the morning (Figure 6). The sharp increase in turbidity at 3 to 4 feet beneath the water surface at Site H-FD on 8/24 corresponds to a DO maximum (Figure 2), which could indicate a layer of photosynthesizing algae was present at this depth four to five days following treatment. The increases in turbidity in bottom waters at Site H-SL on 8/29 in the morning (Figure 6) may indicate an accumulation of senescing algae following algaecide treatment, although the corresponding DO concentrations were greater than 5 mg/L (Figure 2).

3.1.4 pH/ORP

pH readings were stable throughout the water column prior to algaecide treatment on the morning of 8/16, ranging 9.7–10.3 s.u. across sites (Figure 2). Elevated pH in eutrophic lakes like Lake Henshaw is typically indicative of high rates of photosynthesis, and the morning values on 8/16 were substantially higher than those measured in March or May prior to or after algaecide treatment (Figure 8). There were no pre-algaecide treatment pH measurements collected in the afternoon of 8/16.

After algaecide treatment in August, pH decreased, ranging 8.4–9.7 s.u. across sites (Figure 2), indicating that levels of photosynthesis decreased rapidly following treatment. Despite the downward shift, pH in August post-algaecide treatment tended to be higher than pH measured prior to or following algaecide treatment in March and May (Figure 8).

Prior to algaecide treatment on 8/16 in the morning, ORP ranged from approximately -11 to +27 mV and was slightly higher in surface waters (Figure 6). Negative ORP indicates chemically reducing conditions, with values from 0 to +50 indicating that nitrate and manganese reduction are thermodynamically possible. Note that the low ORP values on the morning of 8/16 are not consistent with the generally high and even supersaturated DO concentrations measured in surface waters on 8/16, suggesting that the elevated DO conditions may have been relatively transient (Figure 2).

Post-treatment, August ORP values decreased slightly at sites H-ML (8/22 in the morning) and H-NL (8/19 in the afternoon), but at other sites ORP slightly increased (Figure 6). Sharp post-treatment decreases in ORP occurred in bottom waters of Site H-BL in the afternoon of 8/19 and the morning of 8/22, corresponding to periods of relatively lower DO (< 4 mg/L) (Figure 2). This pattern was in contrast with the March and May 2022 pre- and post-algaecide treatment monitoring results, where ORP remained relatively high despite occasional low DO, and suggests that lower DO was more persistent in August after algaecide treatment.

3.1.5 Conductivity

Conductivity readings were generally stable throughout the water column on all August sampling dates and at all sites, with a range of 688–800 µS/cm and an average of 761 (data not shown). The August values were slightly higher than those measured before and after the March and May 2022 algaecide treatments. Conductivity values less than 1,000 µS/cm for lakes and reservoirs are generally considered to be moderate. There was no pattern with water depth or across sites before, during, or after treatment.

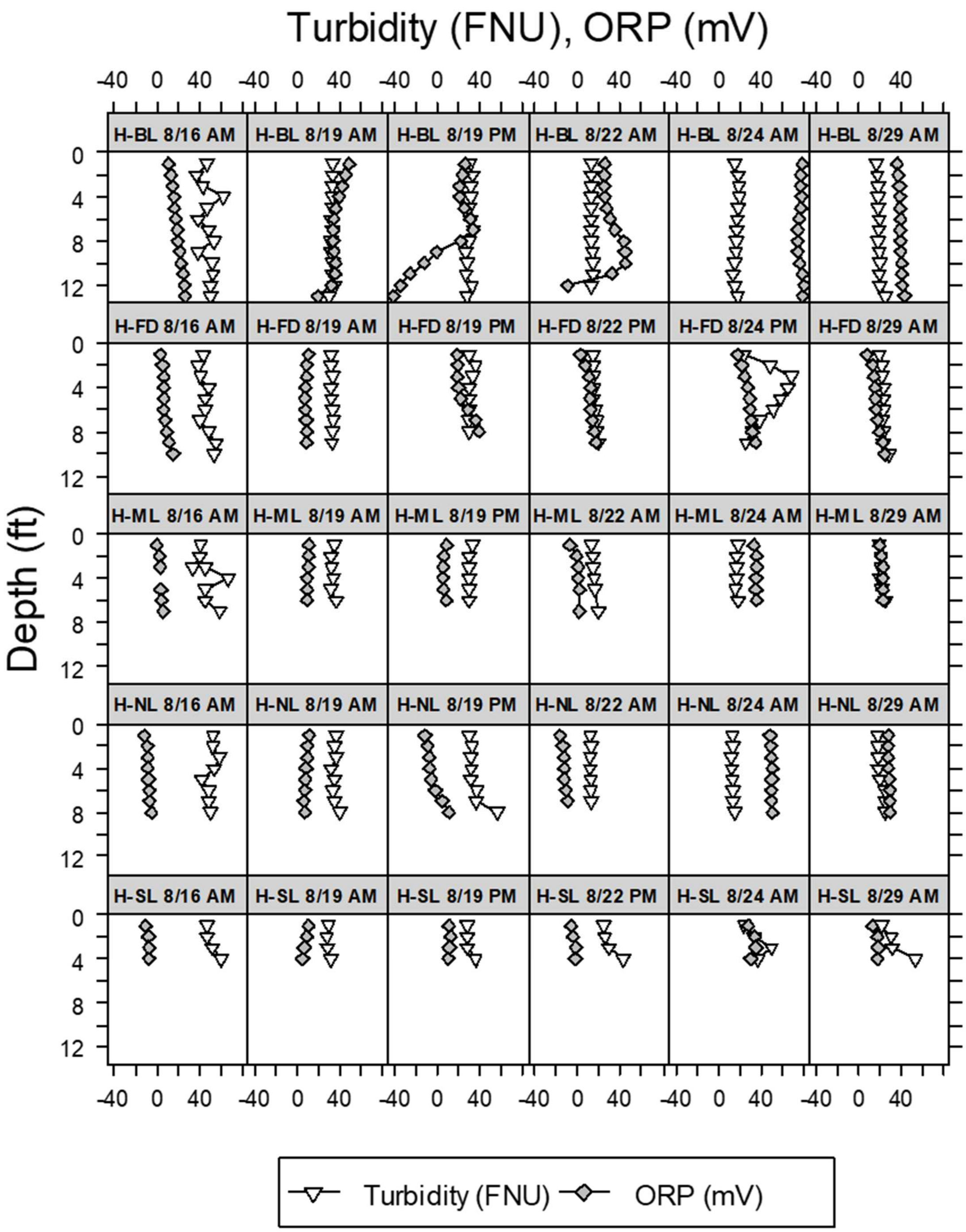


Figure 6. Lake Henshaw *in situ* turbidity (Formazin Nephelometric Units [FNU]) and oxidation-reduction potential (ORP) (millivolts [mV]) during algaecide effectiveness monitoring associated with the August 2022 treatment event.

Notes: Algaecide treatment occurred on 8/17 and 8/18/22, such that data collected on 8/16/22 in the morning (AM) were collected prior to algaecide treatment. Data collected on other dates in the morning (AM) or afternoon (PM) were collected after treatment. Site locations provided in Table 1 and Figure 1.

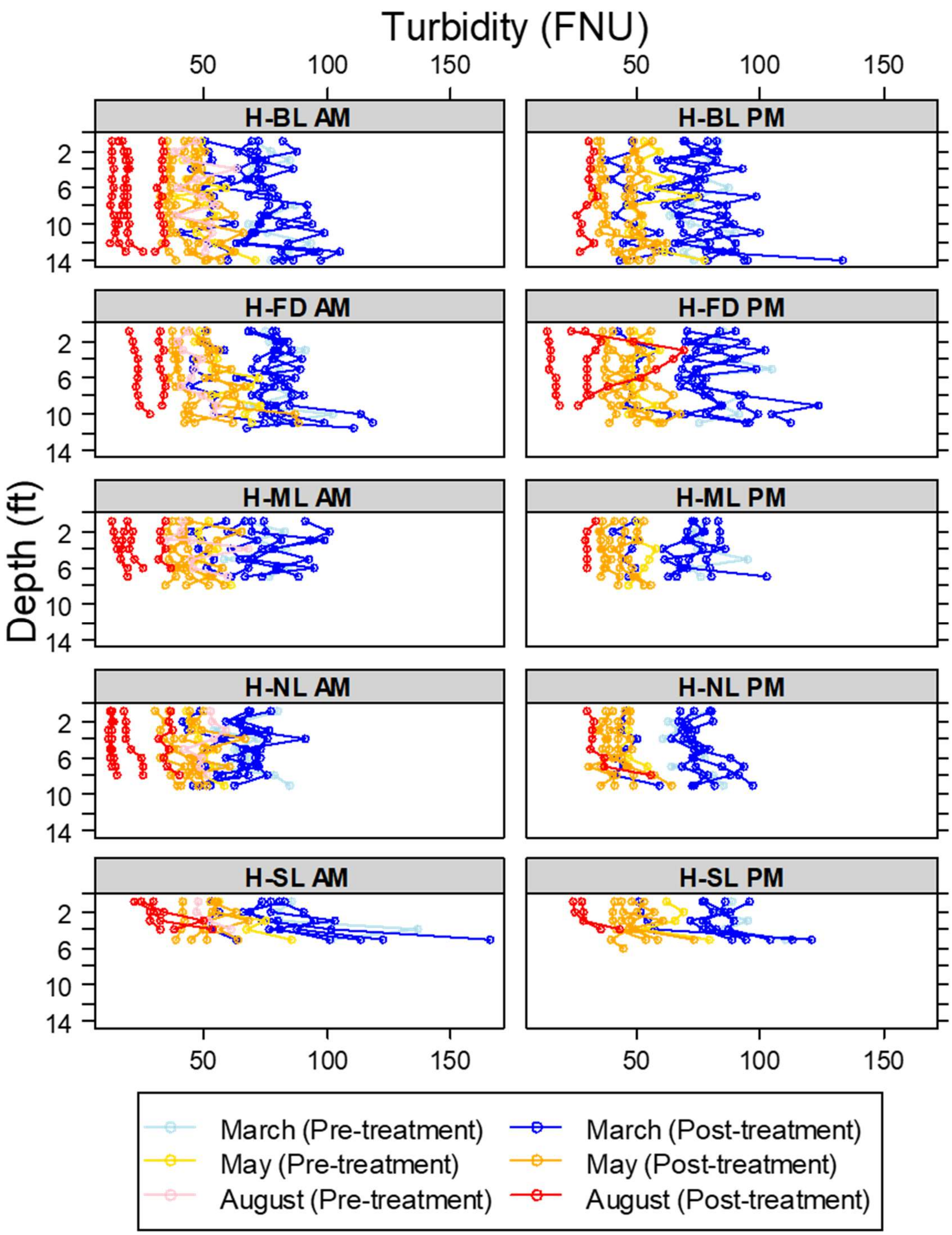


Figure 7. Lake Henshaw turbidity (Formazin Nephelometric Units [FNU]) during algaecide effectiveness monitoring associated with the March, May, and August 2022 treatment events.

Notes: Algaecide treatment occurred on 8/17 and 8/18/22, such that data collected on 8/16/22 in the morning (AM) were collected prior to algaecide treatment. Data collected on other dates in the morning (AM) or afternoon (PM) were collected after treatment. Site locations provided in Table 1 and Figure 1.

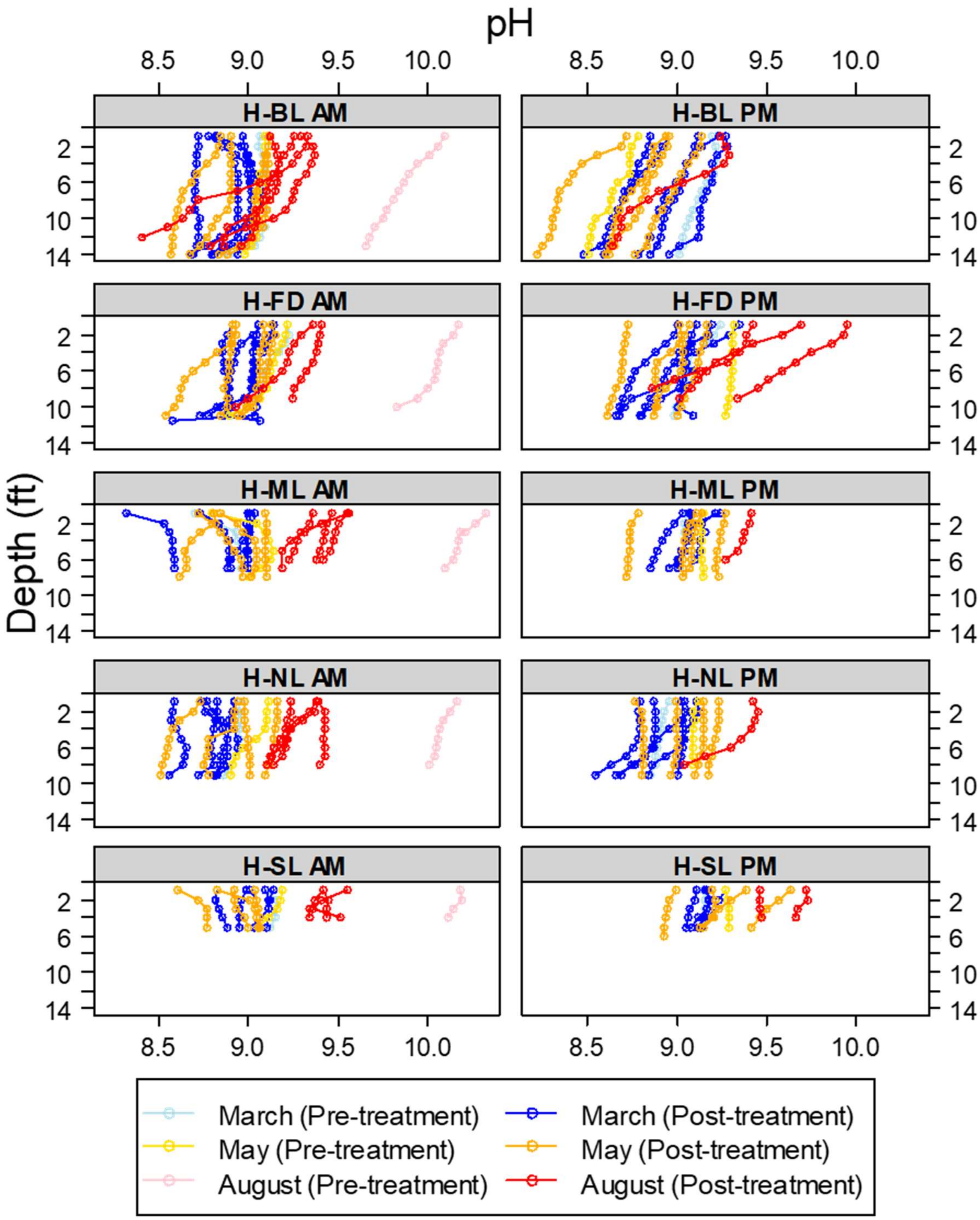


Figure 8. Lake Henshaw pH (standard units [s.u.]) during algaecide effectiveness monitoring associated with the March, May, and August 2022 treatment events.

Notes: Algaecide treatment occurred on 8/17 and 8/18/22, such that data collected on 8/16/22 in the morning (AM) were collected prior to algaecide treatment. Data collected on other dates in the morning (AM) or afternoon (PM) were collected after treatment. Site locations provided in Table 1 and Figure 1.

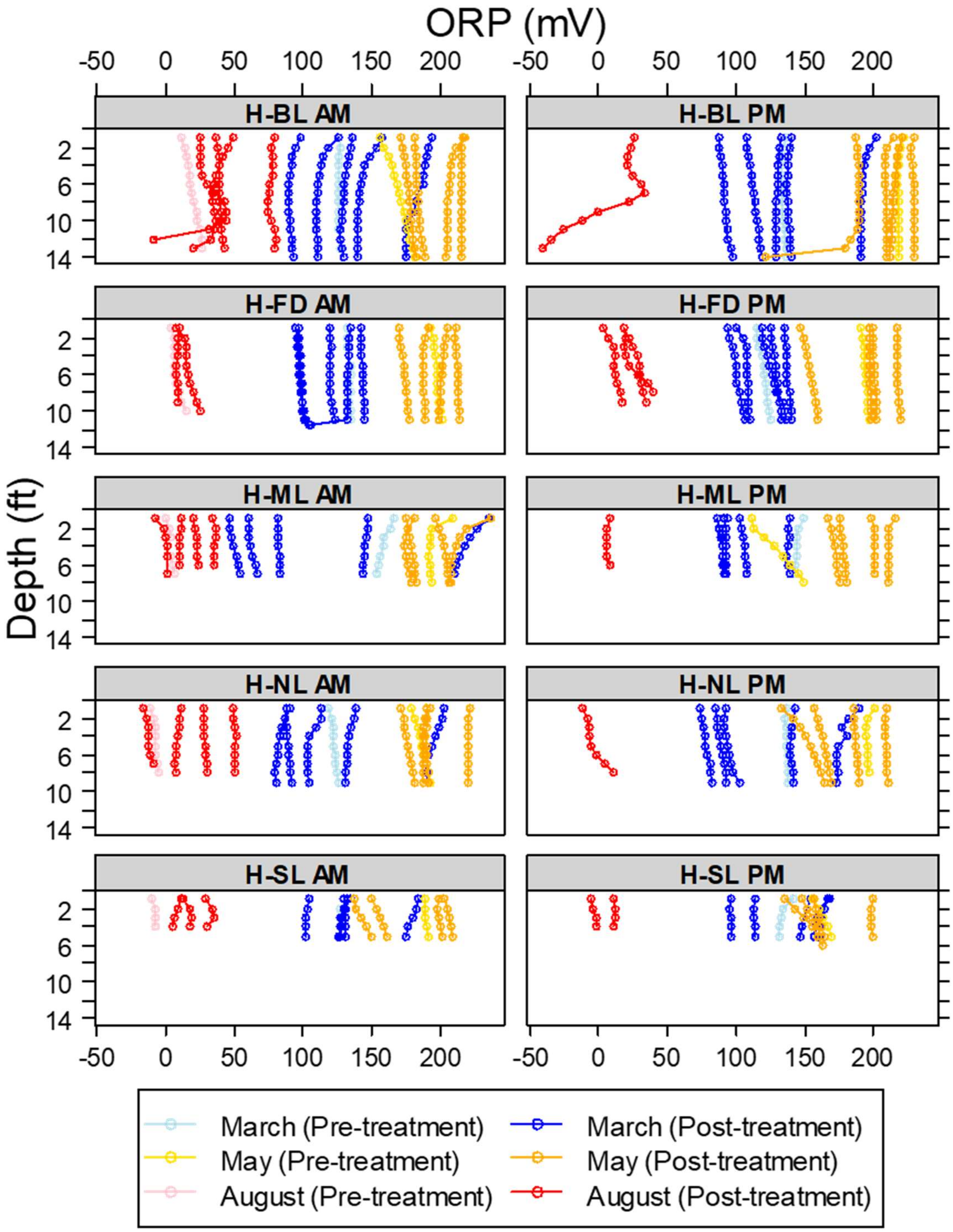


Figure 9. Lake Henshaw oxidation-reduction potential (ORP) (millivolts [mV]) during algaecide effectiveness monitoring associated with the March, May, and August 2022 treatment events.

Notes: Algaecide treatment occurred on 8/17 and 8/18/22, such that data collected on 8/16/22 in the morning (AM) were collected prior to algaecide treatment. Data collected on other dates in the morning (AM) or afternoon (PM) were collected after treatment. Site locations provided in Table 1 and Figure 1.

3.2 Chlorophyll-a, Cyanobacteria, and Cyanotoxins

3.2.1 Chlorophyll-*a* and pheophytin-*a*

For the August treatment event, pre-and post-treatment chlorophyll-*a* (chl-*a*) concentrations (a measure of algal biomass) in Lake Henshaw ranged 56–221 µg/L, with an overall average of 128 µg/L, and varied by sampling site (Appendix A, Table A-1). Comparisons between chl-*a* concentrations at H-FD and H-FDD, H-BLS and H-BL, and H-ML and H-MLD reveal no consistent pattern between surface and depth samples at open water sites. Chl-*a* concentrations well over 50 µg/L at all sites on all sampling dates indicate eutrophic to hypereutrophic conditions in August 2022.

Chl-*a* concentrations measured before the August algaecide treatment were higher than those measured before the March and May 2022 algaecide treatments (Figure 10). The overall average pre-treatment chl-*a* concentration in August was 153±36 (n=28), while that of March was 96±27 µg/L (n=23; Stillwater Sciences 2022a) and that of May was 55±14 µg/L (n=24; Stillwater Sciences 2022b). These data indicate that algal biomass levels were roughly 130% higher just prior to the August treatment as compared with the March treatment and 230% higher as compared with the May treatment. Examination of the longer chl-*a* dataset from February through August also indicates that pre-treatment concentrations were highest in August, and that the August treatment occurred just as bloom strength was beginning to wane (Figure 11).

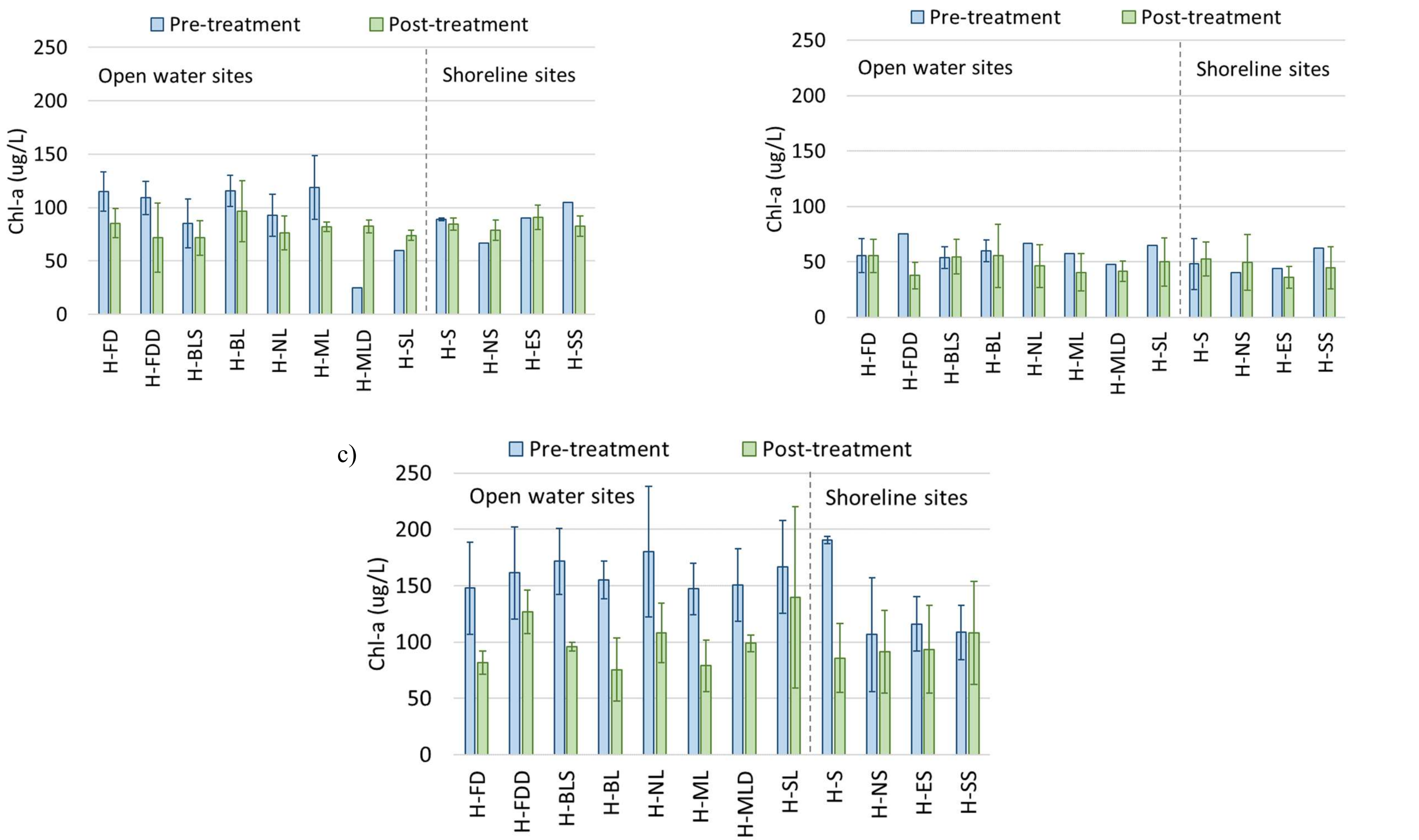
Post-treatment, overall average chl-*a* concentration in August was 99±32 µg/L (n=24), similar to that of March/April at 82±16 µg/L (n=43; Stillwater Sciences 2022a) and greater than that of May/June at 48±17 µg/L (n=40; Stillwater Sciences 2022b). The February through August chl-*a* dataset shows that while concentrations decreased immediately following treatment with the copper-based algaecide in August, they jumped upward again within approximately one week of treatment at some sites (Figure 11).

