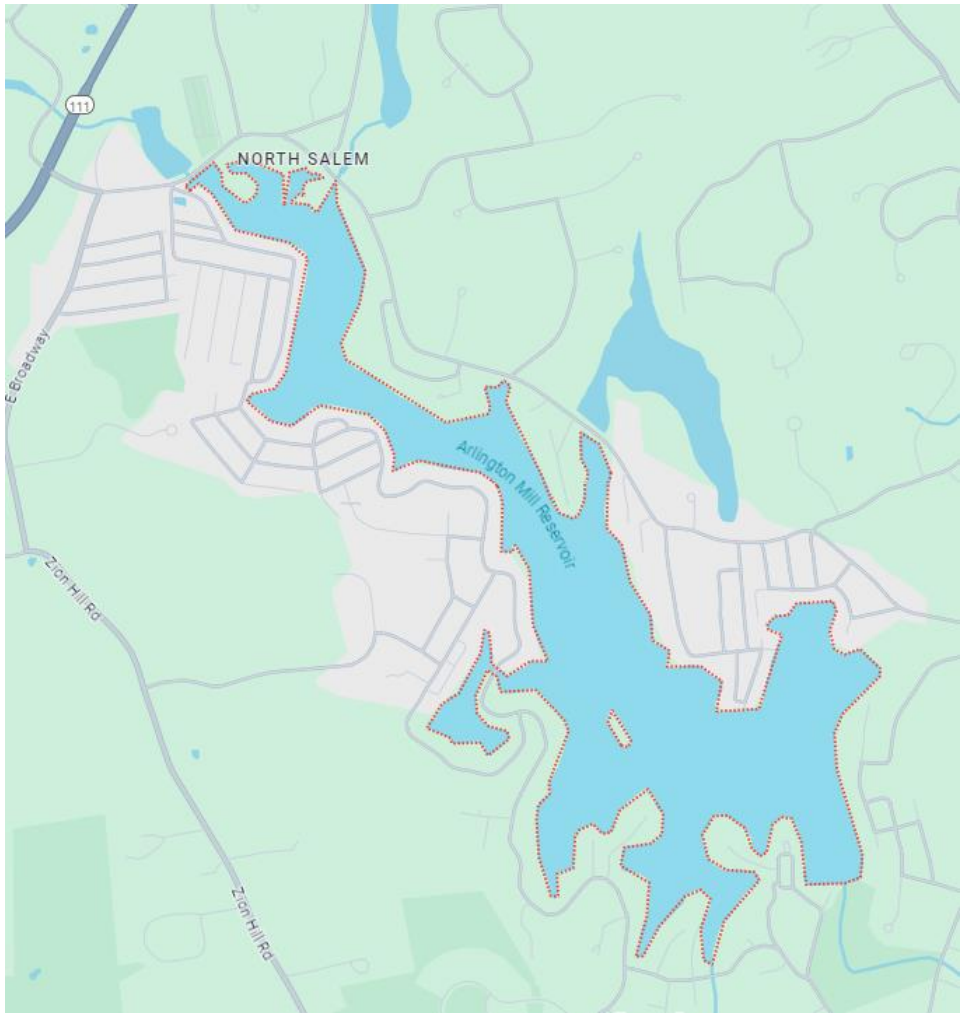
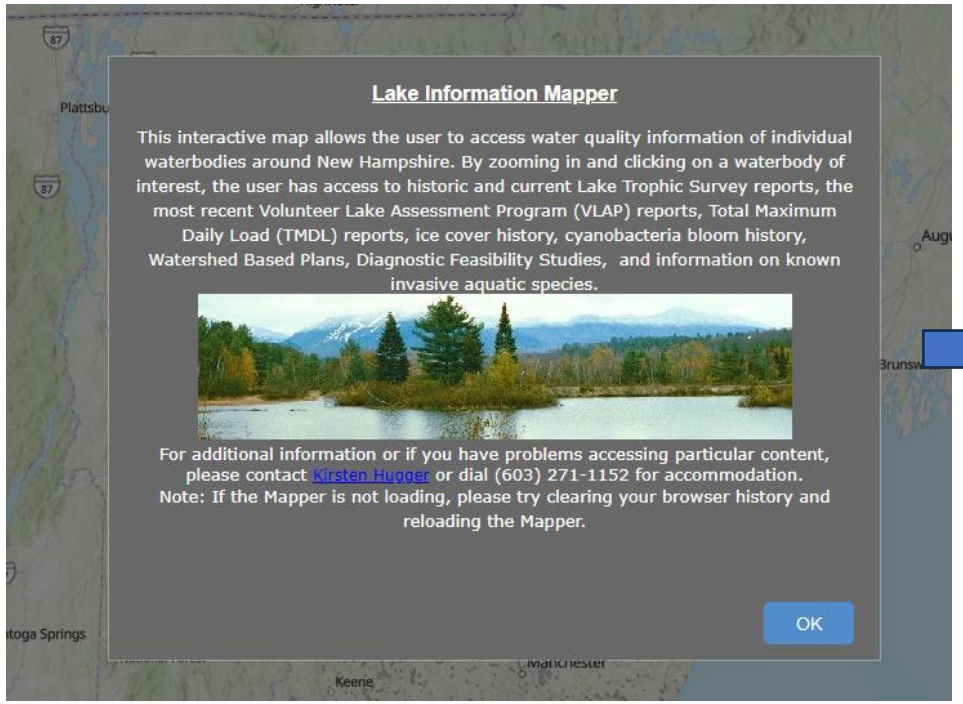
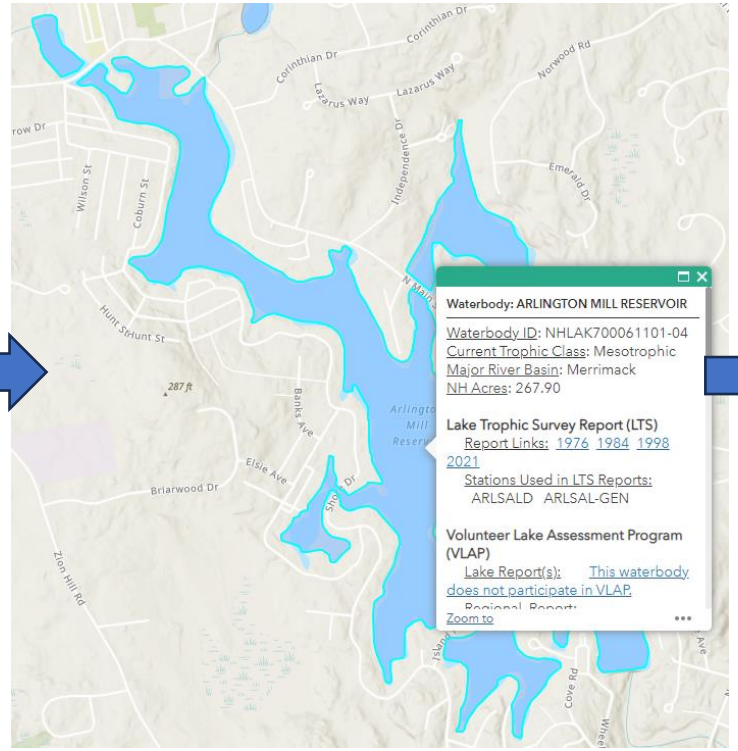
Arlington Mill Pond, Salem, NH: A limnological overview