Post-treatment chl-*a* concentrations (8/19 and 8/22) decreased modestly (i.e., by 20%–55%) following the third algaecide treatment at deeper open water sites (H-FDD, H-BL, H-NL, H-M) and the western shoreline site (H-S) (Figure 10; Appendix A, Table A-1). Chl-*a* concentrations decreased somewhat at one open water site (H-SL) and two shoreline sites (H-NS, H-ES), and remained relatively unchanged at one shoreline site (H-SS) following the August copper-based algaecide treatment. Overall, 11 of 12 sites exhibited an average decrease and zero sites exhibited an average increase in chl-*a* concentrations following the August treatment. However, it is notable that at 8 of 12 sites the lowest chl-*a* concentrations occurred on 8/19, one to two days following treatment, before increasing again by 8/26, eight to nine days following treatment (Figure 11; Appendix A, Table A-1). It may be that nutrient releases occurring during cyanobacteria cell death (see Section 3.3) stimulated the growth of other types of algae (i.e., not cyanobacteria), increasing average chl-*a* concentrations.

The 20%–55% decrease in chl-*a* at most deeper open water sites and the western shoreline site following the August copper-based algaecide treatment was greater than the 10%–50% decrease in May/June and the 10%–40% decrease in March/April following peroxide-based treatments (Stillwater Sciences [2022a,b]).

Similar to conditions following treatment in March and May, pheophytin-*a* (phe-*a*) concentrations were generally lower than chl-*a* samples collected at the same location on the same date. Phe-*a* ranged 49–132 µg/L throughout the August pre- and post-treatment period (Appendix A, Table A-1). The ratio of phe-*a* to chl-*a* was variable across sampling sites and dates, ranging 0.4–0.9 for pre-treatment samples. Ratios tended to be higher following algaecide treatment, ranging 0.6–1.0, which is to be expected from senescing (dying) algae. Compared with ratios following the March and May peroxide-based treatments (Stillwater Sciences 2022 a,b), the ratios following the August copper-based treatment were higher.

a)



c)

Figure 10. Chlorophyll-a (chl-a) concentrations at Lake Henshaw open water sites (to the left of the vertical dashed line) and shoreline sites (to the right of vertical dashed line) before and after the a) March 2022, b) May 2022, and c) August 2022 algaecide treatments. Data are presented as average ±1 standard deviation, with number of samples per site and sampling dates for August 2022 presented in Appendix A, Table A-1. March 2022 details from Stillwater Sciences (2022a) and May 2022 details from Stillwater Sciences (2022b). Bars without standard deviations represent results from a single sample.

Figure 11. Chlorophyll-a (chl-a) concentrations at Lake Henshaw at routine monitoring sites (top) and all monitoring sites (bottom). Peroxide-based algaecide treatments occurred March 13–14 and May 16–19. A copper-based algaecide treatment occurred August 17–18.

3.2.2 Cyanobacterial cell counts

The genera represented in the August 2022 cyanobacterial cell counts were *Planktothrix*, *Microcystis*, *Snowella*, *Aphanocapsa, Dolichospermum, Aphanizomenon, Geitlerinema,* and *Cuspidothrix*. *Planktothrix* was the dominant genus (Figure 12, Appendix A, Table A-2).

Total cyanobacteria cell counts decreased by approximately 70% on average following the August algaecide treatment (Figure 12; Appendix A, Table A-2). As with chl-a (Figure 11), cell counts appeared to be decreasing in the lake leading up to the treatment date, with moderate inter-site variability. Total cyanobacteria cell counts measured prior to the August algaecide treatment were generally higher than those measured prior to the May treatment and lower than those measured prior to the March treatment (Figure 12). However, total cyanobacteria cell counts measured after the August algaecide treatment were substantially lower than counts measured after both the March and May treatments, indicating that the copper-based treatment was highly effective for reducing cyanobacteria cell counts (Figure 12). Based on the available information, it is not clear whether the copper-based treatment was so effective because it hastened along a cyanobacteria bloom that was already declining in strength, or whether the observed effect would have occurred regardless.

Cell counts also decreased for all cyanobacteria genera following the August copper-based algaecide treatment. Only two of the eight genera, *Planktothrix* and *Aphanocapsa*, were present at average densities greater than 1,000 cells/mL following treatment (Figure 13). *Planktothrix*, which has been the dominant cyanobacteria genus in Lake Henshaw throughout 2021–2022, exhibited the lowest cell counts measured to date following August treatment, with counts less than 50,000 cells/mL on average by 8/25/22. Cell counts of *Microcystis*, which may be an important producer of microcystin in Lake Henshaw, were zero by 8/22, within five to six days of treatment. Cell counts of *Dolichospermum*, which may be an important producer of anatoxin-a in Lake Henshaw, were zero by 8/19, within one to two days of treatment. However, note that cell counts of *Dolichospermum* decreased rapidly in early to mid-August prior to algaecide treatment, and counts were low but non-zero on 8/22 and 8/26, suggesting a possible rebound for this genus. *Dolichospermum* cell counts increased by an order of magnitude over the course of the May post-treatment sampling period following peroxide treatment (Stillwater Sciences 2022a), such that the August rebound was relatively muted.

Consistent with the March and May 2022 algaecide treatment (Stillwater Sciences 2022), patterns in cyanobacteria cell biovolume before the August treatment were dominated by *Planktothrix* (14.1 μm^3) and *Microcystis* (22.4 μm^3) due to their relatively large size and high abundance. Patterns in cyanobacteria cell biovolume after the August treatment were dominated by *Planktothrix*.

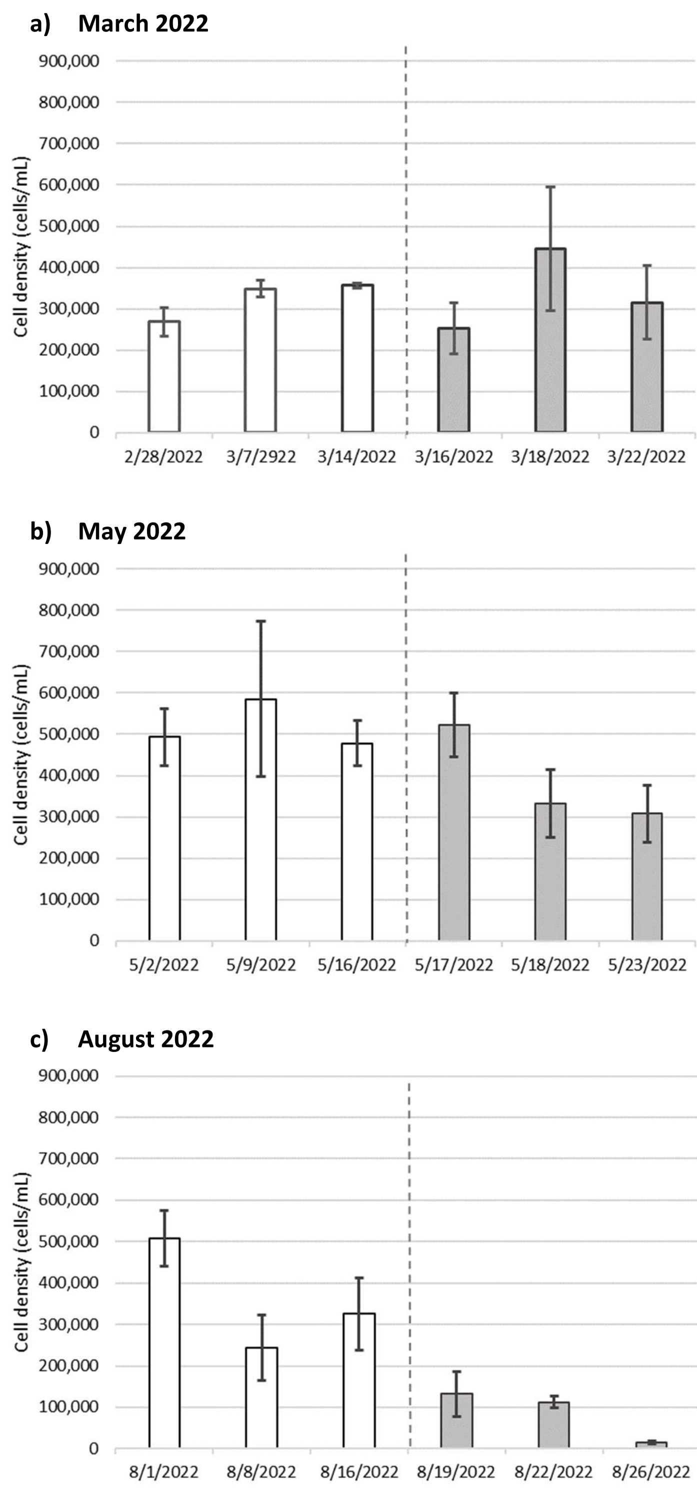


Figure 12. Total cyanobacterial cell densities measured in Lake Henshaw before and after the a) March and b) May peroxide-based algaecide treatments and the c) August copper-based algaecide treatment. Data are presented as average ±1 standard deviation. Number of samples per site and sampling dates for the August algaecide treatment are presented in Appendix A, Table A-2.

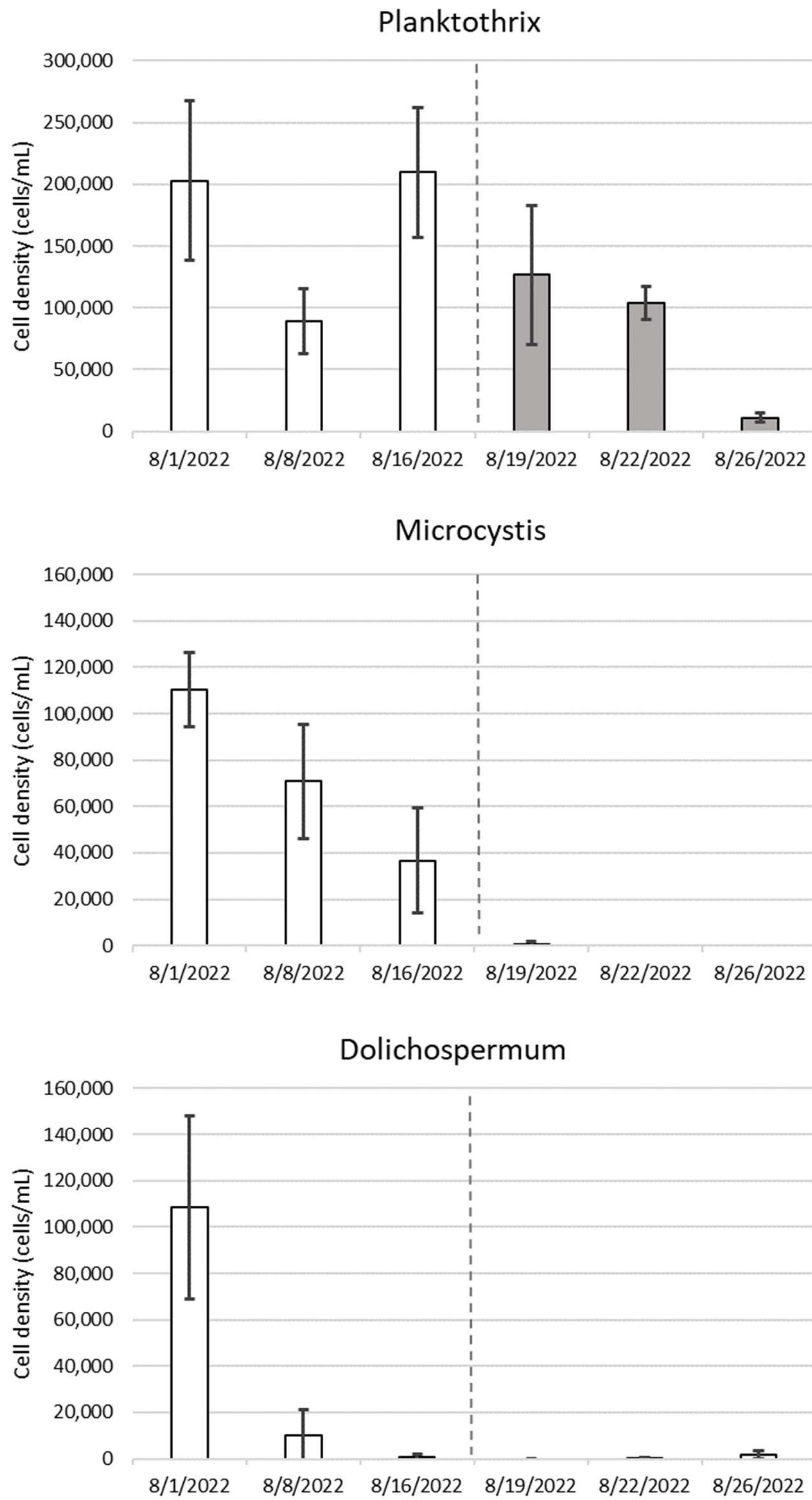


Figure 13. Cyanobacterial cell densities by genus measured in Lake Henshaw before and after the August copper-based algaecide treatments. Data are presented as average ±1 standard deviation. Number of samples per site and sampling dates for the August algaecide treatment are presented in Appendix A, Table A-2.

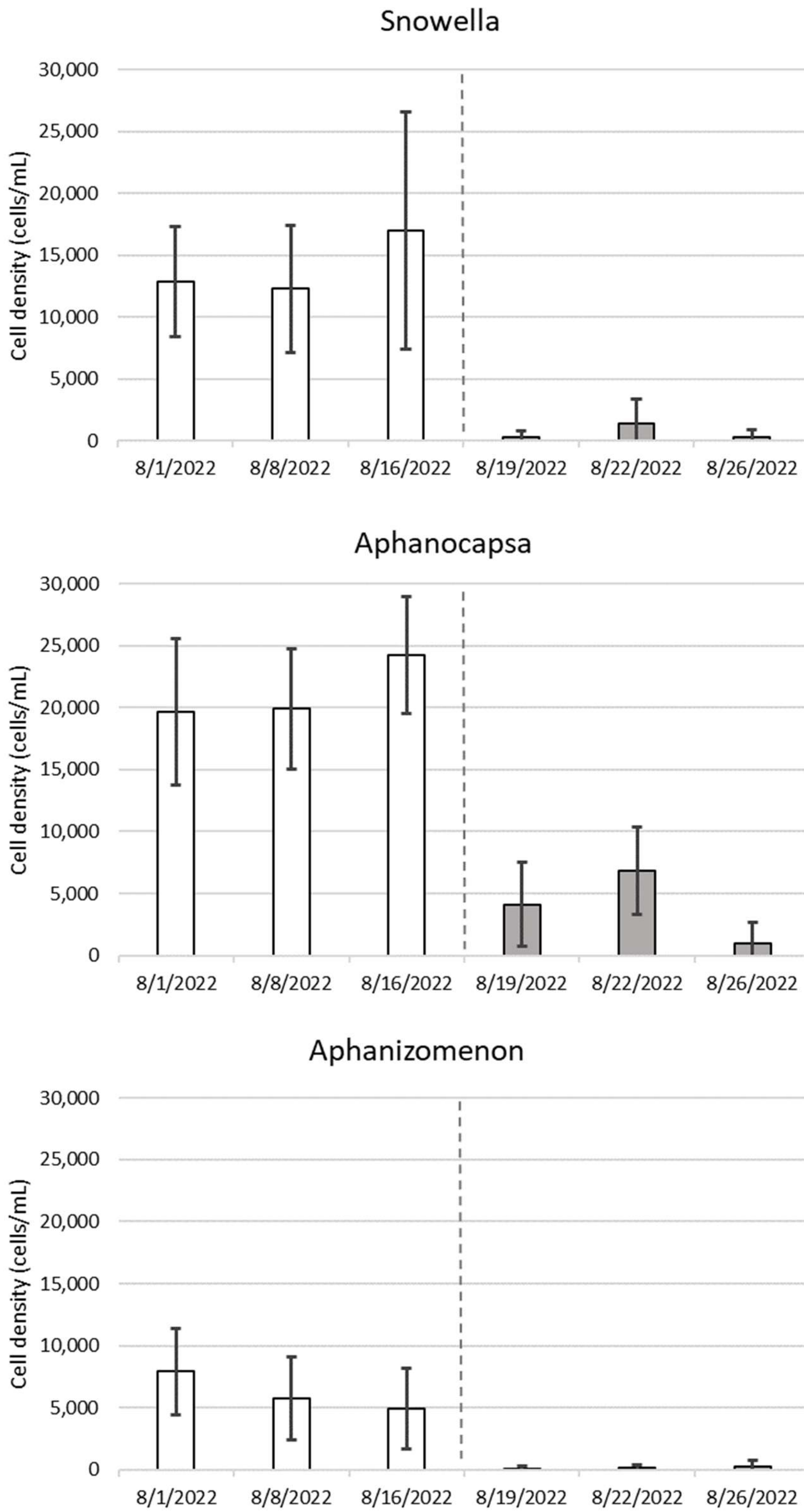


Figure 14. (Cont.) Cyanobacterial cell densities by genus measured in Lake Henshaw before and after the August copper-based algaecide treatments. Data are presented as average ±1 standard deviation. Number of samples per site and sampling dates for the August algaecide treatment are presented in Appendix A, Table A-2.

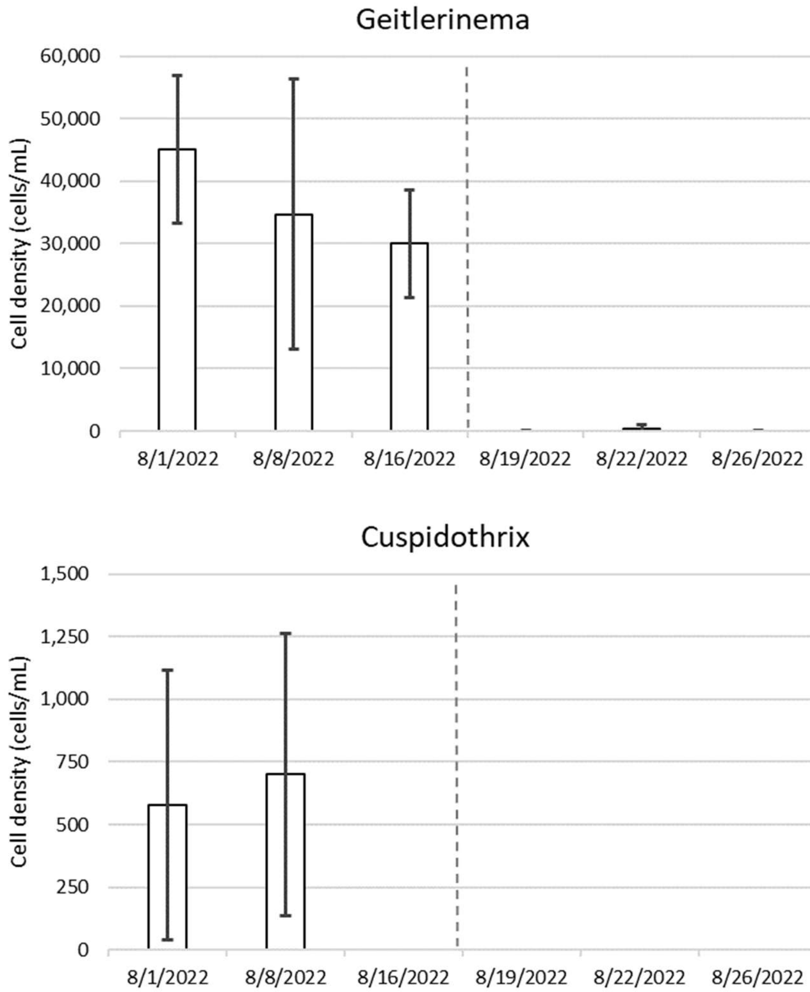


Figure 15. (Cont.) Cyanobacterial cell densities by genus measured in Lake Henshaw before and after the August copper-based algaecide treatments. Data are presented as average ±1 standard deviation. Number of samples per site and sampling dates for the August algaecide treatment are presented in Appendix A, Table A-2.

3.2.3 Microcystin and anatoxin-a

Microcystin concentrations ranged 0.26–0.99 µg/L prior to algaecide treatment and 0.20–0.49 µg/L following treatment (Figure 16, Appendix A, Table A-3). Based on data collected over a longer period from the routine monitoring sites H-S, H-FD, and H-BL, microcystin concentrations were generally decreasing prior to algaecide treatment and further decreased after treatment (Figure 16, Appendix A, Table A-3). Microcystin concentrations did not exhibit a peak within 10–13 days following treatment with the copper-based algaecide, in contrast to patterns observed in March and May when concentrations peaked at multiple sites approximately one to two weeks after the algaecide treatment before returning to pre-treatment levels.

Anatoxin-a concentrations ranged 1.09–7.15 µg/L prior to algaecide treatment and 0.23–1.38 µg/L following treatment (Figure 17, Appendix A, Table A-3). Based on data collected over a longer period from the routine monitoring sites H-S, H-FD, and H-BL, anatoxin-a concentrations were generally increasing prior to algaecide treatment. Within one to two days of treatment, on 8/19, anatoxin-a concentrations were reduced below the reporting limit at nine of twelve sites, and within three to four days of treatment, on 8/22, were reduced below the reporting limit at all sites (Figure 17, Appendix A, Table A-3).

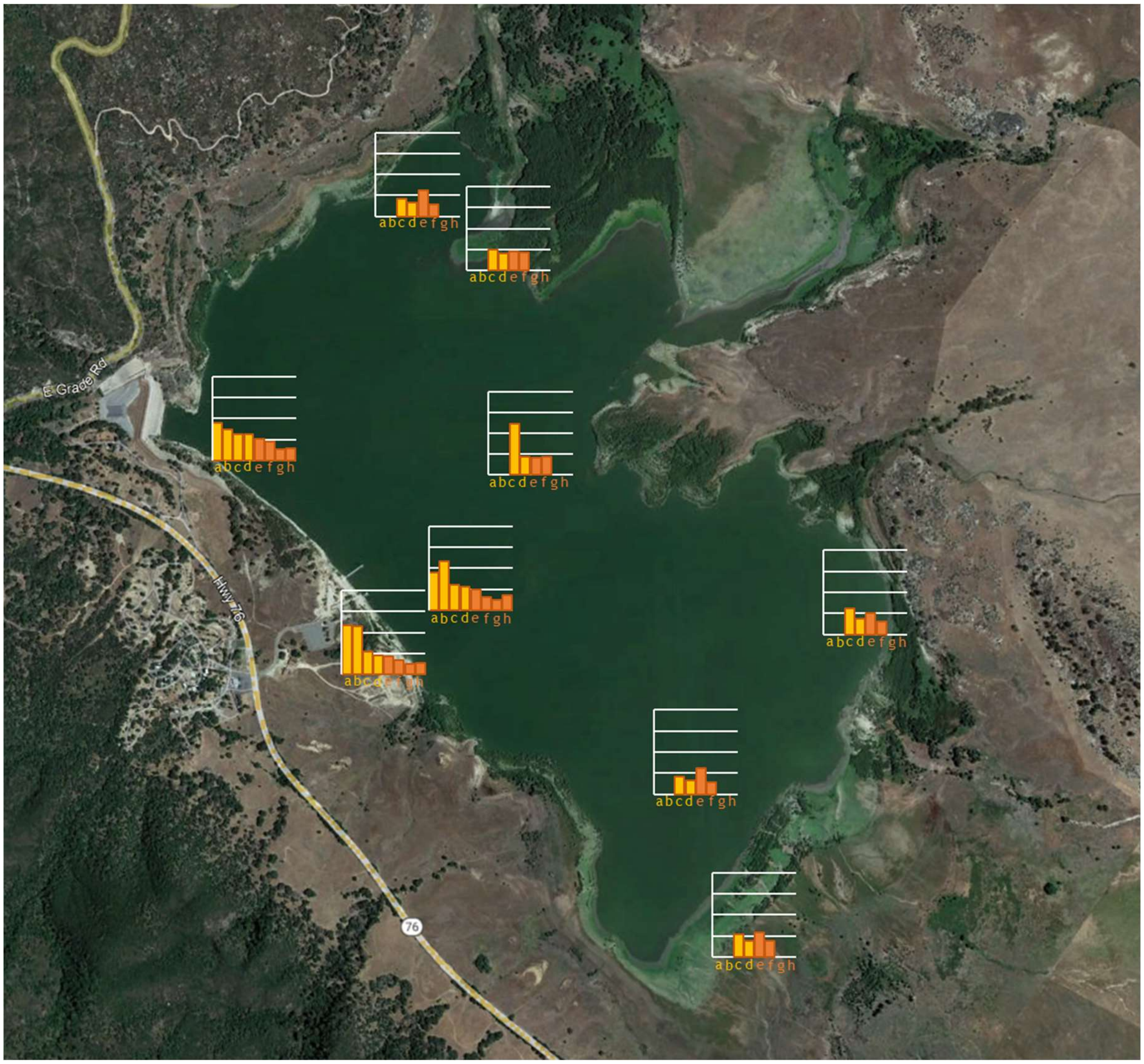


Figure 16. Microcystin concentrations in Lake Henshaw before and after the August 2022 copper-based algaecide treatment.

Yellow bars and lower-case letters represent microcystin concentrations from samples collected prior to algaecide treatment. Orange bars and lower-case letters represent microcystin concentrations from samples collected after algaecide treatment. Sampling dates are as follows: a = 7/25/22; b = 8/1/22; c = 8/8/22; d = 8/16/22; e = 8/19/22; f = 8/22/22; g = 8/26/22; h = 8/29/2022; i = 5/31/2022; and j = 6/6/2022. White horizontal lines indicate 0.0, 0.4, 0.8, 1.2, and 1.4 ug/L microcystin. Missing bars indicate that no sampling occurred at a given sampling site on a given date.