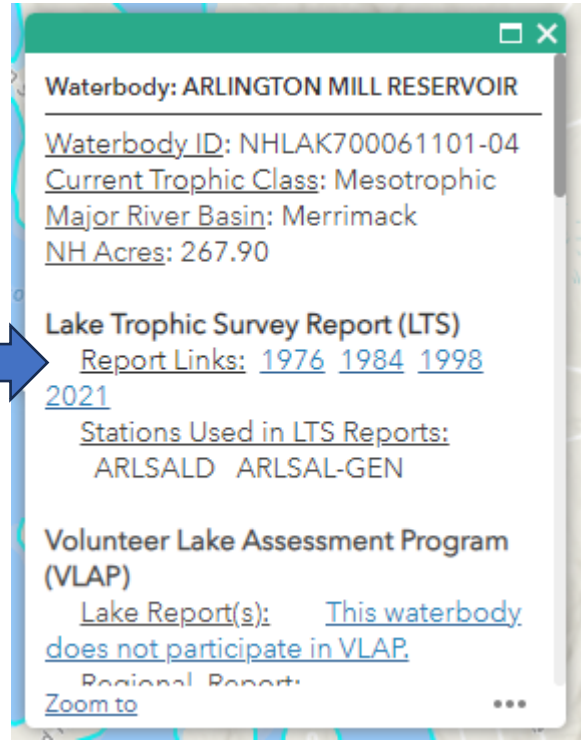


April 6, 2024
David Neils, david.e.neils@des.nh.gov, (603) 271-8865
NHDES, Chief Aquatic Biologist/ Director, Jody Connor Limnology Center

What do we know about Arlington Mill Pond?







Basic Physical and Chemical Characteristics of Arlington Mill Pond

Based on Lake Trophic Survey Data from 1976, 1984, 1998, and 2021

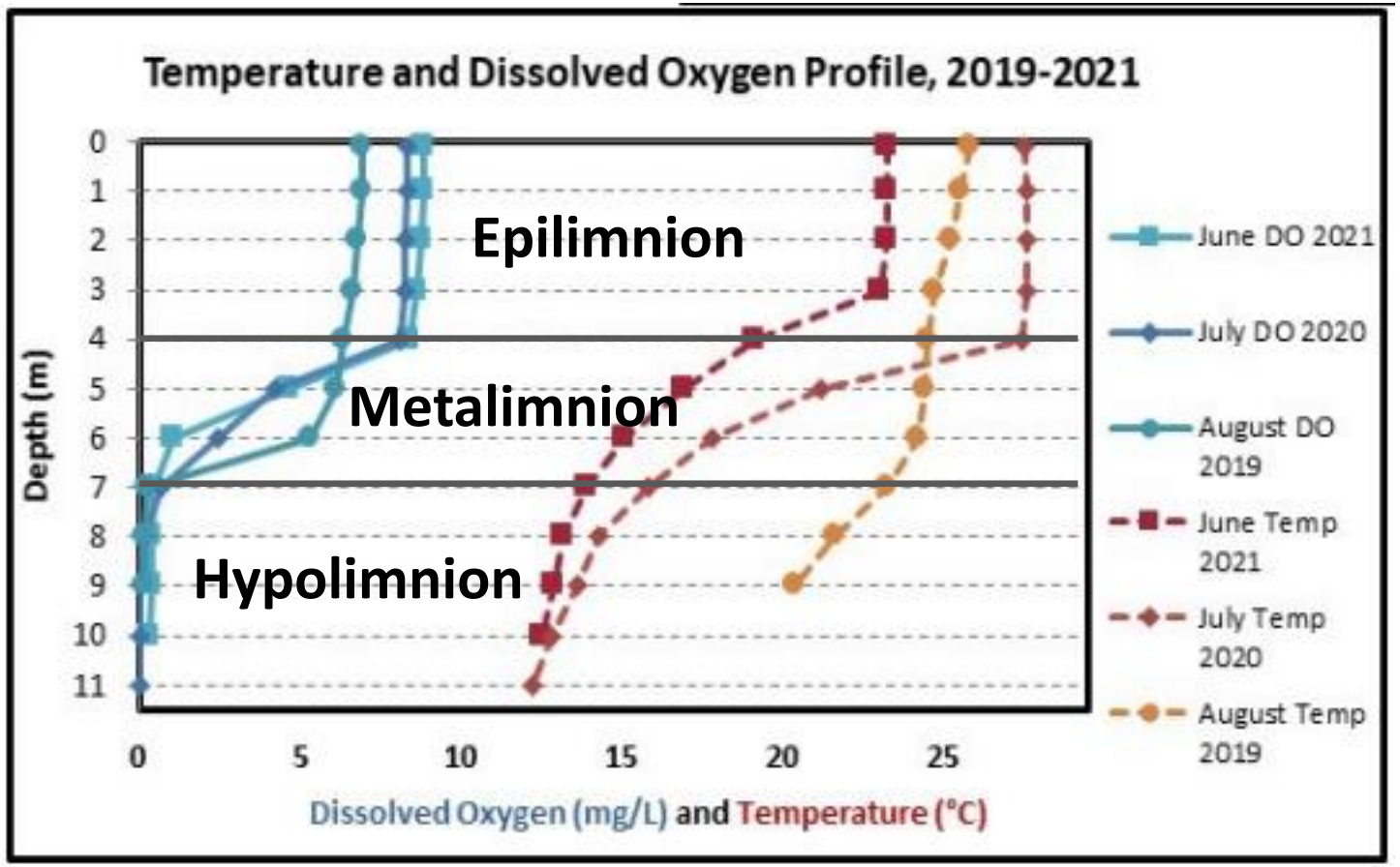
Physical Characteristic	Result
Maximum Depth (ft)	36
Mean Depth (ft)	12
Lake Area (Acres)	267
Watershed Area (Ares)	15,452
Watershed Area / Lake Area	58
Flushing Rate (x/yr.)	8.7

Trophic Classification – A general measure of lake productivity

NHDES Lake Trophic Classification			
1976	1984	1998	2021
Mesotrophic	Eutrophic	Mesotrophic	Mesotrophic