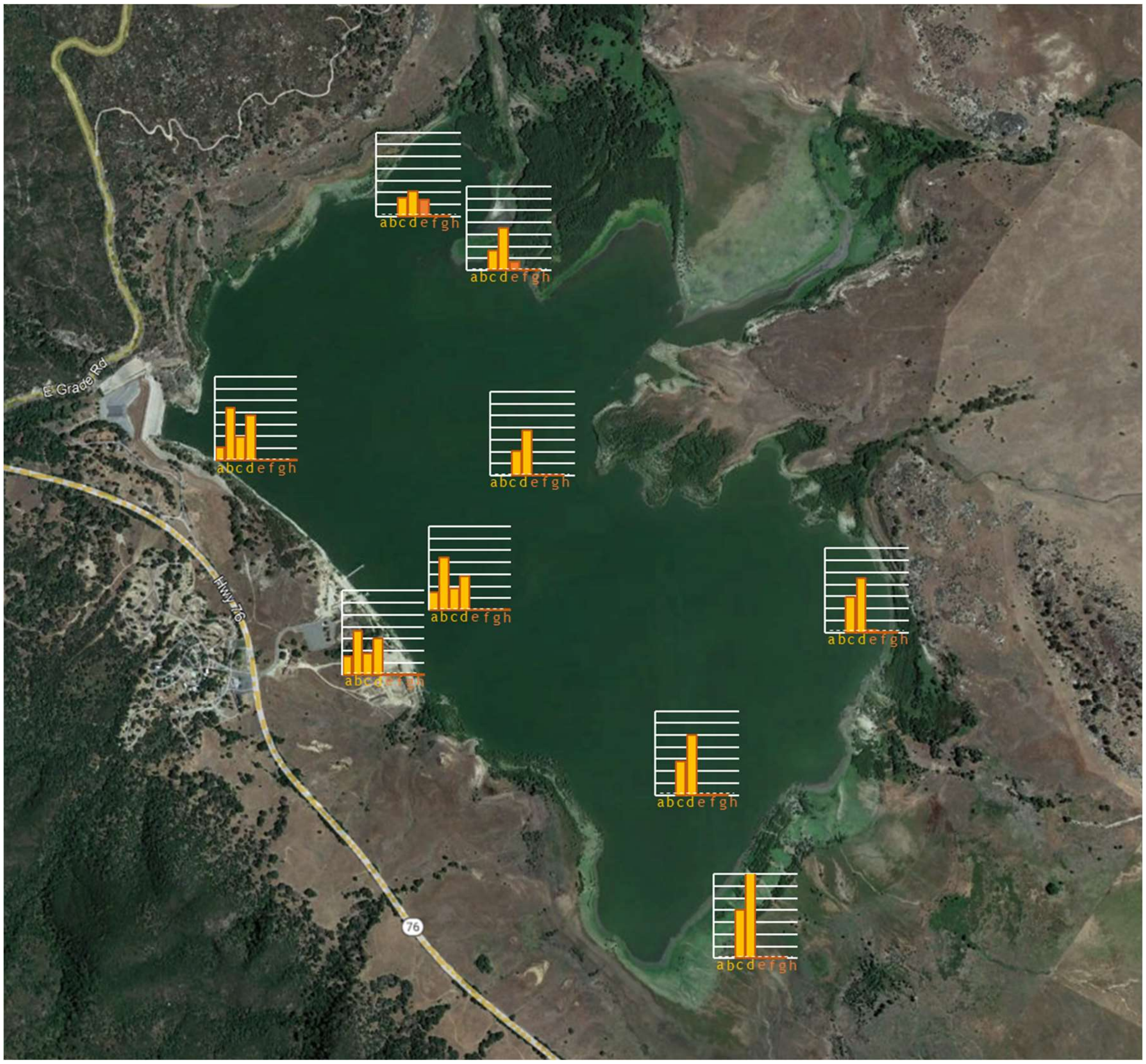


Figure 17. Anatoxin-a concentrations in Lake Henshaw before and after the August 2022 copper-based algaecide treatment.

Yellow bars and lower-case letters represent microcystin concentrations from samples collected prior to algaecide treatment. Orange bars and lower-case letters represent microcystin concentrations from samples collected after algaecide treatment. Sampling dates are as follows: a = 7/25/22; b = 8/1/22; c = 8/8/22; d = 8/16/22; e = 8/19/22; f = 8/22/22; g = 8/26/22; h = 8/29/2022; i = 5/31/2022; and j = 6/6/2022. Missing bars indicate that no sampling occurred at a given sampling site on a given date.

3.3 Nutrients

In general, bioavailable nutrient species increased after the August copper-based treatment, while total nitrogen and phosphorus slightly increased or decreased, depending on the site. Nutrient concentrations were generally similar across sites within given sampling dates. In general, nutrient concentrations associated with the August treatment were more dynamic than those associated with March and May treatments (Stillwater Sciences 2022 a, b).

In August, total nitrogen concentrations ranged 3.99–5.69 mg/L prior to algaecide treatment and 3.50–5.12 mg/L following treatment, with four of five sites exhibiting small decreases ranging 2% to 19% depending on the site (Appendix A, Table A-4). Decreased total nitrogen following treatment indicates that nitrogen contained within cyanobacteria and/or algae may have been settling out of the water column along with senescing (dying) cells. Total nitrogen was generally similar to concentrations measured during the March and May 2022 algaecide application sampling periods (Stillwater Sciences 2022a,b).

While the range of nitrate concentrations was generally similar throughout the sampling period, ranging 0.13–0.39 mg/L and 0.16–0.40 mg/L prior to and following treatment, respectively, on average nitrate increased by 40%–85% at all sites but H-FD, where this nitrogen species decreased by 9% (Appendix A, Table A-4). Increasing nitrate concentrations following treatment suggest that cell death and lysing resulted in release of nitrate, and/or that ammonia released from cells upon their death was subsequently converted to nitrate if sufficient oxygen was available.

Ammonia concentrations ranged two orders of magnitude 0.004–0.47 mg/L prior to treatment due to relatively high concentrations at sites H-BL and H-BLS in late July/early August. Ammonia concentrations also ranged two orders of magnitude after treatment, 0.02–1.97 mg/L, although the reason was because relatively high concentrations (> 1 mg/L) occurred on 8/22 and 8/26, three to seven days following treatment (Appendix A, Table A-4). On average, ammonia increased by 400% to over 3,500% across all sites. The elevated ammonia concentrations, including 0.5−0.7 mg/L on 8/19, correspond to low DO concentrations in bottom waters on 8/19 and 8/22, and would be consistent with the release of ammonia from anoxic bottom sediments. It is also possible that ammonia was released from cyanobacteria cells upon their death, although some of it may have been converted to nitrate (see above).

Nitrate and ammonia concentrations associated with the August algaecide treatment event were generally higher than those measured during March and May, particularly following algaecide treatment (Stillwater Sciences 2022a,b).

Total phosphorous concentrations ranged 0.37–0.45 mg/L prior to algaecide treatment and 0.31–0.58 mg/L following treatment, with two of five sites exhibiting 7% decreases (Appendix A, Table A-4). The lack of consistent decrease in total phosphorus following treatment indicates that any settling-out signal was muted by total phosphorus that remained in the water column. Total phosphorus was 1.5–2.5 times greater than concentrations measured during the March and May 2022 algaecide application sampling periods (Stillwater Sciences 2022a,b).

Orthophosphate concentrations ranged 0.09–0.18 mg/L before treatment and 0.02–0.37 mg/L after treatment (Appendix A, Table A-4) and were 3-4 times greater than concentrations measured during the March and May 2022 algaecide application sampling periods (Stillwater Sciences 2022a,b). Concentrations increased 8% to 88% following treatment, depending on site (Appendix A, Table A-4), where some of the highest values occurred on 8/19 and 8/22, corresponding to low DO concentrations in bottom waters on these dates. The observed increases in orthophosphate would be consistent with the release of this bioavailable nutrient from anoxic bottom sediments. It is also possible that orthophosphate was released from cyanobacteria cells upon their death. Although the copper-based algaecide used in Lake Henshaw in August (SeClear) also contains an orthophosphate binding agent, it does not appear that the chemical binding agent was present in sufficient quantities to eliminate the observed increases in this nutrient following algaecide application.

3.4 Copper and Hardness

3.4.1 Background Copper in Lake Henshaw Surface Water and Sediments

The District collected samples from Lake Henshaw on 8/8/22 to establish background concentrations of total copper in surface waters (Table 3) and sediments (Table 4) prior to application of a copper-based algaecide later in August. Surface water samples from Lake Henshaw averaged 5.6 ± 0.4 ug/L, which is moderately low for aquatic ecosystems. Lake Henshaw sediments averaged 5.9 ± 2.7 mg/kg, which is below the 14.4–16.6 mg/kg range reported by USGS for the top 0 to 5 cm of surface soils in the vicinity of Lake Henshaw (Smith et al. 2014).

Table 3. Lake Henshaw water column background results for total copper. All samples collected on 8/8/22.

Sample Site ID	Surface Water Total Cu (ug/L)[1]
H-BL	6.2
H-FD	5.0
H-ML	5.8
H-NL	5.7
H-SL	5.4
n	5
Mean	5.6
Standard Deviation	0.4

[1] Analyzed using EPA Method 200.8. MRL = 2.4 ug/L, MDL = 0.48 ug/L.

Table 4. Lake Henshaw sediment background results for total copper. All samples collected on 8/8/22.

Sample Site ID	Sediment Total Cu (mg/kg)
H-BL	5.4
H-FD	2.9
H-ML	8.1
H-OUT	1.9
H-1	6.3
H-2	7.3
H-3	2.8
H-4	7.5
H-5	5.8
H-6	8.7
H-NL	7.0
H-7	4.1
H-8	5.3
H-ES	1.0
H-SL	9.8

Sample Site ID	Sediment Total Cu (mg/kg)
H-SS	9.8
n	16
Mean	5.9
Standard Deviation	2.7

3.4.2 Copper and Hardness in Lake Henshaw Following Application of a Copper-based Algaecide

Copper was added to Lake Henshaw in SeClear as copper sulfate pentahydrate ($CuSO_4 \bullet 5H_2O$), which dissociates in water to cupric ion (Cu^{2+}), sulfate (SO_4^{2-}), and water. Cupric ion is rapidly taken up by algae and cyanobacteria through binding on cell surfaces and transport through cell walls, and it rapidly binds to inorganic and organic ligands in water, including hydrous manganese and iron oxides, sulfides, and dissolved organic carbon (DOC). Copper associated with algae and cyanobacteria in the water column is present in particulate form, while copper associated with ligands in water is present as a dissolved form, even if it is complexed with manganese and iron oxides and/or DOC. Total copper measures all forms of copper.

The District measured total copper concentrations in Lake Henshaw before and after the August 17–18, 2022 application of copper-based algaecide (Table 5). Concentrations decreased exponentially following treatment (**Figure 19**), with approximately 94% removal of total copper within seven days of treatment, assuming a 0.87 mg/L (870 ug/L) initial dose (see dosing details in Section 1). Note that the relatively low total copper measurement at H-NL on 8/19 is consistent with some more shallow northern, eastern, and southern areas of the lake not being treated directly due to applicator boat accessibility challenges. Based on the first order exponential equation shown in **Figure 19**, 50% removal of total copper occurred within six days and 70% removal of total copper occurred within ten days. The predicted amount of time for total copper concentrations to return to background is approximately 29 days. These estimated total copper removal times are somewhat faster than those reported for two temperate lakes included in a compilation of field, laboratory, and modeling studies on the fate of copper added to surface water (Rader et al. 2019).

Although the *Aquatic Pesticide Application Plan for Lake Henshaw and the Warner Ranch* (Marine Biochemists 2021) specifies a maximum copper concentration based on total copper, the General NPDES Permit No. CAG990005 for algaecide application, which is applicable to Lake Henshaw, clarifies that the copper criterion is now expressed in dissolved rather than total concentration because it is the dissolved portion of copper that is available to aquatic life (SWRCB 2016). Thus the hardness-based copper limit for Lake Henshaw is based on dissolved copper, as shown below.

$$\text{Maximum dissolved copper} = 0.960\exp\{0.8545\,[\ln(\text{hardness})] - 1.702\} \qquad \text{Equation 1}$$

Where hardness is measured in mg/L and dissolved copper is measured in ug/L.

Hardness is measured in Lake Henshaw two times each year as part of routine monitoring for California Code of Regulations Title 22 (T22) compliance, with an average hardness of 128±34 as $CaCO_3$ for the period 1983–2022 (n=86; range 71–209 mg/L; Figure 18). As part of compliance for General NPDES Permit No. CAG990005 for algaecide application, the District also measured hardness on August 24 and 30, and September 1 and 6, 2022, and these measured values were unusually low, with an average hardness of 80±9 mg/L as $CaCO_3$ (n=14; range 71–95 mg/L (Table 5, Figure 18).

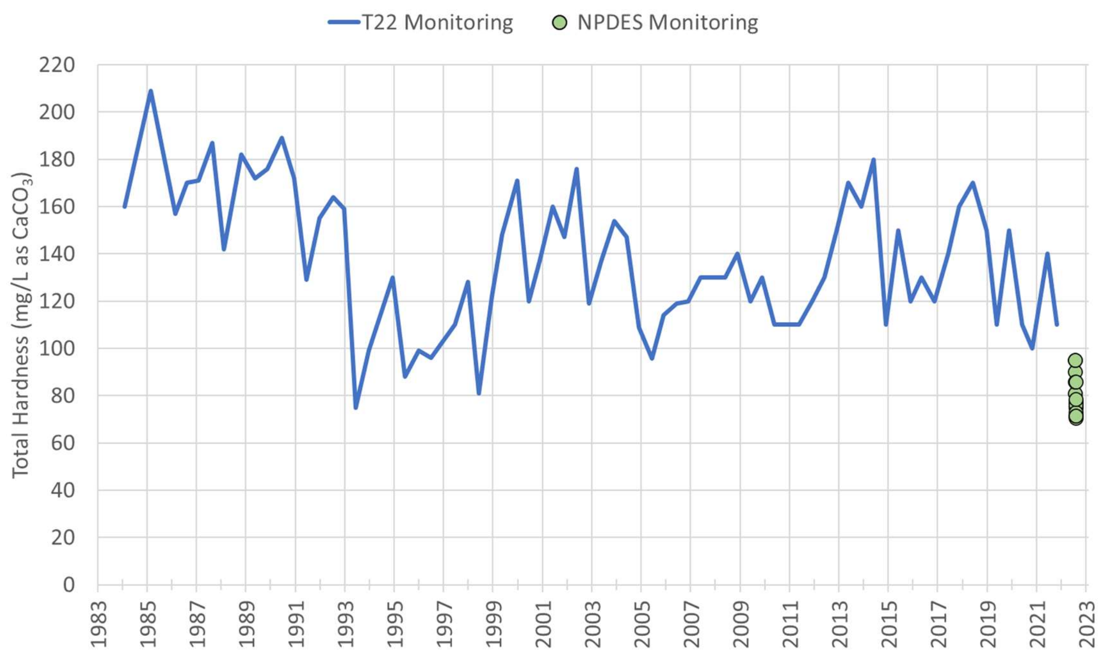


Figure 18. Lake Henshaw measured hardness for the period 1983–2022.

Table 5. Lake Henshaw hardness, total copper, and dissolved copper prior to and following treatment with a copper-based algaecide.

Sample Date	Days Since Treatment[1]	Sample Site ID	Hardness (mg/L)	Measured Total Cu (ug/L)	NPDES Maximum Dissolved Cu Threshold (ug/L)[2]	Measured or Calculated Dissolved Cu (ug/L)	Fraction Diss Cu:Tot Cu
8/2/2022	-17	H-BL	–	6.2	7.4[3]	2.0[5]	–
	-17	H-FD	–	5.0	7.4[3]	1.6[5]	–
	-17	H-ML	–	5.8	7.4[3]	1.9[5]	–
	-17	H-NL	–	5.7	7.4[3]	1.8[5]	–
	-17	H-SL	–	5.4	7.4[3]	1.7[5]	–
8/19/2022	2	H-SL	–	290	7.4[3]	92.7[5]	–
	2	H-ML	–	270	7.4[3]	86.3[5]	–
	2	H-NL	–	37	7.4[3]	11.8[5]	–
	2	H-BL	–	270	7.4[3]	86.3[5]	–
	2	H-FD	–	260	7.4[3]	83.1[5]	–

Sample Date	Days Since Treatment[1]	Sample Site ID	Hardness (mg/L)	Measured Total Cu (ug/L)	NPDES Maximum Dissolved Cu Threshold (ug/L)[2]	Measured or Calculated Dissolved Cu (ug/L)	Fraction Diss Cu:Tot Cu
8/22/2022	5	H-SL	–	53	7.4[3]	16.9[5]	–
	5	H-ML	–	86	7.4[3]	27.5[5]	–
	5	H-NL	–	89	7.4[3]	28.5[5]	–
	5	H-BL	–	94	7.4[3]	30.0[5]	–
	5	H-FD	–	83	7.4[3]	26.5[5]	–
8/24/2022	7	H-SL	90.1	51	8.2[4]	16.3[5]	–
	7	H-ML	81.0	51	7.5[4]	16.3[5]	–
	7	H-NL	95.1	59	8.6[4]	18.9[5]	–
	7	H-BL	95.1	61	8.6[4]	19.5[5]	–
	7	H-FD	86.0	55	7.9[4]	17.6[5]	–
8/30/2022	13	H-BL	77.3	29	7.2[4]	9.2[6]	0.32
	13	H-FD	74.8	28	7.0[4]	9.8[6]	0.35
	13	H-ML	76.0	29	7.1[4]	9.5[6]	0.33
9/1/2022	15	H-BL	73.1	27	6.9[4]	8.9[6]	0.33
	15	H-FD	78.5	26	7.3[4]	9.6[6]	0.37
	15	H-ML	70.6	20	6.7[4]	8.3[6]	0.42
9/6/2022	20	H-BLS	71.5	22	6.7[4]	6.5[6]	0.30
	20	H-FD	71.5	23	6.7[4]	5.7[6]	0.25
	20	H-ML	86.0	24	7.9[4]	5.4[6]	0.23

1 Lake Henshaw treatment with copper persulfate occurred on August 17 and 18, 2022. See Section 1 for dosing details.
2 The dissolved copper threshold for freshwater aquatic life is calculated using Equation 1.
3 Calculated using average hardness measured in Lake Henshaw on August 24 and 30, and September 1 and 6, 2022.
4 Calculated using hardness measured on the same day as dissolved and/or total copper.
5 Calculated using average ratio of dissolved to total copper measured on August 30 and September 1 and 6, 2022.
6 Measured in Lake Henshaw surface waters.

Based on measured hardness, the maximum allowable dissolved copper concentrations for supporting release of Lake Henshaw water to the San Luis Rey River under the NPDES permit ranged 6.7–8.6 µg/L (average = 7.4 µg/L) on August 24 and 30, and September 1 and 6, 2022. Measured dissolved copper fell below this range on September 6, 2022 (Table 5). The maximum dissolved copper concentrations allowable for release on other dates in August are estimated using the average measured hardness for the aforementioned date range, and dissolved copper concentrations for other dates in August are estimated using the average ratio of dissolved to total copper for August 30 and September 1 and 6, 2022 (Table 5).

Concentrations of dissolved copper decreased exponentially following treatment (Figure 20), with approximately 98% removal of dissolved copper within seven days of treatment, assuming a 0.87 mg/L (870 ug/L) initial dose (see dosing details in Section 1). Based on the first order exponential equation shown in Figure 20, 50% removal of dissolved copper occurred within six days and 70% removal of dissolved copper occurred within ten days. The predicted amount of time for total copper concentrations to return to the average maximum allowable lake release concentration of 7.4 µg/L is approximately 16 days and to background is approximately 28 days.

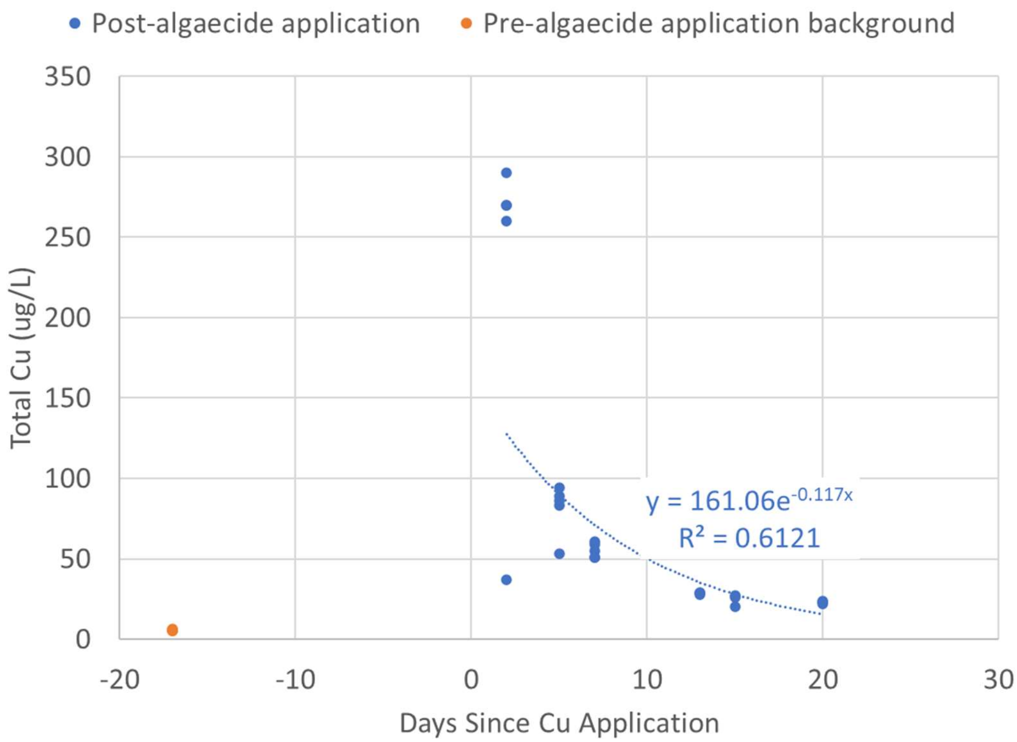


Figure 19. Measured total copper concentrations in Lake Henshaw before and after the August 17–18, 2022 application of copper-based algaecide.

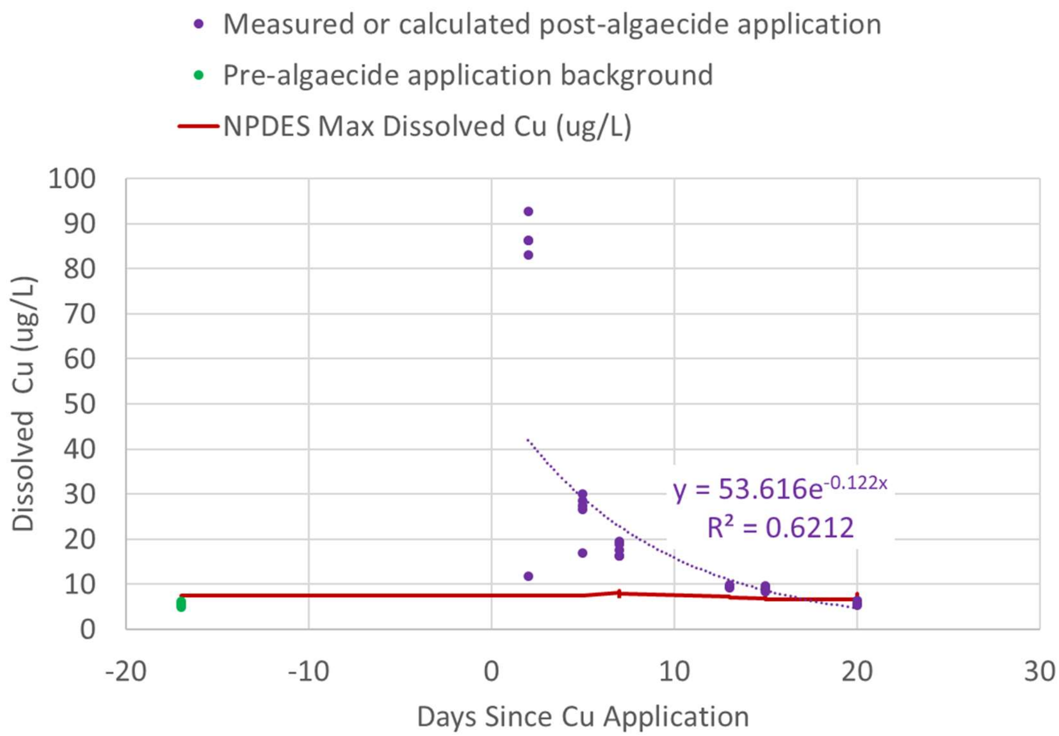


Figure 20. Measured or calculated dissolved copper concentrations in Lake Henshaw before and after the August 17–18, 2022 application of copper-based algaecide.

In addition to resulting in lower than anticipated dissolved copper thresholds constraining the release of Lake Henshaw water for downstream recreational uses, the unusually low hardness measured in Lake Henshaw immediately following copper-based algaecide application suggest that excessive photosynthesis in lake waters during summer months may be resulting in the temporary precipitation of multiple cations including calcium and magnesium (Appendix B). The high pH levels resulting from intense levels of photosynthesis, including pH greater than 10 s.u. prior to algaecide treatment on the morning of 8/16; Figure 2), could have contributed to decreases in hardness through a) the precipitation of calcium and/or magnesium with phosphate as apatite [$Ca_{10}(PO_4)_6(X)_2$, with X = OH, Cl, or F] or struvite ($MgNH_4PO_4$); or b) the precipitation of calcium with carbonate as calcite ($CaCO_3$). It is also possible that calcium precipitated with sulfate as gypsum ($CaSO_4 \cdot 2H_2O$), although this reaction is not pH-dependent. The most likely explanation is that of calcite precipitation, since phosphate and sulfate concentrations in Lake Henshaw were not sufficiently high (even after accounting for algaecide application) to bind a large amount of calcium (Appendix B), but at pH greater than 9 s.u., calcite precipitation from lakes is favored (Ruiz-Agudo et al. 2011).

Given the unexpected decrease in hardness in Lake Henshaw in August 2022, planning for future copper-based algaecide applications should include sampling and analysis of hardness for three to four weeks before and after the application period.

3.5 Fish Mortality

Fish mortality was reported in Lake Henshaw on 8/19 and 8/20/22, two to three days following the copper-based algaecide treatment. An abundance of shad and several dozen individuals of bass, crappie, catfish, and carp were found dead at various locations in the lake on both dates. While copper acute toxicity thresholds are not readily available for each of these fish species, estimates of 96-hour median lethal concentration (LC50) values are reported as 1.75 mg/L Cu (1,075 ug/L) for channel catfish (*Ictalurus punctatus*) and 0.85 mg/L Cu (850 ug/L) for sunshine bass (*Morone chrysops x Morone saxatilis*), presumably as total copper (Straus 2006). Other conditions of the Straus (2006) toxicity testing include filtered well water with a temperature of 18.9°C, an initial pH of 8.71 s.u., and total alkalinity and total hardness of 224 and 110 mg/L, respectively. A 96-hour LC50 means that the fish were exposed to the aforementioned concentrations of total copper for four days, at which point 50% of the test organisms had experienced mortality. While the lower of the two LC50 values reported by Straus (2006) is close to the 0.87 mg/L (870 ug/L) total copper concentration applied in SeClear on 8/17 and 8/18, fish in Lake Henshaw would not have been exposed to the application concentration for multiple days since lateral mixing immediately dilutes the chemical within the water column. Additionally, the applicator boats were constrained to water depths greater than approximately 1.5 feet of depth, such that large swaths of shallow areas in the lake were not directly treated and offered refuge for fish. The maximum concentration of total copper measured in the lake was just under 300 ug/L within one to two days following treatment, and the maximum concentration of bioavailable dissolved copper (calculated) was just under 90 ug/L (Table 5). Further, while hardness appears to have decreased in Lake Henshaw during August (Figure 18), concentrations remained well above “soft water” values that could meaningfully and rapidly increase copper toxicity to fish.

As some fish species have been reported to be sensitive to much lower concentrations of copper (e.g., 14.61 µg/L mean acute toxicity for northern pikeminnow [*Ptychocheilus oregonensis*]; 22.19–54.82 µg/L mean acute toxicity for a variety of salmonid species, life history stages, and exposure periods; USEPA 2007), it is not possible to completely rule out acute copper toxicity as a contributor to the Lake Henshaw fish mortality event on 8/19 and 8/20/22. However, given that *in situ* DO data indicate that the lake experienced three consecutive days of low DO at multiple sites throughout the water column during and after algaecide treatment, with 96% of measurements below 5 mg/L, 87% of measurements below 4 mg/L, 62% of measurements below 3 mg/L, and 32% of measurements below 2 mg/L on 8/19 (Table 2), it is highly likely that depressed DO played a significant role in fish mortality. Warmwater fish, including the species listed above, generally exhibit impaired behavior with DO concentrations that are chronically less than 5 mg/L, with concentrations below 3 or 4 mg/L as potentially lethal.

Section 5.5.2.3 of the *Draft Harmful Algal Blooms Management and Mitigation Plan* states the following:

> *For large-scale treatment within the lake, if dissolved oxygen measured before 0900 at multiple rapid response monitoring sites is generally less than 5 mg/L in surface waters and/or less than 2 mg/L in bottom waters, and cell counts are greater than $1x10^6$ cells/mL, then the HAB may be too dense to be effectively treated with an algaecide. In this case, the District will return to routine monitoring on a weekly basis to track progression of the HAB. If cell count data are not available to inform selection of the minimum effective algaecide dose, then dosing will default to a moderate level.*

The above reference to DO measured before 0900 that is generally less than 5 mg/L in surface waters and/or less than 2 mg/L in bottom waters is intended to protect against fish mortality. On

8/16 prior to the treatment event, all surface water DO measurements were above 5 mg/L and no bottom water measurements were below 2 mg/L (Section 3.1.2). However, on 8/16 the measurements were not taken before 9:00 am, where DO concentrations are often at their 24-hour minimum in the early morning due to nighttime respiration of algal and cyanobacterial colonies. Thus, the DO measurements on 8/18 may not have reflected the full extent of the pre-algaecide treatment water column and bottom sediment DO demand in Lake Henshaw. On 8/17 at approximately 8:18 am and 8:27 am, just before treatment began, the algaecide applicator recorded surface water DO above 5 mg/L, although the results were 5.7 mg/L (78% saturation) at one open water location, which is relatively low for surface water. Bottom water DO concentrations recorded by the applicator at these times were 2.5 mg/L (34% saturation) at approximately 6 feet of depth and 3.3 mg/L (45% saturation) at approximately 7 feet of depth, thus aligning with the aforementioned trigger from the *Draft Harmful Algal Blooms Management and Mitigation Plan*.

Following the first day of the August algaecide treatment event and before the second day of treatment occurred (i.e., at 7:45 am on the morning of 8/18), while surface water DO aligned with the aforementioned trigger at one open water site, at another relatively shallow site in the southern portion of the lake surface water DO was 3.0 mg/L (39% saturation) and bottom water (approximately 4 feet) DO was 0.95 mg/L (13% saturation; see also Section 3.1.2). Thus, by the morning of the second day of treatment, the measured DO concentrations did not align with the aforementioned trigger at all locations in Lake Henshaw.

Note that the above reference to cell counts greater than $1x10^6$ cells/mL refers to total cell counts, including all types of algae (e.g., green, golden, diatoms) and cyanobacteria. The District is currently analyzing only cyanobacteria counts since the latter are the producers of the cyanotoxins measured in Lake Henshaw. Cyanobacteria counts have not exceeded 700,000 cells/mL based on available data. However, because the death of other algae present in the lake in August would also contribute to DO demand, and since many applicators use total cell counts to gage whether a bloom is too dense to effectively treat with algaecides, collection of total cell count data prior to a treatment event would provide additional context for decisions related to treatment and predictions of lake response.

In summary, although the applicator (AquaTechnex) followed algaecide label requirements (i.e., less than 50% of the lake surface area was treated to avoid oxygen depletion from senescing (dying) algae; less than 1 mg/L [1,000 ug/L] copper was applied in a single treatment; the lake was treated in bands to allow for lateral mixing and dilution, and for fish to move into untreated areas) it is likely that low DO resulting from large-scale treatment resulted in limited fish mortality in Lake Henshaw. However, as indicated above, it is not possible to completely rule out acute copper toxicity as a contributor to the Lake Henshaw fish mortality event, such that low DO and copper added in the algaecide may have acted in combination to kill a limited number of fish following algaecide application.

4 CONCLUSIONS AND RECOMMENDATIONS

Conditions in Lake Henshaw during the August copper-based algaecide application event were characterized by a lack of thermal stratification across open water and shoreline locations alike. Algal activity was very high at all sites, as evidenced by occasional supersaturated DO in surface waters, pH > 10.0 at some locations in the lake, and chl-*a* concentrations ranging 56–221 µg/L. DO in August was variable, with low DO (near or below 5 mg/L) in bottom waters at deeper open water sites prior to algaecide treatment, indicating that a fair amount of water column and/or sediment oxygen demand was present prior to treatment. While microcystin concentrations were beginning to wane prior to treatment and were below 1 µg/L, anatoxin-a concentrations were increasing and had reached 7.19 µg/L prior to treatment. Readily bioavailable nutrients were relatively higher in surface and bottom waters prior to treatment compared with March and May 2022 concentrations, although in general nutrients do not appear to be limiting cyanobacteria growth in Lake Henshaw.

The application of 9,075 gallons of a copper-based (SePRO SeClear) algaecide to approximately 45% of the Lake Henshaw surface area on August 17–18, 2022, appears to have had a meaningful effect on HABs as evidenced by the summary of data below. Compared with two earlier doses of peroxide-based SePRO PAK27 in March 2022 (i.e., 40,000 pounds, approximately 2.9 mg/L [ppm], applied to approximately 40% of the lake surface area over two days), and May 2022 (3.3 mg/L [ppm] on average, applied to 80–90% of the lake surface area over four days), the August 2022 copper-based treatment was more effective at reducing cyanobacteria and cyanotoxin concentrations.

- Low DO concentrations following treatment, with 96% of measurements below 5 mg/L, 87% of measurements below 4 mg/L, 62% of measurements below 3 mg/L, and 32% of measurements below 2 mg/L one to two days after treatment, suggesting oxidative stress and/or cell death resulting from treatment. A limited fish mortality event appears to have resulted, at least in part, from these low DO concentrations (see below for recommendations related to the fish mortality event). Within four to five days following treatment, DO concentrations had largely recovered to pre-treatment concentrations throughout the water column, although concentrations in deeper waters remained below 5 mg/L.
- Modest decreases in chl-*a* concentrations (i.e., 20%–55% post-treatment decrease) at deeper open water sites and the western shoreline site, a range that is somewhat higher than the decrease in chl-*a* observed at deeper open water sites following the March and May peroxide doses (Stillwater Sciences 2022a,b). Increasing chl-*a* concentrations eight to nine days following treatment suggest that nutrient releases from dying cyanobacteria are stimulating the growth of other types of algae (i.e., not cyanobacteria) in the lake.
- Increases in the ratio of phe-*a* to chl-*a* following treatment at most sites, at a higher level than those following the March and May 2022 treatments (Stillwater Sciences 2022a,b), suggesting more widespread senescing (dying) algae.
- A 70% decrease in total cyanobacteria cell counts following algaecide treatment, and large decreases in cell counts of all cyanobacteria genera, including the lowest cell counts measured to date for *Planktothrix*, which has been the dominant cyanobacteria genus in Lake Henshaw throughout 2021–2022.
- Generally decreased microcystin concentrations following treatment and no short-term increase in this cyanotoxin one to two weeks after application, as had been observed with the peroxide-based treatments in March and May (Stillwater Sciences 2022a,b). Note that microcystin concentrations were generally decreasing prior to algaecide treatment and further decreased after treatment.
- Interruption of an increasing trend in anatoxin-a concentrations following treatment, such that within one to two days of treatment concentrations were reduced below the reporting limit at nine of twelve sites, and within three to four days of treatment were reduced below the reporting limit at all sites.

- 50% removal of total and dissolved copper occurred within six days and 70% removal of total and dissolved copper occurred within ten days. Based on the observed exponential decline of copper following treatment, the predicted amount of time for dissolved copper concentrations to return to the average maximum allowable lake release concentration for the NPDES permit, at the dose used in August 2022, was approximately 16 days.
- Nitrate, ammonia, and orthophosphate generally increased between pre- and post-treatment values, and although the copper-based algaecide used in Lake Henshaw in August (SeClear) also contains an orthophosphate binding agent, it does not appear that the chemical binding agent was present in sufficient quantities to eliminate the observed increases in orthophosphate following algaecide application.

Based on input from the algaecide applicator, the algaecide manufacturer, and our professional judgment, we offer the following recommendations for the future use of algaecides in Lake Henshaw:

1. Consider strategies to reduce the total load of planktonic algae and cyanobacteria in the lake before algaecide treatment. This could involve strategies identified in the District's Draft Harmful Algal Blooms Management and Mitigation Plan, including the phosphorus control methods of sediment sealing and oxygenation, but could also involve the more frequent use of algaecide at lower doses to keep planktonic algae and cyanobacteria at lower levels.
2. Consider monitoring total cell counts along with chl-a before treatment to better assess the total load of planktonic algae that could be affected by copper-based algaecides, and after treatment to better assess the full response of the lake to treatment.
3. Collect DO vertical profiles at multiple stations in the lake two to three weeks leading up to a treatment, particularly early in the morning (i.e., before 9:00 am) when DO demand tends to be highest.
4. Use lake bathymetric data to better assess treatment volumes and the treatable area of the lake just prior to treatment.
5. Request that the algaecide applicator assess lake conditions immediately prior to and during treatment (including areas accessible for treatment with the applicator's equipment) to fine tune the algaecide application plan prior to and throughout the use of algaecide.
6. Consider creating an algaecide application plan that is adaptable during the course of treatment, so that if DO concentrations are decreasing below acceptable thresholds during treatment, treatment areas and/or doses can be adjusted to reduce potential for fish mortality.
7. Consider reducing the target copper concentration in the treatment area until the lake's full response to copper-based algaecides is better understood.
8. Consider strategies to optimize the use of both peroxide- and copper-based algaecides to keep planktonic communities at manageable levels.
9. For future applications of copper-based algaecides, plan for more than two weeks between application and water release at similar copper doses to allow sufficient time to meet the permit requirements. Lighter doses may not require that much time.
10. Given the unexpected decrease in hardness in Lake Henshaw in August 2022, and because maximum allowable dissolved copper concentrations for supporting release of Lake Henshaw water to the San Luis Rey River under the NPDES permit are based on hardness, planning for future copper-based algaecide applications should include sampling and analysis of hardness for three to four weeks before and after the application period.

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Appendices

Appendix A

Data Tables

Table A-1. Chlorophyll-*a* and pheophytin-*a* concentrations measured in Lake Henshaw before and after the August 2022 copper-based algaecide treatment.

Date	Site ID											
	H-S	H-FD	H-FDD	H-BLS	H-BL	H-NL	H-ML	H-MLD	H-SL	H-NS	H-ES	H-SS
Chlorophyll-a (µg/L)												
8/1/2022	214	191	-	204	171	-	-	-	-	-	-	-
8/8/2022	182	143	181	163	157	221	131	173	196	109	152	126
8/16/2022	176	110	141	147	138	139	163	128	137	104	80	92
Average Pre-treatment	*191*	*148*	*161*	*172*	*155*	*180*	*147*	*151*	*166*	*107*	*116*	*109*
8/19/2022	64	89	113	93	95	127	95	94	82	117	66	76
8/22/2022	107	74	141	98	56	89	63	104	197	65	121	140
8/26/2022												
Average post-treatment	*86*	*81*	*127*	*96*	*76*	*108*	*79*	*99*	*140*	*91*	*93*	*108*
Average % Difference	*-55%*	*-45%*	*-21%*	*-44%*	*-51%*	*-40%*	*-46%*	*-34%*	*-16%*	*-14%*	*-20%*	*0%*
Pheophytin-a (ug/L)												
8/1/2022	86	91	-	118	99	-	-	-	-	-	-	-
8/8/2022	110	92	120	96	100	132	76	100	108	66	103	75
8/16/2022	122	79	94	113	122	109	114	106	98	78	62	62
Average Pre-treatment	*106*	*87*	*107*	*109*	*107*	*121*	*95*	*103*	*103*	*72*	*83*	*68*
8/19/2022	49	60	78	73	69	73	64	76	62	117	66	64
8/22/2022	78	59	113	76	54	70	49	87	126	61	89	109
8/26/2022												
Average post-treatment	*63*	*59*	*96*	*74*	*62*	*71*	*56*	*81*	*94*	*89*	*77*	*87*
Average % Difference	*-40%*	*-32%*	*-11%*	*-32%*	*-42%*	*-41%*	*-41%*	*-21%*	*-9%*	*24%*	*-6%*	*27%*
Ratio (Phe-*a*:Chl-*a*)												
8/1/2022	0.4	0.5	-	0.6	0.6	-	-	-	-	-	-	-
8/8/2022	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.6

Date	Site ID											
	H-S	**H-FD**	**H-FDD**	**H-BLS**	**H-BL**	**H-NL**	**H-ML**	**H-MLD**	**H-SL**	**H-NS**	**H-ES**	**H-SS**
8/16/2022	0.7	0.7	0.7	0.8	0.9	0.8	0.7	0.8	0.7	0.7	0.8	0.7
Average Pre-treatment	0.6	0.6	0.7	0.6	0.7	0.7	0.6	0.7	0.6	0.7	0.7	0.6
8/19/2022	0.8	0.7	0.7	0.8	0.7	0.6	0.7	0.8	0.8	1.0	1.0	0.8
8/22/2022	0.7	0.8	0.8	0.8	1.0	0.8	0.8	0.8	0.6	0.9	0.7	0.8
8/26/2022												
Average post-treatment	*0.7*	*0.7*	*0.7*	*0.8*	*0.8*	*0.7*	*0.7*	*0.8*	*0.7*	*1.0*	*0.9*	*0.8*
Average % Difference	*31%*	*20%*	*13%*	*20%*	*21%*	*-2%*	*13%*	*17%*	*10%*	*43%*	*19%*	*28%*

Shaded cells indicate results from samples collected following algaecide treatment.
- Indicates no sampling occurred.

Table A-2. Cyanobacterial cell densities measured in Lake Henshaw before and after the August 2022 copper-based algaecide treatment.

Date	Site ID			
	H-S	H-FD	H-BLS	H-ML
***Planktothrix* (cells/mL)**				
5/2/2022	383,408	476,875	381,500	-
5/9/2022	674,355	503,350	323,758	-
5/16/2022	475,823	484,930	392,725	375,650
Average Pre-treatment	*511,195*	*488,385*	*365,994*	*375,650*
5/17/2022	473,787	536,813	-	409,130
5/18/2022	*268,212*	*269,514*	*401,250*	*214,830*
5/23/2022	291,005	384,800	219,336	248,538
Average Post-treatment	*344,335*	*397,042*	*310,293*	*290,833*
Average % Difference	*-33%*	*-19%*	*-15%*	*-23%*
***Microcystis* (cells/mL)**				
5/2/2022	23,620	59,050	76,765	-
5/9/2022	43,320	25,270	29,783	-
5/16/2022	19,896	38,678	31,038	36,263
Average Pre-treatment	*28,945*	*40,999*	*45,862*	*36,263*
5/17/2022	30,240	40,488	-	20,160
5/18/2022	19,240	17,760	22,200	35,520
5/23/2022	11,797	7,550	15,100	16,044
Average Post-treatment	*20,426*	*21,933*	*18,650*	*23,908*
Average % Difference	*-29%*	*-47%*	*-59%*	*-34%*
***Snowella* (cells/mL)**				
5/2/2022	24,525	31,338	20,438	-
5/9/2022	56,980	46,127	48,840	-
5/16/2022	18,107	12,933	7,760	12,610
Average Pre-treatment	*33,204*	*30,133*	*25,679*	*12,610*
5/17/2022	21,067	16,853	-	11,850
5/18/2022	15,520	13,192	28,453	18,624
5/23/2022	6,450	4,300	8,256	3,363
Average Post-treatment	*14,346*	*11,448*	*18,355*	*10,994*
Average % Difference	*-57%*	*-62%*	*-29%*	*-13%*
***Aphanocapsa* (cells/mL)**				
5/2/2022	0	969	0	-
5/9/2022	2,400	528	0	-
5/16/2022	0	0	908	3,814

Date	Site ID			
	H-S	H-FD	H-BLS	H-ML
Average Pre-treatment	*800*	*499*	*303*	*3,814*
5/17/2022	0	0	-	0
5/18/2022	0	0	0	0
5/23/2022	0	0	0	0
Average Post-treatment	*0*	*0*	*0*	*0*
Average % Difference	*-100%*	*-100%*	*-100%*	*-100%*
***Dolichospermum* (cells/mL)**				
5/2/2022	368	202	46	-
5/9/2022	330	146	413	-
5/16/2022	156	686	1192	304
Average Pre-treatment	*285*	*345*	*550*	*304*
5/17/2022	6,720	1,870	-	175
5/18/2022	2160	187	1890	4320
5/23/2022	3165	4923	2110	3363
Average Post-treatment	*4,015*	*2,327*	*2,000*	*3,842*
Average % Difference	*1310%*	*575%*	*263%*	*1164%*
***Total cyanobacteria* (cells/mL)**				
5/2/2022	431,921	568,434	478,749	-
5/9/2022	777,385	575,421	402,794	-
5/16/2022	513,982	537,227	433,623	428,641
Average Pre-treatment	*574,429*	*560,361*	*438,389*	*428,641*
5/17/2022	531,814	596,024	-	441,315
5/18/2022	305,132	300,653	453,793	273,294
5/23/2022	312,417	401,573	244,802	271,308
Average Post-treatment	*383,121*	*432,750*	*349,298*	*272,301*
Average % Difference	*-33%*	*-23%*	*-20%*	*-36%*

Shaded cells indicate results from samples collected following algaecide treatment.
\- Indicates no sampling occurred.

Table A-3. Microcystin and anatoxin-a concentrations measured in Lake Henshaw before and after the August 2022 copper-based algaecide treatment.

Date	Site ID											
	H-S	**H-FD**	**H-FDD**	**H-BL**	**H-BLS**	**H-NL**	**H-ML**	**H-MLD**	**H-SL**	**H-NS**	**H-ES**	**H-SS**
Microcystin (µg/L)												
7/25/2022	0.94	0.72	-	0.71	-	-	-	-	-	-	-	-
8/1/2022	0.93	0.93	-	0.6	-	-	-	-	-	-	-	-
8/8/2022	0.43	0.48	0.54	0.51	0.41	0.4	0.99	-	0.51	0.34	0.49	0.42
8/16/2022	0.37	0.44	0.53	0.51	0.32	0.32	0.35	-	0.46	0.26	0.3	0.3
Average Pre-treatment	*0.67*	*0.64*	*0.54*	*0.58*	*0.37*	*0.36*	*0.67*	-	*0.49*	*0.30*	*0.40*	*0.36*
8/19/2022	0.34	0.39	0.4	0.42	0.32	0.36	0.32	-	0.39	0.49	0.41	0.46
8/22/2022	0.28	0.25	0.35	0.35	0.35	0.35	0.34	-	0.34	0.23	0.25	0.31
8/26/2022	0.2	0.2	-	0.22	0.21	-	-	-	-	-	-	-
8/29/2022	0.23	0.29	-	0.24	0.22	-	-	-	-	-	-	-
Average Post-treatment	*0.26*	*0.28*	*0.38*	*0.31*	*0.28*	*0.36*	*0.33*	-	*0.37*	*0.36*	*0.33*	*0.39*
Average % Difference	*-61%*	*-56%*	*-30%*	*-47%*	*-25%*	*-1%*	*-51%*	-	*-25%*	*20%*	*-16%*	*7%*
Anatoxin-a (µg/L)												
7/25/2022	1.57	1.51	-	1.09	-	-	-	-	-	-	-	-
8/1/2022	3.63	4.41	-	4.36	-	-	-	-	-	-	-	-
8/8/2022	1.79	1.78	1.88	1.95	1.94	1.66	2.02	-	2.79	1.54	2.97	4.00
8/16/2022	3.06	2.79	3.77	3.78	3.58	3.53	3.75	4.31	4.98	2.14	4.49	7.15
Average Pre-treatment	*2.51*	*2.62*	*2.83*	*2.80*	*2.76*	*2.60*	*2.89*	*4.31*	*3.89*	*1.84*	*3.73*	*5.58*
8/19/2022	<0.15	<0.15	<0.15	<0.15	<0.15	0.68	<0.15	<0.15	<0.15	1.38	0.23	<0.15
8/22/2022	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
8/26/2022	<0.15	<0.15	-	<0.15	<0.15	-	-	-	-	-	-	-
8/29/2022	<0.15	<0.15	-	<0.15	<0.15	-	-	-	-	-	-	-
Average Post-treatment	*<0.15*	*<0.15*	*<0.15*	*<0.15*	*<0.15*	*0.38*	*<0.15*	*<0.15*	*<0.15*	*0.73*	*0.15*	*<0.15*
Average % Difference	*-97%*	*-97%*	*-97%*	*-97%*	*-97%*	*-91%*	*-97%*	*-98%*	*-98%*	*-78%*	*-97%*	*-99%*

Shaded cells indicate results from samples collected following algaecide treatment.
- Indicates no sampling occurred.

Table A-4. Nutrients measured in Lake Henshaw before and after the August 2022 copper-based algaecide treatment.