NHDES uses **dissolved oxygen**, **water clarity** (Secchi disc transparency), **plant abundance**, and **Chlorophyll-*a*** in assigning trophic class

Water Quality Parameters Over the Years



Water Clarity	Secchi Disc (m)
1976	4.4
1984	3.5
1998	2.3
2021	3.4
NH Mean	2.7

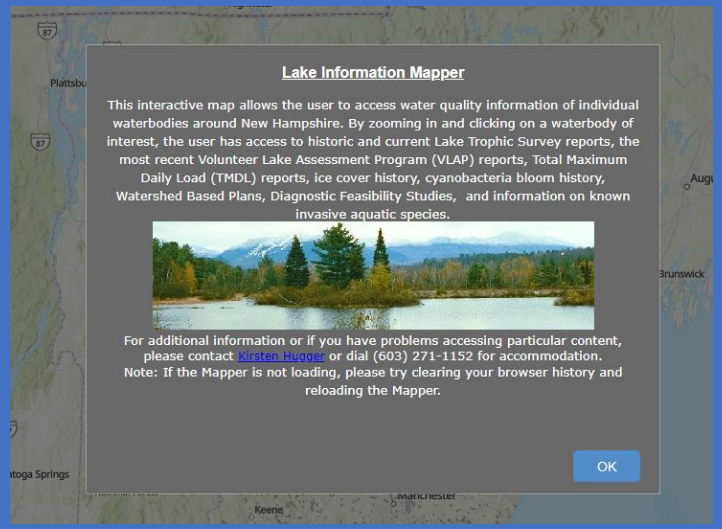
Chlorophyll-a	Micrograms/Liter
1976	0.53*
1984	6.06
1998	6.37
2021	5.72
NH Mean/Threshold	4.55/5.0

Epilimnetic Total Phosphorus (micrograms/Liter)				
1976	1984	1998	2021	NH Mean/Threshold
1.0	9.0	6.0	10.8	11.4/12.0

Plant Abundance			
1976	1984	1998	2021
Abundant	Common	Scattered	Common

Evidence of Rising Chloride

Parameter	1976	1984	1998	2021	NH Mean	NH WQ Criteria
Chloride (mg/L)	15	14	30	69	Not Available	230 mg/L (chronic)
Specific Conductance (µmhos)	81	91	142	237	49	No Criteria



Cyanobacteria Bloom History

Identifier: Arlington.Salem

NHDES

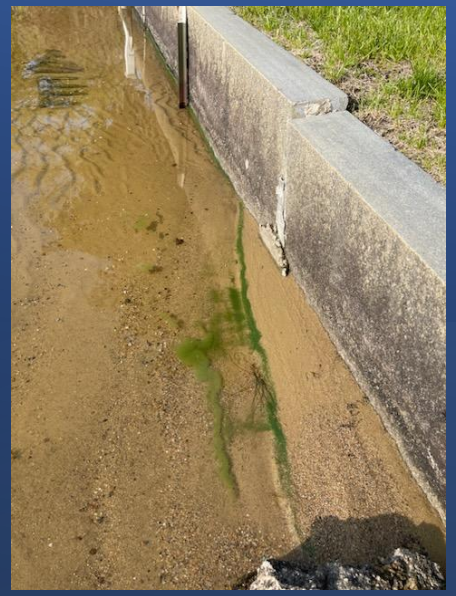
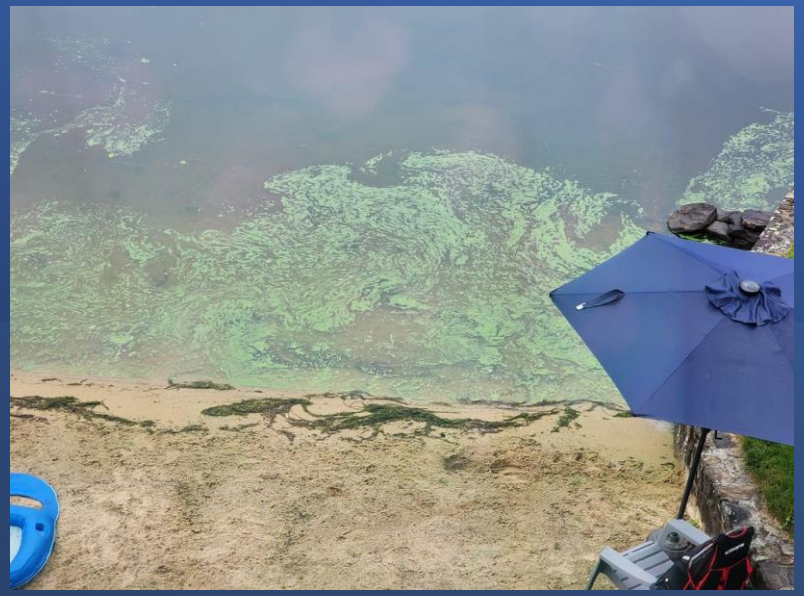
Updated: March 29, 2024