Date	Site ID H-FD	H-FDD	H-BLS	H-BL	H-MLD
Total Nitrogen **(mg/L)**					
7/25/2022	5.08	-	4.37	5.69	-
8/1/2022	4.55	-	4.50	4.46	-
8/8/2022	4.59	4.25	4.29	4.53	4.05
8/16/2022	4.58	4.90	4.85	3.99	5.03
Average Pre-treatment	*4.70*	*4.58*	*4.50*	*4.67*	*4.54*
8/19/2022	4.11	3.80	4.04	4.06	4.19
8/22/2022	3.50	4.55	4.75	5.03	3.92
8/26/2022	3.75	-	4.78	3.67	-
8/29/2022	3.91	5.12	4.85	4.59	4.93
Average Post-treatment	*3.82*	*4.49*	*4.61*	*4.34*	*4.35*
Average % Difference	*-19%*	*-2%*	*2%*	*-7%*	*-4%*
Nitrate **(mg/L)**					
7/25/2022	0.15	-	0.14	0.13	-
8/1/2022	0.18	-	0.16	0.22	-
8/8/2022	0.13	0.13	0.15	0.17	0.16
8/16/2022	0.39	0.18	0.17	0.22	0.16
Average Pre-treatment	*0.21*	*0.16*	*0.16*	*0.19*	*0.16*
8/19/2022	0.16	0.20	0.26	0.24	0.23
8/22/2022	0.18	0.27	0.40	0.30	0.24
8/26/2022	0.23	-	0.21	0.21	-
8/29/2022	0.20	0.39	0.28	0.28	0.28
Average Post-treatment	*0.19*	*0.29*	*0.29*	*0.26*	*0.25*
Average % Difference	*-9%*	*85%*	*85%*	*39%*	*56%*
Ammonia **(mg/L)**					
7/25/2022	0.04	-	0.23	0.07	-
8/1/2022	0.02	-	0.47	0.46	-
8/8/2022	0.04	0.08	0.10	0.04	0.02
8/16/2022	0.03	0.00	0.00	0.02	0.00
Average Pre-treatment	*0.03*	*0.04*	*0.20*	*0.15*	*0.01*
8/19/2022	0.52	0.68	0.54	0.59	0.52
8/22/2022	0.50	1.06	1.97	0.92	0.82
8/26/2022	0.07	-	1.53	0.10	-
8/29/2022	0.04	0.37	0.07	0.04	0.02
Average Post-treatment	*0.28*	*0.70*	*1.03*	*0.41*	*0.45*
Average % Difference	*769%*	*1573%*	*411%*	*180%*	*3683%*
Total Phosphorous **(mg/L)**					
7/25/2022	0.44	-	0.43	0.44	-
8/1/2022	0.45	-	0.42	0.45	-
8/8/2022	0.45	0.44	0.44	0.43	0.40

Date	H-FD	H-FDD	Site ID H-BLS	H-BL	H-MLD
8/16/2022	0.38	0.37	0.37	0.40	0.39
Average Pre-treatment	*0.43*	*0.41*	*0.42*	*0.43*	*0.40*
8/19/2022	0.48	0.47	0.48	0.48	0.46
8/22/2022	0.40	0.49	0.58	0.47	0.50
8/26/2022	0.40	-	0.51	0.32	-
8/29/2022	0.32	0.45	0.31	0.33	0.35
Average Post-treatment	*0.40*	*0.47*	*0.47*	*0.40*	*0.44*
Average % Difference	*-7%*	*16%*	*13%*	*-7%*	*11%*
Ortho-P **(mg/L)**					
7/25/2022	0.09	-	0.12	0.10	-
8/1/2022	0.15	-	0.18	0.18	-
8/8/2022	0.14	0.13	0.13	0.12	0.11
8/16/2022	0.14	0.13	0.13	0.15	0.12
Average Pre-treatment	*0.13*	*0.13*	*0.14*	*0.14*	*0.12*
8/19/2022	0.21	0.22	0.20	0.21	0.21
8/22/2022	0.17	0.22	0.37	0.22	0.21
8/26/2022	0.04	-	0.22	0.21	-
8/29/2022	0.02	0.07	0.07	0.04	0.02
Average Post-treatment	*0.14*	*0.22*	*0.26*	*0.21*	*0.21*
Average % Difference	*8%*	*69%*	*88%*	*55%*	*83%*

Shaded cells indicate results from samples collected following algaecide treatment.
- Indicates no sampling occurred

Appendix B

What Happened to Hardness in Lake Henshaw?

What happened to the Hardness in Henshaw?

The impact of seasonal algal blooms on hardness and alkalinity and impacts on the use of copper-based algaecides

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Summary

The hardness is Lake Henshaw unexpectedly declined by almost 30% within less than two months during summer 2022. Four precipitation theories that could explain the loss of hardness were proposed. These theories were investigated using water chemistry data, solubilities, and reaction thermodynamics. This analysis supports the theory that calcite (calcium carbonate) precipitation was stimulated by the high pH induced by excessive algal growth during this period. Although alkalinity in the lake water was not monitored during this period, alkalinity also likely declined due to the loss of carbonate and precipitation of calcite.

Alkalinity and hardness are critical parameters for determining whether a copper sulfate or chelated copper algaecide should be used to control harmful algal blooms, based on efficacy of controlling the target species and toxicity to the non-target species. Alkalinity and hardness are generally considered to be fundamental parameters of water bodies based on sediment geology and water chemistry of the inflow. However, this analysis suggests that intense algal blooms in Henshaw Lake may significantly alter the hardness and alkalinity in relatively short periods of time. Therefore, it appears to be critical to perform more frequent monitoring of the hardness and alkalinity to determine whether a chelated or non-chelated form of copper algaecide will be most efficacious in the control of harmful algal blooms.

Background

It was observed that the hardness (dissolved divalent metals, typically comprised of predominantly calcium and magnesium) decreased from ~110 mg/L as $CaCO_3$ in early July to 80 mg/L as $CaCO_3$ in late August 2022. Hardness was not measured in the lake during this period, but the lower hardness was observed following the application of a copper-based algaecide, SeClear. The observed data presents two major questions. First, what happened to the dissolved magnesium and/or calcium in the lake between this period? Second, did the algaecide application have anything to do with the observed decrease in hardness in Lake Henshaw? Three major theories were proposed and water chemistry data was utilized to investigate the relative probability of each theory.

Proposed Theories

It was assumed that the loss of hardness in Lake Henshaw was not due to dilution of soft water, but rather due to the precipitation of calcium and/or magnesium-based compounds. The significant precipitation of a variety of calcium and magnesium-based compounds have been observed in lab studies using lake water and cyanobacteria (Thompson and Ferris, 1990) as well as in lakes such as Lake Mead and Lake Powell (Deemer et al., 2020; Hannoun, 2022; Otsuki and Wetzel, 1974). The top five potential calcium and magnesium-based precipitates were chosen for further evaluation based on solubility and environmental prevalence.

1. Dissolved magnesium was lost during the precipitation reaction with hydroxide ions under alkaline conditions to form magnesium hydroxide [$Mg(OH)_2$].
2. Dissolved magnesium was lost during the precipitation reaction with ammonium and/or potassium and phosphate to form struvite (NH_4MgPO_4 or $KMgPO_4$).
3. Dissolved calcium was lost during the precipitation reaction with phosphorus under alkaline conditions to form calcium apatite [$Ca_{10}(PO_4)_6(X)_2$, with X = OH, Cl, or F].
4. Dissolved calcium was lost during the precipitation reaction with sulfate to form gypsum [$CaSO_4 \bullet 2H_2O$] after the application of a copper sulfate based algaecide.
5. Dissolved calcium was lost during the precipitation reaction with carbonate under alkaline conditions to form calcite ($CaCO_3$).

Analysis Methods

Since all proposed theories involve the precipitation of dissolved components within the water column, solubility equilibrium chemical equations can be used to vet the possibility of each precipitation reaction. These equations are simply meant to determine if the precipitation reaction can occur, rather than calculating the rate at which it occurs. Calculating the rate at which a given precipitation reaction occurs is much more complex and typically requires chemical equilibrium software, because the precipitation reaction leads to the presence of less dissolved reactants and therefore a slower rate as it occurs. In each precipitation reaction equation, hypothetically high concentrations of reactants (calcium or magnesium, hydroxide, carbonate, etc.) were utilized to determine if the precipitation reaction could occur under otherwise optimal conditions. Therefore, all analyses undertaken below should be considered qualitative rather than quantitative. All calculations are included at the end of the document.

Mass Balance: The litmus test

The simplest way to rule out a precipitation reaction being a significant cause of the loss of hardness is to perform a mass balance and show that there is not enough of the limiting reactant to result in the loss of ~30 mg/L Ca and/or Mg as $CaCO_3$. If so, this does not mean that the precipitation reaction did not occur, but it does mean that the precipitation reaction theory could not account for all of the loss of hardness observed, even if 100% of the limiting reactant was to react. If the mass balance shows that the limiting reactant was present in large enough concentrations to react with ~30 mg/L Ca and/or Mg as $CaCO_3$, then this analysis will proceed to the next step to better understand the feasibility of the proposed theory.

Chemical Equilibrium Calculations: A Follow up Exam

Precipitation reactions can be predicted by determining if the reactants in the precipitation reaction are present in excessive concentrations or saturated within a given solution. The concentration of the reactants can be used to calculate the reaction quotient (Q), which is a measure of the relative amount of the reactants. Q for a given precipitation reaction where x molecules of reactant A react with y molecules of reactant B can be calculated as follows: $xA + yB \rightarrow A_xB_y$; $Q = [A]^a[B]^b$. Q can then be compared to the solubility constant (K_{sp}), which is a constant at a given temperature and pressure and widely available for major insoluble compounds. If Q is greater than Ksp, then the reactants are present in excessive amounts or saturated in solution and a precipitation reaction is favorable. If Q is less than than K_{sp}, then the reactants are not present in high enough concentrations to result in a precipitation and any precipitants that are present will start to dissolve into solution. When Q is equal to K_{sp}, the solution is said to be in equilibrium and no precipitation or dissolution will occur (Petrucci, 2017).

Analysis of Precipitation Theories

1. Dissolved magnesium was lost during the precipitation reaction with hydroxide ions under alkaline conditions to form magnesium hydroxide [$Mg(OH)_2$]

Magnesium hydroxide can precipitate when excessive magnesium and hydroxide ions are present in the water column. Hydroxide ions are only present in substantial quantities when the pH is high (Abdussalam, 2009).

Mass Balance

Dissolved magnesium is often present in large enough quantities in Lake Henshaw to the point at which the precipitation of a substantial portion could result in the loss of 30 mg/L as $CaCO_3$ hardness. Hydroxide is the only other reactant required for the precipitation of magnesium hydroxide and the lake water will contain excess hydroxide at a high pH, which is induced by excessive algal growth.

Chemical Equilibrium

The chemical equilibrium calculations show that a pH of 10.2 would be required for magnesium hydroxide precipitation at the maximum observed historical magnesium concentration (17 mg/L) and a pH of 10.3 would be required if the magnesium concentration was the average (12 mg/L).

Analysis of Calculations

The pH of Lake Henshaw would need to be greater than ~10.2 – 10.3 in order for magnesium hydroxide precipitation to readily occur. This is possible, however, it is unlikely to account for the loss of ~30% of the hardness in Lake Henshaw. Firstly, it is unlikely that the pH > 10.2 was sustained for very long periods of time or very far below the surface of the water. Second, as the magnesium hydroxide precipitation occurs, the standing pool of dissolved magnesium would decrease and this would require an even higher pH to result in further precipitation. Overall, magnesium hydroxide precipitation likely occurred to some extent if the pH during this period was greater than 10.2 for extended periods of time, but it is unlikely to be the most significant driver in the loss of hardness in Lake Henshaw. Other precipitation reaction theories for the loss of hardness also occur under a high pH and may coincide with the precipitation of magnesium hydroxide.

2. Dissolved magnesium was lost during the precipitation reaction with ammonium and/or potassium and phosphate to form struvite (NH_4MgPO_4 or $KMgPO_4$)

Struvite is a mineral that contains 1 magnesium ion, 1 phosphate ion and either 1 ammonium ion (ammonium struvite) or 1 potassium ion (potassium struvite). Struvite precipitation is common in wastewater treatment of hard water (magnesium-rich) or high salinity water (potassium-rich) when excessive phosphate and ammonium are present (Bhuiyan et al., 2007). It is more likely that potassium struvite will form in oxic surface water due to the rapid oxidation of ammonium that occurs in the presence of oxygen, while ammonium struvite would be more likely to form in anoxic bottom water due to the accumulation of ammonium under anoxic conditions (Horne and Goldman, 2009).

Mass Balance

While historical data do not distinguish between particulate and dissolved magnesium, Lake Henshaw total magnesium concentrations range 5–17 mg/L (for the period 1994–2022), suggesting that dissolved magnesium is often present in large enough quantities in Lake Henshaw to the point at which the precipitation of a substantial portion could result in the loss of 30 mg/L as $CaCO_3$ hardness. Hydroxide is the only other reactant required for the precipitation of magnesium hydroxide and the lake water will contain excess hydroxide at a high pH, which is induced by excessive algal growth.

Analysis of Calculations

Under the liberal assumption that phosphate concentration in Lake Henshaw is 1 mg-P/L or 3.1 mg- PO_4/L, only 3.2 mg/L Magnesium as $CaCO_3$ could precipitate before phosphate is no longer present to react further. This provides compelling evidence that the precipitation of struvite is not responsible for the substantial loss of hardness in Lake Henshaw.

3. Dissolved calcium was lost during the precipitation reaction with phosphorus under alkaline conditions to form calcium apatite [$Ca_{10}(PO_4)_6(X)_2$, with X = OH, Cl, or F]

Calcium apatite is a mineral that contains 10 calcium ions, 6 phosphate ions, and 2 anions, generally hydroxide, chloride, or fluoride (Fan et al., 2019). Calcium apatite formation is generally more favorable in water with a high pH due to the presence of higher concentrations of hydroxide ions. Chloride ions are generally abundant in lake water, but fluoride is generally not present in high enough concentrations, as it readily reacts with other elements and tends to be present in substantially lower concentrations in surface waters.

Mass Balance

Mass balance calculations revealed that even with an extremely high phosphate concentration of 1 mg-P/L (3.1 mg-PO_4/L), only a small portion of the 30 mg/L as $CaCO_3$ hardness could be lost as calcium apatite. Phosphate concentrations in Lake Henshaw ranged 0.09–0.18 mg/L before the copper sulfate-based algaecide treatment and 0.02–0.37 mg/L after treatment (Singer, 2022).

Analysis of Calculations

Under the liberal assumption that phosphate concentration in Lake Henshaw is 1 mg-P/L or 3.1 mg- PO_4/L, only 5.3 mg/L Calcium as $CaCO_3$ could precipitate before phosphate is no longer present to react further. This provides compelling evidence that the precipitation of calcium apatite is not responsible for the substantial loss of hardness in Lake Henshaw.

4. Dissolved calcium was lost during the precipitation reaction with sulfate to form gypsum [$CaSO_4 \cdot 2H_2O$] after the application of a copper sulfate based algaecide

SeClear, a copper-sulfate based algaecide, was applied to Lake Henshaw just prior to the water sample which indicated that hardness had decline by ~30 mg/L as $CaCO_3$ (Shuler, 2022). Magnesium sulfate is very soluble and therefore, the precipitation of magnesium sulfate was ruled out as a potential cause of the loss of sulfate (Masindi et al., 2015). However, calcium sulfate (gypsum) can precipitate when excessive dissolved calcium and sulfate are present in waterbodies (Bennett and Adams, 1972; Thompson and Ferris, 1990). This precipitation reaction is generally independent of pH and exhibits retrograde solubility in which the solubility decreases with increasing temperature (Bennett and Adams, 1972). Therefore, it may be feasible that the increase in sulfate caused by the addition of copper sulfate led to the saturation of sulfate in the water column and the precipitation with calcium as gypsum in the warm surface water.

Mass Balance

Lake Henshaw total calcium concentrations range 20–55 mg/L and sulfate concentrations range 12–110 mg/L for the period 1994–2022 (Singer, 2022). The mass balance indicates that there was more than enough calcium and sulfate present in Lake Henshaw to account for the loss of ~30 mg/L as $CaCO_3$ hardness due to the precipitation of gypsum.

Chemical Equilibrium

The chemical equilibrium calculations reveal that the maximum possible concentration of both dissolved calcium and sulfate are still substantially lower than the amount that would be required to stimulate a precipitation reaction in the water column.

Analysis of Calculations

Although the mass balance shows that more than enough calcium and sulfate are present to substantially reduce the hardness if significant precipitation occurred, chemical equilibrium calculations show that they are not nearly high enough for precipitation to occur in Lake Henshaw. This provides very compelling evidence to rule out the possibility that the precipitation of gypsum (calcium sulfate) led to the decrease in ~30 mg/L of hardness in Lake Henshaw.

5. Dissolved calcium was lost during the precipitation reaction with carbonate under alkaline conditions to form calcite ($CaCO_3$)

Calcium carbonate is a very common mineral precipitate that naturally forms in lakes with hard water (Otsuki and Watson, 1974). Magnesium carbonate can also precipitate from lake waters, but it is less common, as it is significantly more soluble (Masindi et al., 2015; Thompson and Ferris, 1990). The precipitation of calcite is predominantly driven by pH, with studies showing that it readily precipitates from lake waters at a pH above 9.3 (Deemer et al., 2020). Surface water pH exceeded 10 the morning of the algaecide application, where the latter is common during intense algal blooms. Carbonate is the dominant form of alkalinity in most surface waters and generally present at concentrations exceeding 50 mg/L as $CaCO_3$ (Omernik and Powers, 1983).

Mass Balance

Calcium concentrations in Lake Henshaw are generally higher than the magnesium concentrations, indicating that a loss of a significant amount of dissolved calcium could account for a decrease in ~30 mg/L as $CaCO_3$ hardness. A mass balance for the carbonate reactant cannot be performed because even if carbonate concentrations were limiting, carbonate can be replenished through the dissolution of atmospheric carbon dioxide, which forms carbonic acid at a lower pH, bicarbonate at a neutral pH, and carbonate at a high pH. A high pH due to algal blooms and a continual dissolution of atmospheric carbon dioxide would allow for continued and prolonged precipitation of calcite in Lake Henshaw.

Chemical Equilibrium

The generally accepted solubility constant for calcite is extremely low, ~2.8×10^{-9}. This indicates that calcium is almost never the limiting reactant in natural water bodies. Although the total combined concentration of carbonate species (carbonic acid, bicarbonate, and carbonate) is generally high (often > 50 mg/L as $CaCO_3$), carbonate is generally only present in exceedingly small concentrations at most naturally occurring pHs, with carbonic acid and bicarbonate dominating between pH 6-9. However, as the pH increases beyond pH 9, carbonate becomes a substantial component and is present at high enough concentrations to result in significant calcite precipitation. The chemical equilibrium calculations reveal that calcite precipitation becomes favorable right around a pH of 9, although it does not appear to be strongly favored at this pH. By pH 9.5, calcite precipitation is strongly favored, even under low total carbonate alkalinity, 50 mg/L as $CaCO_3$, which is considered low-buffered or low alkalinity water (Omernik and Powers, 1983).

Analysis of Calculations

Due to the high pH observed at the time of the algaecide application (exceeding 10), it appears that calcite precipitation was favorable and may well have been occurring in Lake Henshaw during July and August of 2022. Both the mass balance and the chemical equilibrium calculations provide compelling evidence to suggest that calcite precipitation was favorable and may have been significant in Lake Henshaw during the period in which the hardness significantly declined. Overall, calcite precipitation appears to be the leading theory out of those examined in this analysis. However, chemical equilibrium models that take into account reaction kinetics and the dynamic changes of the reactants as the precipitation occurs would need to be employed to definitely prove that the precipitation of calcite was indeed the cause of the loss of hardness in Lake Henshaw.

Results

Struvite, calcium apatite, and gypsum precipitation can be ruled out as significant contributors to the loss of hardness observed in Lake Henshaw. Magnesium hydroxide precipitation may have played a role, as formation of this compound appears to be favorable under the high pH observed in Lake Henshaw. However, magnesium hydroxide precipitation does not appear to be as significant of a factor in the loss of hardness as the precipitation of calcite, of which precipitation is strongly favored at a pH of 9.5 and greater and even if the water had low alkalinity.

Discussion

It appears as if hardness declined following an algal bloom due to high pH and the stimulation of calcite formation and precipitation. Hardness controls the non-target toxicity of dissolved copper – with lower hardness leading to higher non-target toxicity following the biotic ligand model (BLM) where copper displaces calcium and magnesium within cell membranes (Slaveykova and Wilkinson, 2005). High copper and low hardness can result in enzymatic disfunction and toxicity, while higher hardness can reduce this impact. Chelated copper-based algaecides have been shown to present lower non-target toxicity in soft waters due to organic chelation which prevents ionic transport into cell membranes (Closson and Paul, 2014).

In addition to the decline in hardness, alkalinity also likely declined due to the loss of carbonate as calcium carbonate (calcite). Alkalinity impacts the longevity and therefore efficacy of copper-sulfate based algaecides due to the precipitation with carbonate/bicarbonate to form insoluble calcium carbonate, which precipitates and reduces exposure of algae/cyanobacteria to dissolved copper (Closson and Paul, 2014). Copper-sulfate based algaecides are more therefore more effective in waters with lower alkalinity. However, they may also present more non-target toxicity in soft water due to the extended period in which toxic dissolved copper is present in the water.

The balance of alkalinity and hardness is therefore very important to consider before using copper-based algaecides. In general, an appropriate algaecide dose should be determined using a safety factor such that the applied dose is enough to kill the algae/cyanobacteria present without adversely impacting non-target organisms. In waters with low alkalinity and hardness, copper sulfate will be more effective due to slower rates of copper carbonate precipitation, but more toxic to non-target organisms such as fish and zooplankton. In waters with high alkalinity and hardness, copper sulfate rapidly precipitates as copper carbonate and chelated coppers are required for control of algae/cyanobacteria. In rare situations where the water exhibits low alkalinity and moderate or high hardness, copper sulfate based algaecides can be both effective (due to less precipitation) and less toxic (due to less calcium displacement). In the rare situations where water exhibits moderate or high alkalinity and low hardness, copper sulfate will be both ineffective (due to copper carbonate precipitation) and more toxic (due to more calcium displacement).

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Calculations

1. Magnesium Hydroxide Precipitation

Mass Balance

- Hydroxide ions can be present in very high concentrations when the pH is high and they can also be produced from water molecules (H_2O) during intense algal blooms which raise the water pH.
- Magnesium ions are often more than 30% of the total hardness in Lake Henshaw (Singer, 2022)
- Therefore, the precipitation of magnesium hydroxide does not have substantially limiting reactants and it could potentially account for the loss of ~30% of the hardness in Henshaw.

Chemical Equilibrium (Abdussalam, 2009)

- The solubility product (K_{sp}) for $Mg(OH)_2$ is equal to approximately 1.8×10^{-11} (25 C, 1 atm).
- The precipitation of $Mg(OH)_2$ is as follows: $Mg^{2+} + 2(OH^-) \rightarrow Mg(OH)_2$
- $Q = [Mg^{2+}] \times [OH^-]^2$

Maximum Magnesium Concentration

- While historical data do not distinguish between particulate and dissolved magnesium, Lake Henshaw total magnesium concentrations range 5–17 mg/L for the period 1994–2022. The maximum concentration of total magnesium in the Lake Henshaw dataset at 17 mg/L can be used as a liberal assumption for dissolved magnesium.
    - This is ~0.71mM = 0.00071 M Mg^{2+}
    - 17 mg/L Mg^{2+} = 70 mg/L Mg as $CaCO_3$
- The pH is unknown, but by setting Q = Ksp, we can calculate the pH which the solution would be at equilibrium and therefore, a higher pH would lead to the precipitation of magnesium hydroxide.
- $Q = Ksp = 1.8 \times 10^{-11} = [0.00071 \text{ M}] \times [OH]^2$
- $[OH]^2 = (1.8 \times 10^{-11})/(0.00071 \text{ M}) = 2.5 \times 10^{-8}/\text{M}$

- [OH] = 0.000159 M = 1.59×10^{-4} M
- pOH = -log(OH^-) = -log(1.59×10^{-4}) = 3.80
- pOH + pH = 14
- pH = 10.2

Average Magnesium Concentration

- The average concentration of magnesium in the Lake Henshaw dataset was 17 mg/L.
  - This is ~0.5mM = 0.0005 M Mg^{2+}
  - 12 mg/L Mg^{2+} = 49.4 mg/L Mg as $CaCO_3$
- The pH is unknown, but by setting Q = Ksp, we can calculate the pH which the solution would be at equilibrium and therefore, a higher pH would lead to the precipitation of magnesium hydroxide.
- Q = Ksp = 1.8×10^{-11} = [0.0005 M] x $[OH]^2$
- $[OH]^2$ = (1.8×10^{-11})/(0.0005 M) = 3.6×10^{-8}/M
- [OH] = 0.000141 M = 1.90×10^{-4} M
- pOH = -log(OH^-) = -log(1.90×10^{-4}) = 3.72
- pOH + pH = 14
- pH = 10.28

2. Struvite Precipitation

Mass Balance

- Phosphate can accumulate in eutrophic lakes, but it is present in much lower concentrations that ammonium or potassium.
- For this analysis, it will be assumed that either potassium or ammonium are present in excess and that phosphate (PO_4) would be the limiting reactant.
- Phosphate data for Lake Henshaw are limited, but they are well below 1 mg-P/L (3.1 mg-PO_4/L).
- The Phosphate concentration will be set to 1 mg-P/L (3.1 mg-PO_4/L) as a liberal assumption.
  - Phosphorus has a molecular weight of 95 g/mol
  - 3.1 mg-PO_4/L is equivalent to 0.032 mmol/L (0.032 mM).
- Phosphate and magnesium would react in a 1:1 molar ratio.
  - Magnesium has a molecular weight of 24 g/mol
  - 0.032 mmol/L Magnesium = 0.77 mg/L as Mg^{2+}
  - 0.77 mg/L as Mg^{2+} = 3.2 mg/L as $CaCO_3$

Chemical Equilibrium

Chemical equilibrium calculations were not performed due to the results showing that phosphate was not present in high enough concentrations to result in enough struvite precipitation to account for a substantial portion of the loss of hardness (3.2 mg/L as $CaCO_3$ << ~30 mg/L as $CaCO_3$).

3. Calcium Apatite Precipitation

Mass Balance

- It will be assumed that chloride/hydroxide are present in excess and that phosphate (PO_4) would be the limiting reactant.
- Lake Henshaw calcium concentrations range from 20-55 mg/L for the period 1994–2022 (Singer, 2022).

- The Phosphate concentration will be set to 1 mg-P/L (3.1 mg-PO_4/L).
    - Phosphorus has a molecular weight of 95 g/mol
    - 3.1 mg-PO_4/L is equivalent to 0.032 mmol/L (0.032 mM).
- Phosphate and calcium would react in a 6 PO_4:10 Ca^{2+} molar ratio.
    - Calcium has a molecular weight of 40 g/mol
    - 0.032 mmol/L PO4 = 0.053 mM Calcium = 2.13 mg/L as Ca^{2+}
    - 1.28 mg/L as Ca^{2+} = 5.3 mg/L as $CaCO_3$

Chemical Equilibrium

Chemical equilibrium calculations were not performed due to the results showing that phosphate was not present in high enough concentrations to result in enough calcium apatite precipitation to account for a substantial portion of the loss of hardness (5.3 mg/L as $CaCO_3$ << ~30 mg/L as $CaCO_3$).

4. Gypsum Precipitation

Mass Balance

- The sulfate concentration maximum in the historical Lake Henshaw dataset is 110 mg/L, with an average concentration of 67 mg/L (for the period 1994–2022).
    - 9,100 gallons of SeClear containing 564,651 pounds of sulfate was applied to lake Henshaw during the algaecide application in August
    - The lake volume is approximately 3,822 acre-ft or 4713,000,000 L.
    - This equates to an increase of 54.3 mg/L sulfate
    - If the sulfate concentration was at the maximum before the algaecide application, it would have been 164.3 mg/L
    - If the sulfate concentration was about the average of the historical data before the algaecide application, it would have been 121.3 mg/L.
- Calcium and sulfate react in a 1:1 ratio.
    - The molecular weight of calcium is 40 g/mol
    - The molecular weight of sulfate is 96.1 g/mol
- A loss of 30 mg/L Calcium as CaCO3 is equivalent to the loss of 12 mg/L as Ca^{2+}.
    - 12 mg/L Ca2+ = 0.3 mM or 0.3 mmol/L calcium
    - 0.3 mM sulfate is equal to 28.8 mg/L sulfate
- Therefore, more than enough sulfate was present after the algaecide application to potentially result in the precipitation of enough gypsum to account for the loss of ~30 mg/L as $CaCO_3$ hardness.

Chemical Equilibrium Equation (Bennett and Adams, 1972)

- Chemical equilibrium for gypsum precipitation:
    - $Ca^{2+} + SO_4^{2-} + 2H_2O \rightarrow CaSO_4 \cdot 2H_2O$
- Solubility product (K_{sp}) for gypsum is approximately 2.5 x 10^{-5} M (25 C, 1 atm)
- The precipitation of gypsum is as follows: $Ca^{2+} + SO_4^{2-} + 2H_2O \rightarrow CaSO_4 \cdot 2H_2O$
- $Q = [Ca^{2+}] \times [SO_4^{2-}]$

Maximum Sulfate and Calcium Concentrations

- The maximum concentration of magnesium in the Lake Henshaw historical dataset (for the period 1994–2022) plus the sulfate added during the algaecide application was 163.3 mg/L.
    - The molecular weight of sulfate is 96.1 g/mol
    - 163.3 mg/L is 1.70mM = 0.0017 M sulfate

- The maximum calcium concentration in the Lake Henshaw dataset was 55 mg/L.
    - The molecular weight of calcium is 40 g/mol
    - 55 mg/L is 1.375mM = 0.001375 M calcium.
- Q = $[Ca^{2+}]$ x $[SO_4^{2-}]$ = [0.001375 M] x [0.0017 M] = 0.00000234 = 2.34 x 10^{-6}.
- Q (2.34 x 10^{-6}) < K_{sp} (2.5 x 10^{-5})
- Therefore, no precipitation could occur in Lake Henshaw

5. Calcite Precipitation

Mass Balance

- The average calcium concentration in the historical Lake Henshaw dataset was 35 mg/L.
- This concentration is equivalent to 87.5 mg/L as $CaCO_3$.
- Therefore, the precipitation of a calcium-based compound such as calcite could easily account for the loss of ~30 mg/L as $CaCO_3$ hardness.
- Carbonate is formed from carbonic acid, which is continually replenished when atmospheric carbon dioxide dissolves into lake water.
- Therefore, given a high enough pH, the concentration of carbonate could be more than high enough to react with enough calcium to result in the loss of ~30 mg/L as $CaCO_3$ hardness.

Chemical Equilibrium (Abdussalam, 2009)

- The solubility product (K_{sp}) for $CaCO_3$ is equal to approximately 2.8 x 10^{-9} (25 C, 1 atm).
- The precipitation of $CaCO_3$ is as follows: $Ca^{2+} + CO_3^{2-} \text{->} CaCO_3$
- Q = $[Ca^{2+}]$ x $[CO_3^{2-}]$

Average Calcium Concentration

- The average concentration of calcium in the Lake Henshaw dataset was 35 mg/L.
    - 35 mg/L Ca^{2+} = 87.5 mg/L Ca as $CaCO_3$
    - The molecular weight of calcium is 40 g/mol
    - 35 mg/L Ca^{2+} = 0.875mM = 0.000875 M Ca^{2+}
- The carbonate concentration is unknown, but by setting Q = Ksp, we can calculate the concentration of carbonate needed for the water to be at equilibrium.
- If the carbonate concentration is greater than that needed for equilibrium, then calcite precipitation would be favorable.
- Q = Ksp = 2.8 x 10^{--9} =$[Ca^{2+}]$ x $[CO_3^{2-}]$ = [0.000875 M] x $[CO_3^{2-}]$
- $[CO_3^{2-}]$ = (2.8 x 10^{-9})/(0.000875 M) = 3.2 x 10^{-6} M = 3.2 x 10^{-6} mol/L
- The molecular weight of carbonate (CO_3^{2-}) is 60 g/mol
- 60 g/mol x 3.2 x 10^{-6} mol/L = 0.000192 g/L = 0.192 mg/L
    - The pH can be used to calculate the percent carbonate out of the total carbonate species (carbonic acid, bicarbonate, and carbonate).
- (Low pH) $H_2CO_3 \leftrightarrow HCO_3^- \leftrightarrow CO_3^{2-}$ (High pH)
    - Above the pH 8.2, the concentration of carbonic acid is not substantial and only bicarbonate and carbonate exist in solution.
    - Therefore, $HCO_3^- \leftrightarrow CO_3^{2-}$
    - Using the Henderson-Hasselbalch equation to determine the proportion of each:
    - pH = pK_a HCO_3^- + log[(CO_3^{2-})/(HCO_3^-)]
    - pK_a HCO_3^- = 10.3

pH = 9

- 9 = 10.3 + log[(CO_3^{2-})/(HCO_3^-)]

- $\log[(CO_3^{2-})/(HCO_3^-)] = -1.3$
- $10^{-1.3} = (CO_3^{2-})/(HCO_3^-)$
- $0.05011 = (CO_3^{2-})/(HCO_3^-)$
- $(CO_3^{2-}) = 0.05011(HCO_3^{2-})$
- If $CO_3^{2-} = 1$, then $HCO_3^- = 199.6$
- $1/(199.6 + 1) = 0.005 = 0.5\%$
- At this pH, carbonate (CO_3^{2-}) is only 0.5% of the total carbonate in the system (99.5% is HCO_3^-)
    - Assuming an average carbonate alkalinity of 100 mg/L as $CaCO_3$
    - $CaCO_3$ molecular weight = 100 mg/L
    - CO_3^{2-} molecular weight = 60 mg/L
    - 100 mg/L as CaCO3 = 60 mg/L as CO_3^{2-}/HCO_3^-
    - 60 mg/L total carbonate x 0.5% CO_3^{2-}= 0.3 mg/L carbonate (CO_3^{2-})
    - At pH 9 and a total carbonate alkalinity of 100 mg/L as $CaCO_3$, the carbonate concentration is 0.3 mg/L
    - Compared to the equilibrium concentration of 0.192 mg/L, precipitation is slightly favorable, but likely insignificant (kinetic calculations required to determine the rate).

pH = 9.5

- $9.5 = 10.3 + \log[(CO_3^{2-})/(HCO_3^-)]$
- $\log[(CO_3^{2-})/(HCO_3^-)] = -0.8$
- $10^{-0.8} = (CO_3^{2-})/(HCO_3^-)$
- $0.1585 = (CO_3^{2-})/(HCO_3^-)$
- $(CO_3^{2-}) = 0.1585(HCO_3^{2-})$
- If $CO_3^{2-} = 1$, then $HCO_3^- = 6.3$
- $1/(6.3 + 1) = 0.137 = 13.7\%$
- At this pH, carbonate (CO_3^{2-}) is now 13.7% of the total carbonate (86.3% is HCO_3^-)
- Using the same assumption of moderate alkalinity (100 mg/L as $CaCO_3$ = 60 mg/L as CO_3^{2-})
    - 60 mg/L total carbonate x 13.7% CO_3^{2-}= 8.22 mg/L (CO_3^{2-})
    - At pH 9.5 and a total carbonate alkalinity of 100 mg/L as $CaCO_3$, the carbonate concentration is 8.22 mg/L
    - Compared to the equilibrium concentration of 0.192 mg/L, precipitation is strongly favorable.
- Low alkalinity (50 mg/L as $CaCO_3$ = 30 mg/L as CO_3^{2-})
    - 30 mg/L total carbonate x 13.7% CO_3^{2-}= 4.11 mg/L (CO_3^{2-})
    - At pH 9.5 and a total carbonate alkalinity of 50 mg/L as $CaCO_3$, the carbonate concentration is 8.22 mg/L
    - Compared to the equilibrium concentration of 0.192 mg/L, precipitation is still strongly favorable.
- A higher pH will result in a higher percent carbonate and therefore even more favorable precipitation of calcium carbonate.

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February 15, 2023

Vista Irrigation District	City of Escondido
Attn: Jo MacKenzie, President	Attn: Dane White, Mayor
Vista Board of Directors	Escondido City Council
1391 Engineer Street	3440 East Valley Parkway
Vista, CA 92081	Escondido, CA 92027

Re: Treatment Plan for Harmful Algal Blooms in Lake Henshaw to Ensure 2023 Releases

Dear President MacKenzie, Members of the Vista Irrigation District Board of Directors, and Mr. McKinney:

The San Luis Rey Indian Water Authority (SLRIWA) is encouraged by the steps the Local Entities have taken toward monitoring, treatment, and development of a long-term management strategy to reduce and eventually prevent Harmful Algal Blooms (HABs) in Lake Henshaw. We appreciate the Local Entities' renewal of the contract with Stillwater Sciences for Phase II and all the work you have been doing toward HAB mitigation and management. The SLRIWA is also pleased that present cyanobacterial abundances and cyanotoxins in the lake are low at this time, although the situation may be temporary given that winter conditions (low light, cool water temperatures) and recent rain events are not favorable for cyanobacterial blooms.

The purpose of this letter is to emphasize the need for a clear, and immediate, plan of action to address blooms that may occur in the lake in 2023, and ensure that La Jolla's in-stream flow needs are met this year, and going forward. The SLRIWA requests that the Local Entities provide the SLRIWA with a clear timeline and plan for treatment as soon as possible so that we can ensure we are on track for Memorial Day releases. In addition, the SLRIWA has asked Dr. Caron to provide his thoughts and recommendations for 2023, which are attached.

As you know, the lack of releases for the past three years, 2020, 2021, and 2022, has caused extreme hardship (personal, community-based, cultural) and financial losses to the La Jolla Band. It is critical that we find a long-term, viable solution for HAB management to ensure the delivery of safe, high quality, water through the La Jolla Reservation and continuing downstream of Lake Henshaw.

We remain dedicated to working jointly with the Local Entities to address HABs and other issues as we implement our Settlement. We look forward to our next government-to-government consultation, to be hosted at the Rincon Tribal Government Center on March 20, 2023, from 12:30 to 3:00 p.m. We also appreciate the Local Entities' commitment to ongoing quarterly consultation and are available on the dates you proposed for the remainder of 2023: April 18, July 18, and October 17.

Sincerely,

Bo Mazzetti

Bo Mazzetti, President
San Luis Rey Indian Water Authority

Cc: Brett Hodgkiss
Don Smith
Holly Roberson
Chris McKinney
Don Lincoln

February 15, 2023

San Luis Rey Indian Water Authority
P.O. Box 428
Pauma Valley, CA 92061

Dear President Mazzetti,

Thank you for the opportunity to comment on the present state of activities related to HAB mitigation and long-term management strategies for Lake Henshaw. My comments below are based on my present understanding of the activities ongoing in the lake, and planned or under discussion by the Local Entities.

1) *Monitoring and its importance to mitigative treatments in Lake Henshaw*: The Local Entities have increased monitoring of Lake Henshaw, relative to a year ago, to include some additional parameters, most notably chlorophyll concentration (a proxy for total algal biomass) and enumeration of cyanobacterial cells. This is a very good development.

   Cyanobacterial identifications (noting the presence of potentially toxin-producing species) and cell counts are essential for assessing the potential for a HAB, but effective lake mitigative treatments also involve an understanding of the total amount of algal biomass because all algae are affected by treatments (not just the cyanobacteria). As a consequence of recent monitoring, we know that the present levels of chlorophyll (58-65 µg chl/L; sampling on Jan 31, 2023) indicate a eutrophic state for the lake even now during winter, although cyanobacterial abundances are quite low.

   At present, the lake is being monitored approximately once a week, a situation that makes sense for winter. Given the high biomass already present in the lake, however, the potential for the rapid onset of a bloom exists as spring brings improved growth conditions for the algae. The present weekly schedule may result in a slow response to an emerging bloom, particularly if a specific mitigative plan is not ready and immediately actionable (see #3 below). Further, high temporal resolution for lake monitoring is absolutely essential for identifying an emerging bloom event and for responding in a timely manner, as has been noted by Stillwater Sciences. Once underway, an emerging bloom is more difficult (and more costly) to treat effectively, as evidenced by last year's mitigative attempts. Higher temporal resolution than is presently being conducted for monitoring the lake likely will be necessary to provide sufficient time for bloom response, particularly during the period of rapid algal growth that occurs in spring. I therefore strongly recommend that the Local Entities begin a higher frequency of monitoring. With regard to the mitigative treatments to Lake Henshaw, hydrogen peroxide compounds should be used as the primary mitigative tool, given the SLRIWA's concerns about long-term use of copper and the potential legacy impacts.

2) *Permit acquisitions*: My understanding is that the Local Entities are working towards permitting of treatments involving the reduction of phosphorus in the well water entering the lake, and the use of phosphorus-binding compounds in the lake to prevent the movement of that element out of the sediments and into the overlying water column (which can stimulate and sustain HABs). Unfortunately, however, progress toward obtaining the permits has been slow, and is subject to the San Diego Regional Water Quality Control Board process and timeline.

   The February 10, 2023, update on the permitting process indicated that the Local Entities anticipate receiving a permit for use of Lanthanum-Modified Clay, (Phoslock or its equivalent) at the beginning of May, but that this is dependent upon how long it takes the San Diego Regional Water Quality Control Board to approve the permit.
   It is critical that the Local Entities apply for the required permits as soon as possible, given the review timeframe for the San Diego Regional Water Quality Board. During the January 17, 2023, consultation, both of the 2023 treatment scenarios Maia Singer outlined included use of sediment sealing. Although exact timing was not clear as to when the sediment sealant would be applied, Ms. Singer noted the need for treatment of HABs to begin early in the year (April or May) because Lake Henshaw is so highly eutrophic. Having the permit in place as soon as possible will give the Local Entities more treatment options for 2023, rather than reliance on algaecide treatment alone.

   The February 10, 2023, update also indicated that the Local Entities are exploring permitting to reduce phosphorus in the pumped groundwater (source water treatment), but no information was provided as to the permit process, timeline, or whether that is something that would be implemented in 2023.

   Management of the HABs in Lake Henshaw will require a multi-faceted approach; algaecide treatment alone is not a long-term, sustainable solution. Permits for sediment sealing and source water treatment should be obtained as quickly as possible, and ideally by this spring, when the toxic blooms are likely to return. In addition, the Local Entities are evaluating costs of the various treatments, and plan to report further in mid-March. While cost is a factor, it is not the only one. Reducing phosphorus is a key element of long-term HAB management.

   The SLRIWA should be informed of the *specific plan(s)* for mitigation in Lake Henshaw that can and will be accomplished this year (#3 below).

3) *A definitive plan for the upcoming spring*: At this time, I am not aware of a specific program or timeline for mitigating HABs that might emerge in Lake Henshaw this year, or a plan to treat the lake proactively to maintain lower overall algal and

cyanobacterial biomass. I am concerned that without a specific, immediately actionable plan in place coupled with adequate monitoring, blooms will develop and progress until they are become difficult or impossible to treat effectively. In this regard, I strongly recommend consideration of a 'proactive' rather than 'reactive' plan to address the highly probable development of a HAB in Lake Henshaw in the coming months. Prophylactic treatment (using a peroxide-based product) would probably be more effective in preventing the development of a toxic bloom event than allowing the bloom to begin and progress. Such a plan was broadly outlined by Stillwater Sciences during our January 17, 2023, consultation, but it is not clear whether that recommendation will be adopted by the Local Entities. Securing the necessary permits for reducing phosphorus in Lake Henshaw and incorporating those mitigative measures into the 2023 treatment plan is much preferred over simply waiting for a toxic bloom event and applying algaecide alone. A more proactive approach, that starts *before* the toxic bloom event and includes phosphorus-binding compounds, would likely reduce overall cost for annual lake treatments because an impending bloom is much more easily controlled than a fully emerged one.

I am happy to address any questions that you might have.

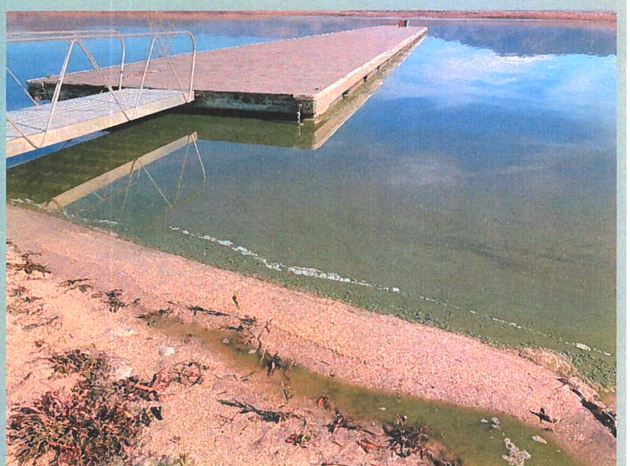
Respectfully,

David A. Caron, President
Aquatic EcoTechnologies, LLC

EXHIBIT A


Recommended Lake Henshaw Treatments for Harmful Algal Blooms in 2023
Vista Irrigation District Board Meeting
March 15, 2023
Stillwater Sciences
AHA
Brown AND Caldwell
Robertson - Bryan, Inc.
Solutions for Progress

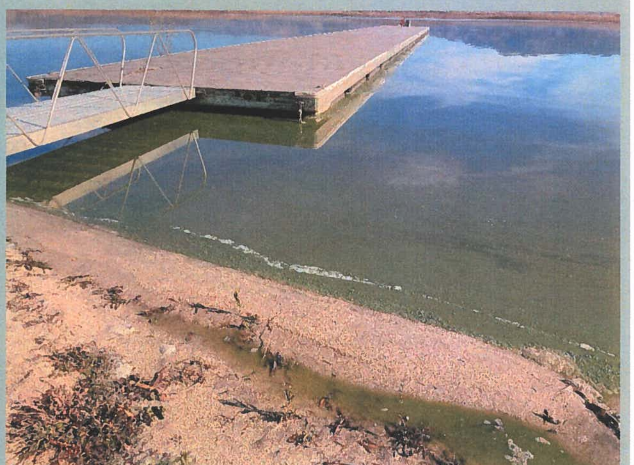
Lake Henshaw Recommended Treatments for HABs in 2023



FY 2023 Lake Treatments Prior to the Memorial Day Weekend (May 25 - 29, 2023)

- Two light doses peroxide-based algaecide (7 to 10 days apart)
  - Target *cyanobacteria* biomass ahead of late spring/early summer bloom
- One medium dose copper-based algaecide within 7 to 10 days of last peroxide-based algaecide
  - Treat at least 30 days ahead of intended releases to avoid residual problems
  - Use copper before dissolved oxygen is seasonally low
  - Balance release of free reactive P held in algae/cyanobacteria with impacts to community
- One light dose lanthanum-modified clay within ~2 days of completing copper-based algaecide and after Regional Board NOA
  - Strip free reactive P from water column immediately after release from cells affected by copper-based treatment

Lake Henshaw Recommended Treatments for HABs in 2023



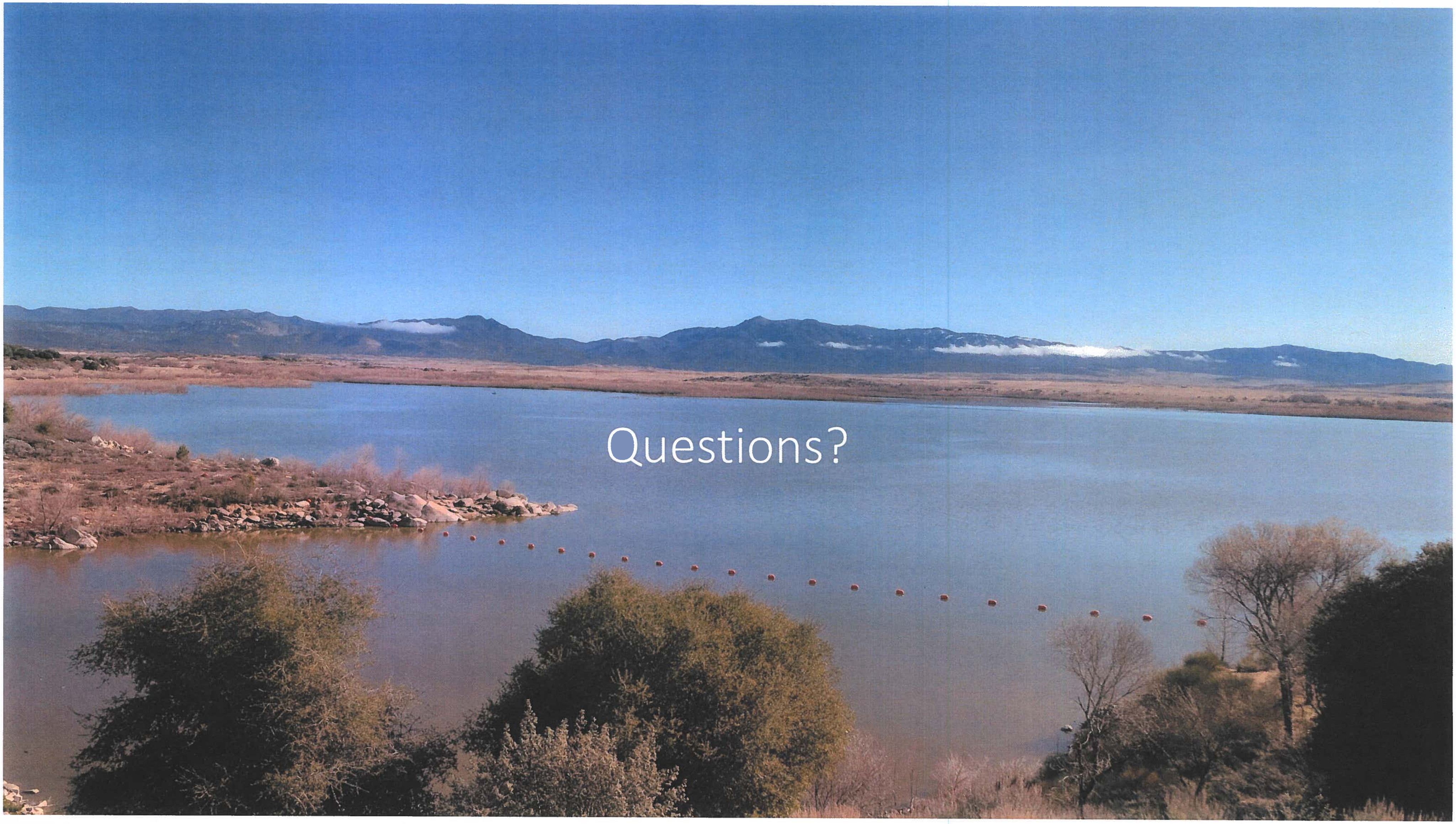
Remaining Lake Treatments in FY 2023

- One or two light doses peroxide-based algaecide as informed by cyanobacteria community
  - Target *cyanobacteria* biomass to keep low after prior treatments
- Schedule to facilitate weekend releases
  - Father's Day (June 16 – 19, 2023)
  - Independence Day (June 30 – July 4, 2023)

Lake Henshaw Recommended Treatments for HABs in 2023

FY 2024 Lake Treatments Prior to Labor Day Weekend (August 31 - September 4, 2023)

- One or two light doses peroxide-based algaecide as informed by cyanobacteria community
  - Target *cyanobacteria* biomass to keep low after prior treatments
- One medium dose copper-based algaecide in late July, unless cyanobacteria levels dictate early use
  - At least 30 days ahead of intended releases to avoid residual problems
  - Balance release of free reactive P held in algae/cyanobacteria with impacts to community
- One medium/heavy dose lanthanum-modified clay within ~2 days of completing copper-based algaecide
  - Medium/heavy dose over 30-40% of lake surface area
  - Strip free reactive P from water column immediately after release from cells affected by copper-based treatment
  - Sequester ~13% of biologically available P in deepest 400 acres of lake bottom


Questions?

100th ANNIVERSARY AD HOC COMMITTEE REPORT	Agenda Item: 8	
	Board Meeting Date:	**March 15, 2023**
	Prepared By:	**Dirs. Sanchez & Vásquez**

SUBJECT: VISTA IRRIGATION DISTRICT 100TH ANNIVERSARY CELEBRATION UPDATE

RECOMMENDATIONS:

1. Adopt Resolution No. 23-XX celebrating Vista Irrigation District's 100th Anniversary; and
2. Receive informational report.

PRIOR BOARD ACTION: At its July 20, 2022 meeting, the Board appointed a 100th Anniversary ad hoc committee comprised of Directors Sanchez and Vásquez. At its October 5, 2022 meeting, the Board approved a not to exceed budget of $25,000 to support the mission of the District and in commemoration of the District's 100 years of service in providing a reliable supply of high-quality water that meets the needs of its customers in an economically and environmentally responsible manner. On March 1, 2023, the Board approved increasing the budget from $25,000 to $35,000, including sponsorship of the 2023 Spring Association of California Water Agencies (ACWA) Conference, to support the mission of the District and to commemorate 100 years of fulfilling said mission.

FISCAL IMPACT: As noted in the October 5, 2022 ad hoc committee report, outreach activity costs were not included in the Fiscal Year 2023 Budget; therefore, any expenditures on planned programs and outreach activities during Fiscal Year 2023 would be unbudgeted. It is proposed that $23,000 be spent in Fiscal Year 2023 and $12,000 be spent in Fiscal Year 2024 for planned programs and outreach activities; $12,000 will be included in the Fiscal Year 2024 for planned programs and outreach activities.

Below is a table showing the budget, amounts paid (as of the writing of this report) and remaining balance for each category of planned outreach items/activities:

Description	Budget	Paid	Remaining Balance
Internal Correspondence/Promotion	$ 8,870.00	$ 1,908.50	$ 6,961.50
External Promotional Items	2,870.00	2,425.42	444.58
Publications and Promotion	9,200.00	-	9,200.00
Board Action/Other Agency Action	-	-	-
Sponsorship/Advertising	4,000.00	-	4,000.00
Activities and Events	10,060.00	-	10,060.00
Total	$ 35,000.00	$ 4,333.92	$ 30,666.08

SUMMARY: On September 11, 2023, the District will have fulfilled its mission of providing a reliable supply of high quality water that meets the needs of its customers in an economically and environmentally responsible manner for 100 years. Celebrating this achievement is important to employee retention, morale and recruitment and helps the District continue to achieve its mission for present and future customers. Recognizing that it will take time to plan for commemoration of this milestone, the Board appointed an ad hoc committee of Directors Sanchez and Vásquez to help with the planning activities to commemorate and educate its customers on how it has fulfilled its mission for the past 100 years and how it plans to do so into the future.

The ad hoc committee has met with staff on six occasions to plan activities to commemorate the upcoming milestone. At this time, the ad hoc committee would like to update the Board on the status of various activities and outreach items as well as request that the Board approve a resolution to officially kick-off our celebration of "A

Century of Service and Stewardship". The District will be sponsoring the 2023 Spring ACWA Conference at the "Bronze" level to promote the District's 100^{th} Anniversary and support ACWA's efforts to educate attendees, including commissioners and members of state boards, about issues affecting water agencies' abilities to secure and deliver reliable, affordable water to their current and future customers.

DETAILED REPORT: The ad hoc committee and staff have been working on various outreach items/activities to commemorate the District's 100^{th} Anniversary. The following summarizes completed and planned outreach items/activities by category (Internal Correspondence/Promotion, External Promotional Items, Publications and Promotion, Board/Other Agency Action, Sponsorship/Advertising and Activities and Events):

Internal Correspondence/Promotion: Letterhead and business cards have been printed and distributed for use; anniversary patches have been sewn on uniforms; decals are being placed on vehicles when they are serviced in the garage; and jackets have been ordered.

External Promotional Items: Promotional items (water bottles, pens, magnets, etc.) have been ordered.

Publications and Promotion: Customer bill message regarding 100 years of service is included on current billings, and envelope and bill messaging about the open house to begin in July 2023. Development of a historical brochure, lobby display, banners and web page are underway.

Board Action/Other Agency Action: The ad hoc committee is recommending that a resolution officially kicking-off our celebration of "A Century of Service and Stewardship" be adopted at today's meeting. Commence requesting other community organizations, local municipalities and special districts, legislative and congressional offices and appropriate non-profit organizations recognize the District's 100^{th} Anniversary by adopting a resolution/proclamation or any other form of recognition that they may choose.

Sponsorship/Advertising: Sponsoring the 2023 Spring ACWA conference at the "Bronze" level to promote the District's 100^{th} Anniversary and support the ACWA's efforts educate attendees, including commissioners and members of state boards, about issues affecting water agencies' abilities to secure and deliver reliable, affordable water to their customers. The need to advertise in local publications has yet to be determined.

Activities and Events: Planning of the open house event to be held on Saturday, September 9, 2023 is underway. Participation in a community event, such as the Vista Farmer's Market, to be determined. Additional details, activities and a schedule of events will be brought back to Board as an informational item as final arrangements are completed.

ATTACHMENTS:

- Resolution No. 23-XX
- 2023 Spring ACWA Conference Sponsorship Opportunities

RESOLUTION NO. 23-XX

RESOLUTION OF THE BOARD OF DIRECTORS OF
VISTA IRRIGATION DISTRICT
CELEBRATING ITS 100TH ANNIVERSARY

WHEREAS, on September 11, 2023, the Vista Irrigation District will celebrate 100 years of providing a reliable supply of high quality water that meets the needs of its customers in an economically and environmentally responsible manner; and

WHEREAS, an election was held on August 28, 1923, and 100% of the eligible voters participated with the outcome of the election being 104 votes for and 4 votes against formation of Vista Irrigation District; and

WHEREAS, on September 11, 1923, Vista Irrigation District was created to provide water to the farms and orchards of the growing community of Vista; and

WHEREAS, following the arrival of the first water from Lake Henshaw on February 27, 1926, crops of all kinds were planted, and the Vista area became known as the "Avocado Capital of the World"; and

WHEREAS, in June 1946, the Vista Irrigation District purchased San Diego Water Company, which included the 43,000-acre Warner Ranch, a former Spanish Land Grant, and encompassed Henshaw Dam and Lake Henshaw, securing a less expensive water supply for its customers; and

WHEREAS, in the midst of a drought, Vista Irrigation District sought to secure other sources of water and became a member of the San Diego County Water Authority in February 1954, providing access to water from Colorado River and northern California; and

WHEREAS, the Vista Irrigation District had the foresight to secure a local water supply and an imported water supply to draw upon during drought, ensuring that its water supply would never run dry; and

WHEREAS, the dedicated efforts of the Board of Directors of the Vista Irrigation District and staff have played a major role in maintaining the quality of life and contributing to the economic growth in the communities it serves, including the City of Vista, portions of the cities of Escondido, Oceanside and San Marcos and unincorporated areas of the County of San Diego.

NOW, THEREFORE, BE IT RESOLVED that the Board of Directors of the Vista Irrigation District recognize and celebrate the Vista Irrigation District's century of service and stewardship to the community.

PASSED AND ADOPTED by the following roll call vote of the Board of Directors of Vista Irrigation District this 15th day of March 2023.

AYES:
NOES:
ABSTAIN:
ABSENT:

____
Jo MacKenzie, President

ATTEST:

____
Lisa Soto, Secretary
Board of Directors
VISTA IRRIGATION DISTRICT

Throughout the year, ACWA hosts a variety of conferences and events that provide your company with a chance to connect with key decision makers in California's water community.

All sponsors are eligible to earn sponsor benefits. However, **non-members may only receive Bronze-level sponsorship benefits**, while ACWA members, associates, and affiliates may participate in any sponsorship level (Bronze, Silver, Gold, Platinum or Diamond) allowing them to receive additional benefits and special recognition at ACWA's Fall Conference & Expo.

By sponsoring any item associated with an ACWA conference and/or event, ACWA members, associates and affiliates will receive the benefit of each sponsorship level when they reach the specified dollar amount for that level during a single calendar year (January – December).

MAXIMIZE YOUR SPONSORSHIP

ACWA members, associates, and affiliates can take full advantage of all the sponsorship level benefits.

Become an ACWA Associate today! Contact Joseph Ramos at (916) 669-2429.

BECOME AN ACWA SPONSOR

ORDER FORM

SPONSORSHIP RESERVATION
Become an ACWA Sponsor by completing the Sponsorship Reservation From on page 10.

QUESTIONS?
Please email **josephr@acwa.com** or call (916) 669-2429.

BENEFITS FOR 2023 UNLESS OTHERWISE NOTED	Available to ALL sponsors	Available ONLY to ACWA members, associates and affiliates.			
	BRONZE $1,000+	SILVER $3,000+	GOLD $6,500+	PLATINUM $10,000	DIAMOND $15,000+
Company representatives identified as sponsors on their ACWA conference name badge	✔	✔	✔	✔	✔
Acknowledgment as a sponsor with sponsor level in *ACWA News*	✔	✔	✔	✔	✔
Listing on ACWA website with link to sponsor's website	✔	✔	✔	✔	✔
Company logo signage for specific sponsorship	✔	✔	✔	✔	✔
Recognition as sponsor in conference mobile app	✔	✔	✔	✔	✔
Company logo displayed on media presentation during Fall Conference & Expo meal functions	✔	✔	✔	✔	✔
Receive pre-/post-conference attendee mailing list		✔	✔	✔	✔
Sponsorship level recognition on banners at Fall Conference & Exhibition (Gold, Platinum, Diamond includes logo)		✔	✔	✔	✔
Receive complimentary registration package(s) to be used for Spring or Fall conferences in 2024		**1** Package	**2** Packages	**3** Packages	**4** Packages
Receive complimentary quarter-page (3.25" w x 4.5" h) display ad in *ACWA News* in 2024 (issue determined by ACWA). See ad specs below.				✔	✔
Receive special sponsorship award at Fall Conference & Expo meal function				✔	✔
Receive complimentary banner ad in conference mobile app during the 2024 Fall or Spring Conference & Expo					✔
Receive one complimentary exhibit booth to be used at the 2024 Fall or Spring Conference & Expo					✔

COMPLIMENTARY DISPLAY AD IN *ACWA NEWS* FOR PLATINUM AND DIAMOND SPONSORS

Ad Submission Deadline

Feb 1, 2024

Specifications

- Size: 3.25" wide x 4.5" height
- All ads are in color.
- High resolution (300 dpi) JPEG, TIFF or vector EPS files in CMYK color. Package all fonts or convert fonts to outlines.
- Ad can be hyperlinked. Please provide link when submitting your ad.
- Press-ready PDF files preferred.

The conference sponsorship amounts listed are **cost per conference** and co-sponsorships of items/events unless otherwise noted. Any item listed also may be exclusively sponsored.

Each sponsorship opportunity below includes the Bronze-level sponsorship benefits listed on page 6. Additional benefits for each sponsorship opportunity appear under the listing.

EXCLUSIVE ANNUAL MATERIALS FOR ATTENDEES

Description	Advantage	Standard
Notebooks – Includes your logo to the cover of notebooks provided to ACWA conference attendees at check-in. SOLD	$7,500 annually	$11,250 annually
Tote Bags – Includes your logo on 1,000 tote bags provide to ACWA conference attendees at check-in. SOLD	$7,000 annually	$10,500 annually
Badge Pouches – Includes your logo on all name badge pouches which are required for admittance to sessions and meal functions and provided to ACWA conference attendees at check-in. SOLD	$5,500 annually	$8,250 annually
Badge Lanyard – Includes your logo on all name badge lanyards which are required to for admittance to sessions and meal functions and provided to ACWA conference attendees at check-in. SOLD	$4,500 annually	$6,750 annually

MEAL FUNCTIONS

Description	Advantage	Standard	Spring & Fall Bundle*
Tuesday Committee Meetings Lunch – Reach approximately 250 ACWA committee members by sponsoring this lunch.	$1,500	$2,250	$2,700
Wednesday Opening Breakfast – Reach approximately 700 attendees by sponsoring the Opening Breakfast. Receive recognition as a sponsor during the meal function.	$3,000	$4,250	$5,400
Wednesday Opening Breakfast Video – Reach approximately 700 attendees by sponsoring the video shown during the Opening Breakfast to kick off the conference. Receive recognition as a sponsor in the video.	$2,000	$3,000	N/A
Wednesday Networking Lunch – Reach approximately 700 attendees by sponsoring this lunch. Receive recognition as a sponsor during the meal function.	$3,000	$4,250	$5,400
Thursday Networking Continental Breakfast – Reach approximately 300 attendees by sponsoring this breakfast in the Exhibit Hall. Receive recognition as a sponsor during the meal function.	$2,000	$3,000	$3,600
Thursday Lunch – Reach approximately 700 attendees by sponsoring this lunch. Receive recognition as a sponsor during the meal function.	$3,000	$4,250	$5,400

SESSIONS

Description	Advantage	Standard	Spring & Fall Bundle*
Statewide Issue Forum Session – Reach approximately 300-400 attendees each session by sponsoring a Statewide Issue Forum. Limited to one sponsor per session, total of three spots available. Opportunity also includes: • Signage with sponsor logo in session room • Company logo displayed above session in conference mobile app	$1,000	$1,500	N/A
Track Sessions – Reach approximately 1,000 attendees by sponsoring a 2-day track session. Choose from Attorney, Finance, Energy, Water Trends or Region program tracks. Limited to one sponsor per track. Opportunity also includes: • Signage with sponsor logo in each session room for 2-day period • Company logo displayed above session in conference mobile app	$2,000	$3,000	N/A
Wednesday Afternoon Ice Cream Break – Sponsor our most popular break of the week with an ice cream station during the Region membership meetings. Opportunity includes custom signage next to the ice cream station and mobile app recognition.	$2,500	$3,500	$4,500

**Spring & Fall Bundle is exclusively for ACWA agency members, associates and affiliates. This bundle sponsors both ACWA's Spring and Fall conferences.*

EXHIBIT HALL FUNCTIONS

Description	Advantage	Standard	Spring & Fall Bundle*
Fruit-Infused Water Stations – Sponsor fruit-infused water stations offered in the Exhibit Hall during the conference.	$2,000	$2,750	$3,600
Tuesday Bar Sponsor at Welcome Reception – Be the **exclusive** sponsor to host the bar at ACWA's Welcome Reception that kicks off the conference. Opportunity includes custom cocktail napkins with sponsor logo, custom signage in and at the entrance of the exhibit hall, banner ad in conference mobile app, complimentary sizzle reel video, and listing in the At-A-Glance schedule.	$10,000	$13,000	N/A
Morning Coffee Break – Sponsor our morning coffee breaks on both Wednesday and Thursday in the exhibit hall. Includes sponsor logo on coffee cup sleeves, logo on printed At-A-Glance schedule, and mobile app listing.	$3,000	$3,750	$5,400
Wednesday Reception in the Exhibit Hall – Mix and Mingle reaching approximately 700 attendees with this **exclusive** sponsorship of beverages. Opportunity also includes custom cocktail napkins with sponsor logo, custom signage in and at the entrance of the exhibit hall, banner ad in conference mobile app, complimentary sizzle reel video, and listing in the At-A-Glance schedule.	$10,000	$13,000	N/A

**Spring & Fall Bundle is exclusively for ACWA agency members, associates and affiliates. This bundle sponsors both ACWA's Spring and Fall conferences.*

CHARGING STATION

Description	Advantage	Standard
Charging Station Sponsor – Your organization logo printed on popular Charging Station available to attendees in Exhibit Hall throughout conference.	$2,500	$3,750

ACWA REGISTRATION COUNTERS

Description	Advantage	Standard
Floor Clings – Customized floor cling with your logo. 12" x 12"	$100	$150
Floor Clings – Customized floor cling with your logo. 24" x 24"	$200	$300

CUSTOM SPONSORSHIPS

Description	Advantage	Standard
General Sponsorship – "Name your price" with this flexible sponsorship opportunity. General sponsorship funds are used for conference costs at ACWA's discretion.	$500 minimum	$750 minimum
"Create Your Own" Sponsorship – Have an idea for an item you'd like to sponsor? Let's work together to make your idea a reality.	$500 minimum	$750 minimum
Attendee Give-Away – Host a special freebie for conference attendees such as water bottle or pens.	Request Pricing	Request Pricing
Head Shot Sponsor – Help support water professionals with this unique sponsor opportunity. Includes logo signage at head shot location and mobile app listing.	$1,000	$1,500

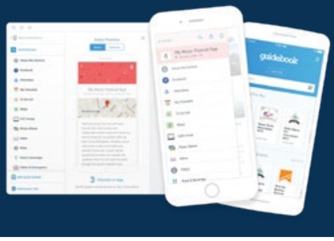
Advantage pricing applies to ACWA public agency members, associates & affiliates.
Standard pricing applies to non-members of ACWA.

PRINTED SCHEDULE

Description	Advantage	Standard
Onsite At-A-Glance Schedule – 6 spots available. Get your logo in front of all conference registrants by sponsoring the onsite at-a-glance schedule. This valuable reference schedule is distributed at conference check-in.	$500	$750

MOBILE APP ADVERTISING

Description	Advantage	Standard
Conference Mobile App Banner Ad (3 opportunities per conference) – Purchase a banner ad to appear on our Conference Mobile App during ACWA's Spring and Fall conferences. Ads must be 720 pixels wide x 160 pixels high.	$1,500	$2,250
Conference Mobile App Activity Feed Ad – Get your ad in the activity feed of our Conference Mobile App during ACWA's Spring and Fall conferences. Ads must be 410 pixels wide x 410 pixels high.	$2,000	$3,000



ACWA's Conference Mobile app provides all attendees with conference information such as maps, schedules, exhibitor information and speaker details and also allows them to interact with peers at the conference.

2023 SPONSORSHIP RESERVATION FORM

Return completed form with payment to ACWA or email **josephr@acwa.com** by **Apr. 14, 2023**

1 ENTER YOUR CONTACT INFORMATION

Date: ____________________

Organization Name (Exactly as you want it printed for recognition): ____________________

Contact Person: ____________________ Email: ____________________

Full Address: ____________________ Phone: ____________________

2 MAKE YOUR SELECTION(S)

Advantage pricing applies to ACWA public agency members, associates & affiliates. **Standard pricing** applies to non-members of ACWA.

	Conference Sponsorship Opportunities (pricing per conference or as noted)	Advantage	Standard	Spring & Fall Bundle*
☐	Exhibitor Cash Prize Contribution *(Adv. $50 increments / Std. $75 increments)*	$	$	
☐	Exhibitor Demo *5 SPOTS*	$550	$825	
☐	Exhibitor Spotlight *10 SPOTS*	$350	$525	
☐	Exhibitor Sizzle Reel *6 SPOTS* ☐ 2 min. $1,000/$1,500 ☐ 1.5 min $750/$1,125 ☐ 1 min $500/$750 ☐ 30 sec. $250/$375	$	$	
☐	~~Notebooks (annual)~~ SOLD	~~$7,500~~	~~$11,250~~	
☐	~~Tote Bags (annual)~~ SOLD	~~$7,000~~	~~$10,500~~	
☐	~~Badge Pouch (annual)~~ SOLD	~~$5,500~~	~~$8,250~~	
☐	~~Badge Lanyard (annual)~~ SOLD	~~$4,500~~	~~$6,750~~	
☐	Tue. Committee Meetings Lunch: ☐ Spring Conference ☐ Spring & Fall Bundle	$1,500	$2,250	$2,700
☐	Wed. Opening Breakfast: ☐ Spring Conference ☐ Spring & Fall Bundle	$3,000	$4,250	$5,400
☐	Wed. Opening Breakfast Video	$2,000	$3,000	
☐	Wed. Network Lunch: ☐ Spring Conference ☐ Spring & Fall Bundle	$3,000	$4,250	$5,400
☐	Thur. Networking Continental Breakfast: ☐ Spring Conference ☐ Spring & Fall Bundle	$2,000	$2,750	$3,600
☐	Thur. Lunch: ☐ Spring Conference ☐ Spring & Fall Bundle	$3,000	$4,250	$5,400
☐	Track Session (per track): ☐ Attorney ☐ Energy ☐ Finance ☐ Region Programs ☐ Water Trends	$2,000	$3,000	
☐	State Wide Issue Forum Session *3 SPOTS*	$1,000	$1,500	
☐	Tue. Bar Sponsor at Welcome Reception	$10,000	$13,000	
☐	Fruit-Infused Water Stations: ☐ Spring Conference ☐ Spring & Fall Bundle	$2,000	$2,750	$3,600
☐	Morning Coffee Break: ☐ Spring Conference ☐ Spring & Fall Bundle	$3,000	$3,750	$5,400
☐	Wed. Afternoon Ice Cream Break: ☐ Spring Conference ☐ Spring & Fall Bundle	$2,500	$3,500	$4,500
☐	Wed. Reception in Exhibit Hall	$10,000	$13,000	
☐	Charging Station Sponsor	$2,500	$3,750	
☐	Floor Cling 12"x12"	$100	$150	
☐	Floor Cling 24"x24"	$200	$300	
☐	Printed Onsite At-A-Glance Schedule *6 SPOTS*	$500	$750	
☐	Mobile App Banner Ad *3 SPOTS*	$1,500	$2,250	
☐	Ad in Mobile App Activity Feed	$2,000	$3,000	
☐	Specialty Sponsorship: ☐ Attendee Give-Away ☐ Create Your Own	Request Pricing		
☐	General Sponsorship – *Name your price (Adv. $500 min./Std. $750 min.)*	$	$	

**Spring & Fall Bundle is exclusively for ACWA agency members, associates and affiliates. This bundle sponsors both ACWA's Spring and Fall conferences.*

3 CALCULATE TOTAL AMOUNT OF YOUR SPONSORSHIP

. . . . $ ____________

4 MAKE PAYMENT

☐ **Credit card** (AmEx not accepted), contact ACWA Accounting at (916) 669-2443 ☐ **Check**: Payable to ACWA, mail to 980 9th Street, Ste 1000, Sacramento, CA 95814

FILE SUBMISSION

Files must be submitted electronically in either of the two ways:

- If smaller than 20MB and your email system allows it, email file to **josephr@acwa.com**.
- For larger files that are unable to be emailed, use a file sharing service and send the **download link** to **josephr@acwa.com**.

VISTA IRRIGATION DISTRICT **STAFF REPORT**	**Agenda Item: 9** **Board Meeting Date:** **March 15, 2023** **Prepared By:** **Lisa Soto** **Approved By:** **Brett Hodgkiss**

SUBJECT: 2023 ASSOCIATION OF CALIFORNIA WATER AGENCIES JOINT POWERS INSURANCE AUTHORITY EXECUTIVE COMMITTEE ELECTION

RECOMMENDATION: Consider request to adopt a resolution concurring in the nomination of James Pennock of the Vallecitos Water District to the Association of California Water Agencies Joint Powers Insurance Authority Executive Committee.

PRIOR BOARD ACTION: None.

FISCAL IMPACT: None.

SUMMARY: The District has received a written request from the Vallecitos Water District to concur in the nomination of James Pennock for a position on the Association of California Water Agencies Joint Powers Insurance Authority (ACWA/JPIA) Executive Committee.

DETAILED REPORT: ACWA/JPIA is soliciting nominations for four Executive Committee member positions, each for a four-year term. James Pennock has been nominated by Vallecitos Water District and is now seeking the required three resolutions from other ACWA JPIA member agencies concurring in his nomination. ACWA JPIA must receive concurring nomination resolutions by Friday, March 24, 2023. The date, time, place, and list of candidates for the election will be announced as part of the ACWA JPIA Board of Directors meeting packet on or about April 24, 2023.

ATTACHMENTS:

- Election Notice and Nomination Procedures from ACWA/JPIA
- Request for support of nomination for James Pennock, Vallecitos Water District
- Statement of Qualifications for James Pennock
- Draft resolution concurring in the nomination of James Pennock

Executive Committee Election

The ACWA JPIA Executive Committee Election will take place during the JPIA's Board of Director's Meeting on May 8th, 2023 at the Spring Conference in Monterey, California.

This election will fill four Executive Committee member positions, each for a four-year term.

The information in this section has Nomination Procedures for the Executive Committee, Samples of Nominating Resolution and a Concurring Resolution.

All nominations must be received by Friday, March 24th, 2023.

ACWA JPIA
Nomination Procedures for Executive Committee

Approximately 120 Days before Election (January 9, 2023)

All ACWA JPIA Directors and Member Districts are to be notified of:

A) Date and place of Election;
B) Executive Committee positions and terms of office to be filled by Election;
C) Nomination Procedures.

120 to 45 Days before Election (January 9 – March 24, 2023)

A) A district (that participates in all four of the JPIA's programs: Liability, Property, Workers' Compensation and Employee Benefits) may place into nomination its member of the Board of Directors of ACWA JPIA with the concurrence of three districts, then members of the ACWA JPIA, in addition to the nominating district.
B) Sample resolutions are available on the ACWA JPIA website.
C) The **district is solely responsible** for timely submission of the nominating resolution and the three additional concurring in nomination resolutions of its candidate for office.

45 Days before Election (March 24, 2023)

A) Deadline and location for receiving the nominating and concurring in nomination resolutions in the ACWA JPIA office:

Friday – March 24, 2023 – 4:30 p.m.

Laura Baryak
Administrative Assistant II
(lbaryak@acwajpia.com)
ACWA JPIA
P. O. Box 619082
Roseville, CA 95661-9082

B) Candidates' statement of qualifications must be submitted, if desired, with the nominating resolutions. The statement of qualifications must be submitted on one side of an 8½ x 11" sheet of paper suitable for reproduction and distribution to all districts. (MSWord or PDF documents preferred).

14 Days before Election (April 24, 2023)

Final notice of the upcoming Election of Executive Committee members will be included as part of the Board of Directors' meeting packet. Final notice shall include:

A) Date, Time, and Place of Election;
B) Name and District of all qualified candidates;
C) Candidate's statement of qualifications (if received); and
D) Election Procedures and Rules.

VALLECITOS
WATER DISTRICT
Water and Wastewater Specialists since 1955

201 Vallecitos de Oro · San Marcos, California · 92069-1453 · (760) 744-0460

March 7, 2023

Subject: Request for support for James Pennock, Director on the Vallecitos Water District Board, for his nomination for the ACWA/JPIA Executive Committee

Dear Fellow ACWA/JPIA Member Agency:

The Vallecitos Water District (Vallecitos) is seeking your support for the nomination of James Pennock for a seat on ACWA/JPIA's Executive Committee. JPIA's continued success depends on the vision and leadership of its Executive Committee. Director Pennock's 30-plus years of experience in the insurance industry makes him uniquely qualified to assume that responsibility.

Although Director Pennock is relatively new to the Vallecitos Board of Directors, having first been elected in 2020, he has spent the majority of his adult life serving his community. His work in the San Marcos area includes teaching in the San Marcos Unified School District, serving on the City's Planning Commission and Budget Review Committees, Chairing the Kit Carson District for the Boy Scouts of America, and coaching youth sports teams for more than 30 years. In addition to his seat on the Vallecitos Board, Director Pennock is one of Vallecitos' representatives on the Encina Wastewater Authority, a regional wastewater treatment Joint Powers Authority, of which Vallecitos is a member. Director Pennock is also Vallecitos' representative on the ACWA/JPIA Board.

Vallecitos asks that you join us in supporting Director Pennock's candidacy for the JPIA Executive Committee by adopting a resolution concurring with his nomination. As you know, nominations are due by March 24.

If you have any questions about Director Pennock, please see his attached resume, or contact our General Manager, Glenn Pruim, at (760) 250-8541.

Thank you for your consideration,

James R. Hernandez

James Hernandez
Vallecitos Board President

Attachment: Director James Pennock resume

e-mail: vwd@vwd.org · http://www.vwd.org

Jim Pennock
jpennock@sbcglobal.net
760-815-4402

I look to utilize the interpersonal relationship skills and knowledge obtained through running my own business for the past 30 years to help propel public agencies to be more effective and efficient. I hope to increase moral and attitude within human resources and increase financial responsivity through effective planning and budgeting. Found to be Hardworking, honest and innovative in my approaches to helping others succeed.

EXPERIENCE

Pennock Insurance Agency
01-Aug-2016 - Present
Sales and service of Insurance contracts

Farmers Insurance Group
01-Aug-1991 - 11-Aug-2016 – Insurance Agency Owner
I enjoyed a long career as an Insurance agent with Farmers Insurance.
Operated my own agency for 25 years - growing from 0 to 2900 policies and generating millions of dollars in annual premium.
Director of Sales – Recruited, trained and mentored producers: helped them meet their income goals
Focused on all lines of business - Home / Auto / Life / Health and Commercial.
Managed day to day sales, service, claims, underwriting of personal and commercial lines policies.
Managed accounting, finance, human resource.
Oversaw all Financial Management of agency, including auditing and reporting

EDUCATION
Brigham Young University / United States International University -
Graduated in 1991 with BS in International Business Administration

Other Skills and Experience
*** Fluent in English and Spanish**
*** Teacher in San Marcos Unified School District**
*** Provided consulting for Public Administration policies**
*** Served on Student and Neighborhood relations committee for City of San Marcos**
*** Served on the Budget Review committee for City of San Marcos 2009-2011**
*** Served on the Planning Commission for City of San Marcos 2013-2015**
*** Served as Chairman of Kit Carson District for Boy Scouts of America**
*** Coached multiple youth sports teams for last 30 years**
*** Served on multiple boards with non-profits over last 30 years**
*** Board Member for Hope Legacy 2017 to Present: assist youth to become self-reliant in area of education and finances.**
***Petco Park Customer service agent for San Diego Padres games**
***Board Member for Vallecitos Water District in San Marcos 2020 – Present**
***Board Member for Encina Waste Water 2023**
*** Delegate on board for ACWA JPIA 2021- Current**

RESOLUTION NO. 23-XX

RESOLUTION OF THE BOARD OF DIRECTORS OF THE
VISTA IRRIGATION DISTRICT
CONCURRING IN THE NOMINATION OF JAMES PENNOCK
TO THE EXECUTIVE COMMITTEE OF THE
ASSOCIATION OF CALIFORNIA WATER AGENCIES
JOINT POWERS INSURANCE AUTHORITY ("ACWA/JPIA")

WHEREAS, Vista Irrigation District is a member district of the ACWA/JPIA; and

WHEREAS, the Bylaws of the ACWA/JPIA provide that in order for a nomination to be made to ACWA/JPIA's Executive Committee, three member districts must concur with the nominating district; and

WHEREAS, another ACWA/JPIA member district, the Vallecitos Water District, has requested that this district concur in its nomination of its member of the ACWA/JPIA Board of Directors to the Executive Committee of the ACWA/JPIA.

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors of the Vista Irrigation District that this district concurs with the nomination of James Pennock of the Vallecitos Water Conservation District to the Executive Committee of the ACWA/JPIA.

BE IT FURTHER RESOLVED that the District Secretary is hereby directed to transmit a certified copy of this resolution to the ACWA/JPIA at P.O. Box 619082, Roseville, California 95661-9082, forthwith.

PASSED AND ADOPTED by the following roll call vote of the Board of Directors for the Vista Irrigation District this 15th day of March 2023.

AYES:
NOES:
ABSTAIN:
ABSENT:

____
Jo MacKenzie, President

ATTEST:

____
Lisa R. Soto, Secretary
Board of Directors
VISTA IRRIGATION DISTRICT

VISTA IRRIGATION DISTRICT	Agenda Item: 10
STAFF REPORT	**Board Meeting Date:** **March 15, 2023** **Prepared By:** **Brett Hodgkiss**

SUBJECT: MATTERS PERTAINING TO THE ACTIVITIES OF THE SAN DIEGO COUNTY WATER AUTHORITY

SUMMARY: Informational report by staff and directors concerning the San Diego County Water Authority. No action will be required.

STAFF REPORT	**Agenda Item: 11.A** **Board Meeting Date:** **March 15, 2023** **Prepared By:** **Lisa Soto** **Approved By:** **Brett Hodgkiss**

SUBJECT: REPORTS ON MEETINGS AND EVENTS ATTENDED BY DIRECTORS

SUMMARY: Directors will present brief reports on meetings and events attended since the last Board meeting.

VISTA IRRIGATION DISTRICT	Agenda Item: 11.B
STAFF REPORT	**Board Meeting Date:** **March 15, 2023** **Prepared By:** **Lisa Soto** **Approved By:** **Brett Hodgkiss**

SUBJECT: SCHEDULE OF UPCOMING MEETINGS AND EVENTS

SUMMARY: The following is a listing of upcoming meetings and events. Requests to attend any of the following events should be made during this agenda item.

	SCHEDULE OF UPCOMING MEETINGS AND EVENTS	ATTENDEES
1	**Intro to Special District Finance for Board Members** (CSDA) *Mar. 21, 2023; Live webinar* *Registration deadline: None*	Kuchinsky (R)
2	**ACWA Legislative Symposium** *Mar. 23, 2023; Sutter Club, Sacramento* *Registration deadline: Closed*	MacKenzie (R)
3	**How and Why Involvement in LAFCO Matters for Special Districts** (CSDA) *Apr. 4, 2023; Live webinar* *Registration deadline: None*	
4 *	**Vista Chamber Government Affairs** *Apr. 4, 2023; Noon-1:30 p.m.; The Film Hub, Vista* *Registration deadline: None*	Kuchinsky ◊
5	**State Water Project & Bay-Delta tour** *Apr. 14-15, 2023; Begins and ends at the San Diego International Airport* *Registration deadline: Open until full*	Kuchinsky (R)
6	**Financial Management for Special Districts** (CSDA) *Apr. 26, 2023; CSDA offices, Sacramento* *Registration deadline: TBD*	
7 *	**Vista Chamber Government Affairs** *May 4, 2023; Noon-1:30 p.m.; The Film Hub, Vista* *Registration deadline: None*	Kuchinsky ◊
8	**ACWA Spring Conference** *May 9-11, 2023; Monterey* *Registration deadline: 4/21/23*	MacKenzie Sanchez
9	**Special Districts Legislative Days** (CSDA) *May 16-17, 2023; Sheraton Grand Sacramento Hotel; Sacramento* *Early-bird deadline: 4/21/23*	MacKenzie
10 *	**CSDA Quarterly Meeting** *May 18, 2023; 6:00 p.m.; The Butcher Shop Steakhouse, Kearny Mesa* *Registration deadline: TBD*	MacKenzie
11 *	**Vista Chamber Government Affairs** *Jun. 1, 2023; Noon-1:30 p.m.; The Film Hub, Vista* *Registration deadline: None*	Kuchinsky ◊
12	**ACWA Region 10 Event** *June 29, 2023; Location TBD* *Registration deadline: TBD*	Kuchinsky MacKenzie
13 *	**Vista Chamber Government Affairs** *July 6, 2023; Noon-1:30 p.m.; The Film Hub, Vista* *Registration deadline: None*	Kuchinsky ◊

	SCHEDULE OF UPCOMING MEETINGS AND EVENTS	ATTENDEES
14 *	**Vista Chamber Government Affairs** *Aug. 3, 2023; Noon-1:30 p.m.; The Film Hub, Vista* *Registration deadline: None*	Kuchinsky ◊
15 *	**CSDA Quarterly Meeting** *Aug. 17, 2023; 6:00 p.m.; The Butcher Shop Steakhouse, Kearny Mesa* *Registration deadline: TBD*	
16	**CSDA Annual Conference** *Aug. 28-31, 2023; Monterey Conference Center* *Registration deadline: Early-bird deadline: 8/5/23*	
17 *	**Vista Chamber Government Affairs** *Sept. 7, 2023; Noon-1:30 p.m.; The Film Hub, Vista* *Registration deadline: None*	Kuchinsky ◊
18	**Effective Meeting Management through Parliamentary Procedure** (CSDA) *Sept. 12, 2023; Live webinar* *Registration deadline: TBD*	
19	**Sixth Annual Western Groundwater Congress** *Sept. 12-14, 2023; Los Angeles Marriott Burbank Airport Hotel* *Registration deadline: TBD*	
20 *	**Vista Chamber Government Affairs** *Oct. 5, 2023; Noon-1:30 p.m.; The Film Hub, Vista* *Registration deadline: None*	Kuchinsky ◊
21	**CALAFCO Annual Conference** *Oct. 18-20, 2023; Hyatt Regency, Monterey;* *Registration deadline: TBD*	
22	**Special District Leadership Academy** (CSDA) *Oct. 22-25, 2023; Hyatt Regency Sonoma Wine Country;* *Early-bird deadline: 9/22/23*	Kuchinsky
23 *	**Vista Chamber Government Affairs** *Nov. 2, 2023; Noon-1:30 p.m.; The Film Hub, Vista* *Registration deadline: None*	Kuchinsky ◊
24 *	**CSDA Quarterly Meeting** *Nov. 16, 2023; 6:00 p.m.; The Butcher Shop Steakhouse, Kearny Mesa* *Registration deadline: TBD*	
25	**ACWA Fall Conference** *Nov. 28-30, 2023; Indian Wells;* *Registration deadline: TBD*	
26 *	**Vista Chamber Government Affairs** *Dec. 7, 2023; Noon-1:30 p.m.; The Film Hub, Vista* *Registration deadline: None*	Kuchinsky ◊
27	**Colorado River Water Users Association Conference** *Dec. 13-15, 2023; Paris, Las Vegas;* *Registration deadline: TBD*	

** Non-per diem meeting except when serving as an officer of the organization*

The following abbreviations indicate arrangements that have been made by staff:

R=Registration; **H**=Hotel; **A**=Airline; **S**=Shuttle; **C**=Car; **T**=Tentative; ◊=Attendee to Self-Register

Vista Government Affairs Hears North County Multimodal Corridor Plan Proposal

By **Tom Robertson** - March 2, 2023

By TR Robertson

The Vista Chamber of Commerce Government Affairs Committee heard a presentation by Brian Lane and Kareem Scarlett, representing SANDAG and the Department of Transportation speaking about the SANDAG Draft North County Multimodal Corridor Plan. Using a power point presentation, the development and implementation of the Plan was detailed. Lane said accessibility, state policy, goals and funding were key elements to the Plan. Senate Bill 1 is currently responsible for funding road improvements. It was pointed out that North County is growing and changing, and transportation and mobility is increasing. For the Transportation Planning Regional Plan mobility challenges, land use, limited access, safety and regional facilities are but a few of the consideration in establishing the Plan. In the Developed Strategy they looked at biking, transit, busing, commuter services and highway management as well as a few additional concerns to develop the strategies. Main arteries were shown that provide additional mobility for the area. Improved connections, intersections, rail connections, bike access, signal improvement and safe community access are needed all throughout the area. Some of the cost to the $5.6 billion-dollar 30-year Plan includes $3.5 million for corridor improvement, and an operating budget of $70 million.

Kareem Scarlett and Brian Lane from SANDAG and the Department of Transportation

The Coastal Gateway Bundle and the Inland Gateway Bundle were shown pointing out where major improvements are needed in areas with the highest traffic flow. Policy Recommendations for the Plan include Short Term Implementation, Creating an Innovative Testing of Transportation, Tools, and Technology and Integrating and Collaborating were discussed. A question-and-answer session followed the presentation. A discussion ensued about the viability of mass transit being the answer to North County transportation issues.

The accessibility of Sprinter and buses was also questioned as well as the various hubs and drop off points that are established. One example given was the drop off point for the Sprinter and riders getting to Tri-City Medical Center does not give riders close access from the Sprinter. It was pointed out that only so much money is yearly allocated for road improvements, one reason it takes so long for various projects to be completed. Funding for all of these projects was also questioned with no definitive answer on who would be paying for all of these 30-year projects. The feasibility of the Plan and the priorities listed were also questioned by one attendee.

One other question centered around getting people who use the Sprinter lines getting to their different work areas once they arrived at various hub stations. For information about the North County Multimodal Corridor Plan go to cmco@sandag.org or www.sandag.org or https://sandag.mysocialpinpoint.com/northcounty or call 888-317-8976

Governmental Updates

Jessica Ramirez from Congressman Mike Levin's Office – The Congressman is working on re-introducing legislation establishing assistance for Veterans seeking benefits and has sent a letter to the Chairman of the Federal Energy Regulatory Commission requesting an investigation to the rising cost of natural gas in California. He has also joined in on a letter looking into the management of water from the Colorado River.

Fernando Hernandez from Senator Catherine Blakespear's Office – The Senator is working on legislation to investigate and study the Rail Corridor's along the coast to access the safety of the rail lines. She has also and funds for homes, especially for those seeking affordable housing.

Ryan Ewart from Assembly Member Laurie Davies' Office – The Assembly Member has helped introduce AB 75 which would increase penalties for shoplifters. She also has co-signed a letter to the Federal Energy Regulatory Commission to investigate the reason for the rise in cost for natural gas and concerning the release of climate change credit to taxpayers. Citizens are encouraged to attend online the virtual meetings sponsored by SDG&E concerning rate increases. It was also pointed out that those that received middle class tax refunds are not to be taxed on those refunds.

Kristal Jabara from Supervisor Jim Desmond's Office – COVID Emergency restrictions have ended. Homelessness is still an issue around the county. The Supervisor is looking at the Federal government plan concerning homelessness to see what in their proposals might work for our county, recognizing that communities have different situations that need to be considered. The Supervisor's are also looking at Traffic Mitigating Plans and the differences in each city.

John Conley, City Manager, City of Vista – John recently selected as the City Manager. City Council looking at increasing penalties for Tobacco retailers that are in violation of laws concerning sales of tobacco. City Council passed a resolution to support abolishing the state gas tax. City Council discusses the councils relationship with the City Manager. The council also discussed compensation for employees moving forward in their positions. Black Bear Diner will be taking over the former Coco's location in the next few months.

Rachel Beld, Vista Chamber of Commerce CEO – The Heroes of Vista event will be on March 10th beginning at 4 pm at the Vistonian. Meet the Leaders will be held on April 13th at Shadowridge Country Club. Watching the Velocity Podcasts was encouraged as they feature a variety of interviews.

From the Vista Irrigation District – The VID will be sponsoring an Open House on Sept. 9th. Learn about the variety of device rebates available to residential customers by going to https://socalwatersmart.com/en/residential/# Rebates are also available for replacing lawns with WaterSmart landscaping. A 2023 WaterSmart Landscape Contest is available for those eligible, go to www.landscapecontest.com or contact Brent Reyes at 760-597-3107.

STAFF REPORT	**Agenda Item: 12** **Board Meeting Date:** **March 15, 2023** **Prepared By:** **Brett Hodgkiss**

SUBJECT: ITEMS FOR FUTURE AGENDAS AND/OR PRESS RELEASES

SUMMARY: This item is placed on the agenda to enable the Board to identify and schedule future items for discussion at upcoming Board meetings and/or identify press release opportunities.

Staff-generated list of tentative items for future agendas:

- Cast Ballot for Regular and Alternate Special District Member on San Diego Local Agency Formation Commission (April)
- Association of California Water Agencies Joint Powers Insurance Authority Presentation (April)
- Association of California Water Agencies President and Vice President and Region 10 elections (May)
- Fiscal Year 2024 Budget (May – after Fiscal Policy Committee review)
- Rename Edgehill Reservoir after former Director Paul Dorey

VISTA IRRIGATION DISTRICT	**Agenda Item: 13**
STAFF REPORT	**Board Meeting Date:** **March 15, 2023** **Prepared By:** **Lisa Soto**

SUBJECT: COMMENTS BY DIRECTORS

SUMMARY: This item is placed on the agenda to enable individual Board members to convey information to the Board and the public not requiring discussion or action.

VISTA IRRIGATION DISTRICT	Agenda Item: 14
STAFF REPORT	**Board Meeting Date:** **March 15, 2023** **Prepared By:** **Brett Hodgkiss**

SUBJECT: COMMENTS BY GENERAL COUNSEL

SUMMARY: Informational report by the General Counsel on items not requiring discussion or action.

VISTA IRRIGATION DISTRICT	**Agenda Item: 15**
STAFF REPORT	**Board Meeting Date:** **March 15, 2023** **Prepared By:** **Brett Hodgkiss**

SUBJECT: COMMENTS BY GENERAL MANAGER

SUMMARY: Informational report by the General Manager on items not requiring discussion or action.

EXHIBIT B

VISTA IRRIGATION DISTRICT

INTEROFFICE MEMORANDUM

DATE: March 15, 2023

TO: Brett Hodgkiss

FROM: Shallako Goodrick

RE: Service Charge Adjustment

Per section 4.4.3 (B) of the District's Rules and Regulations, effective each July 1, the District's water rates are adjusted to reflect inflationary costs. The impact of inflationary costs on District water rates has been calculated, and the service charge has been adjusted accordingly. The water usage charges are not changing. A typical residential customer's total water bill will increase by 4.6% as a result of the adjustment. (NOTE: A typical residential customer has a ¾" meter and uses 24 units in bi-monthly billing period.)

The changes are detailed in the table below.

MONTHLY SERVICE CHARGE

Meter Size	Current	Effective July 1, 2023
5/8"	$32.82	$36.66
3/4"	$43.30	$48.37
1"	$63.98	$71.47
1 1/2"	$116.14	$129.73
2"	$178.50	$199.39
3"	$344.85	$385.21
4"	$531.89	$594.14
6"	$1,259.65	$1,407.07
8"	$1,675.71	$1,871.82
10"	$2,507.47	$2,800.92

A message regarding the service charge increase will be on customer water bills for the billing prior to the effective date.

Attachment: Annual Inflationary Adjustment calculation

Vista Irrigation District
Annual Inflationary Adjustment

Overview

Vista Irrigation District prepares water rate studies, also known as cost of service studies, to ensure water rates and charges are sufficient to recover costs incurred by the water system, including water purchases from the San Diego County Water Authority, system operation and maintenance, facility and equipment maintenance, system rehabilitation, regulatory compliance, metering/billing, conservation and infrastructure projects. In January 2022, the Board of Directors conducted a public hearing and approved one-time increases to water rates and service charges, based on the water rate study, and the pass-through of San Diego County Water Authority costs and annual inflationary adjustments (Rate Adjustment Policy) for the next five years. Vista Irrigation District's Rules and Regulations were revised to incorporate the new water rates and service charges as well as approval the Rate Adjustment Policy.

Vista Irrigation District Rules and Regulations Section 4.4.3 (B) states that the District rates will be adjusted to reflect inflationary costs effective each July 1. Such inflationary adjustments shall be calculated as an increase or decrease equal to the amount of the increase or decrease in the U.S. Department of Labor's Consumer Price Index – All Urban Consumers – San Diego, California (CPI) for the previous calendar year ended; these adjustments shall be effective July 1 each year, commencing July 1, 2023 through July 1, 2026. This inflationary adjustment is only applied to District capital costs/capital reserves and operating costs (excluding San Diego County Water Authority costs, which are adjusted via the annual pass-through calculation).

Explanation of Annual Inflationary Adjustment Calculation

The annual inflationary adjustment ensures that the water rate revenue is sufficient to cover inflation on District operating costs as well as capital projects and reserves; therefore, the annual inflationary adjustment calculation is based on District revenues. To calculate the inflationary adjustment, the change in CPI (represented by a percentage) is multiplied by projected net water revenue (total projected water revenue less purchased water and purchased water treatment costs) to arrive at the additional revenue amount required to offset inflation. The last step is to allocate the additional required revenue amount to the existing service charge amounts (based on meter size) to get the new service charge amounts.

Below are detailed explanations of the key components used in the annual inflationary adjustment calculation:

- The CPI change is based on the difference between the CPI at the most recent calendar year-end and the CPI at the calendar year-end of the prior year. The percentage change is calculated by dividing the amount of the difference by the CPI at the calendar year-end of the prior year; this represents the inflation percentage from the prior year.

- Net Water Revenue is derived by deducting the cost of water purchased from the San Diego County Water Authority and the cost of treating said purchased water from projected water revenue (comprised of water sales, service charge and infrastructure access fee) for the next fiscal year. This amount represents the funds needed to cover operating and capital costs and capital reserve requirements. Net Water Revenue is multiplied by the percentage change in CPI (percentage) to get the amount of revenue required to offset inflationary costs.

- Required revenue (the amount needed to offset inflation) is allocated to the current monthly service charge amount based on meter size to get to the new monthly service charge.

Vista Irrigation District
CPI PASS THROUGH CALCULATION

CPI Inflation Percentage Calculation	**2021**	**2022**
U.S. Department of Labor CPI-All Urban Consumers-San Diego	319.761	344.416
Percentage Increased/(Decreased)		7.71%

Projected Fiscal Year 2024		
Water Sales	$ 38,050,000	
Service Fee	18,138,192	
Infrastructure Access Fees	1,840,000	
Water Revenues		$ 58,028,192
San Diego County Water Authority Variable Costs	(20,660,000)	
San Diego County Water Authority Fixed Costs	(7,176,000)	
Water Purchases		(27,836,000)
Escondido Water Treatment Costs		(2,375,450)
Weese Water Treatment Costs		(250,741)
Net Water Revenue		27,566,001
Change in CPI		7.71%
7/1/23 CPI Inflationary Increase		**$ 2,125,339**

Service Charge Calculation

Meter Size	*All Meters	Equivalent Meters	Current Charge	CPI Increase	New Charge	Current Annual Service Charge	Estimated Annual Service Charge
5/8"	6,829	6,829	$ 32.82	$ 3.84	**$ 36.66**	$ 2,689,533	$ 3,004,214
3/4"	17,031	22,481	43.30	5.07	**48.37**	8,849,308	9,885,474
1"	2,894	5,643	63.98	7.49	**71.47**	2,221,897	2,482,010
1 1/2"	1,313	4,648	116.14	13.59	**129.73**	1,829,902	2,044,026
2"	887	4,825	178.50	20.89	**199.39**	1,899,954	2,122,307
3"	55	578	344.85	40.36	**385.21**	227,601	254,239
4"	24	389	531.89	62.25	**594.14**	153,184	171,112
6"	13	499	1,259.65	147.42	**1,407.07**	196,505	219,503
8"	2	102	1,675.71	196.11	**1,871.82**	40,217	44,924
10"	1	76	2,507.47	293.45	**2,800.92**	30,090	33,611
Totals	**29,049**	**46,071**				$ 18,138,192	$ 20,261,419
						Increase/ (Decrease)	**$ 2,123,227 rounding**

* as of January 25, 2023