Arlington Mill Reservoir

Salem, NH

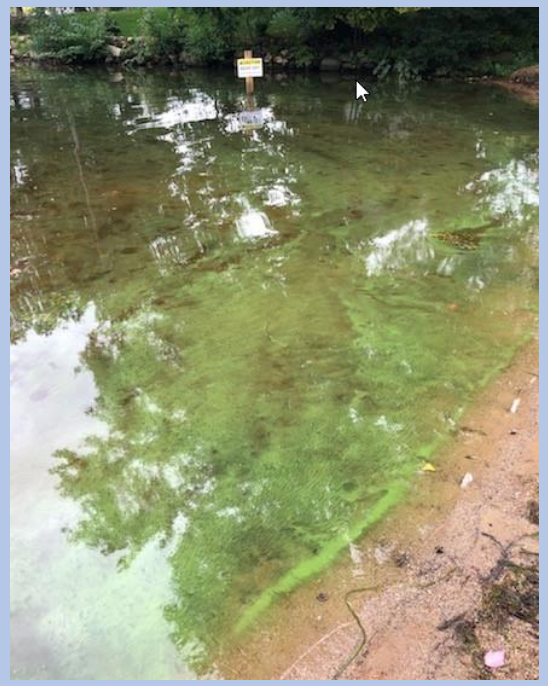
Type of Notification	Date Issued	Date Removed	# of Days Issued	*Dominant Taxa*	Initial Cyanobacteria Cell Density (cells/mL)
Warning	8/17/2018	10/22/2018	66	*Microcystis*	1,000,000
Alert	8/10/2021	**	**	**	**
Alert	9/14/2021	**	**	**	**
Warning	9/23/2021	11/3/2021	41	*Microcystis, Woronichinia, Dolichospermum lemmermannii*	1,075,000
Warning	5/20/2022	6/2/2022	13	*Dolichospermum*	300,000
Warning	5/16/2023	6/6/2023	21	*Dolichospermum, Microcystis*	422,200
Warning	7/28/2023	11/8/2023	103	*Microcystis, Woronichinia, Dolichospermum*	407,800

123 Warning Days in 2023




2022 Cyanotoxin Testing

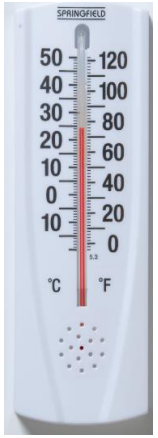


ELISA Plate

Date-Sample	Anatoxin (ppb)	Microcystin (ppb)	Microcystin Thresholds
5/20/2022-1	0.40	0.87	EPA Rec. Use = 8.0 ppb
5/20/2022-2	0.29	0.33	
5/20/2022-3	0.22	0.38	EPA Health Advis. = 1.6 ppb
5/27/2022-1	Below Detection	1.46	

Simplified Cyanobacteria Bloom Equation

+

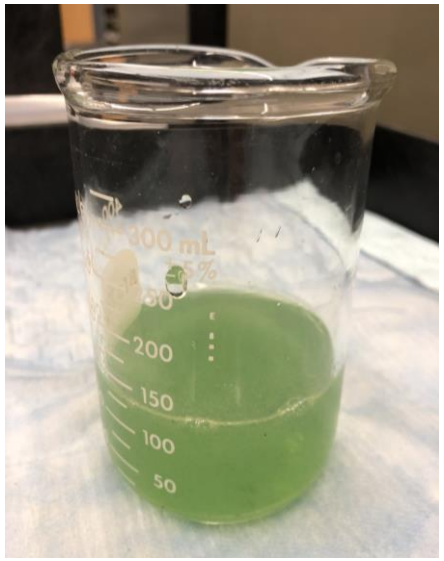


+

Phosphorus (P)

Nitrogen (N)

=



Light + Heat + Nutrients = Boom!

Things we can't control at the local level

Things we can control at the local level

What we want to AVOID

There is no guarantee we can manipulate the equation to avoid the outcome

Where do the Nutrients come from?

Stormwater accounts for 50% of water quality impairments in NH.

Stormwater has a high concentration of nutrients.

Stormwater impacts are most severe in waters that drain urban and suburban (developed) lands

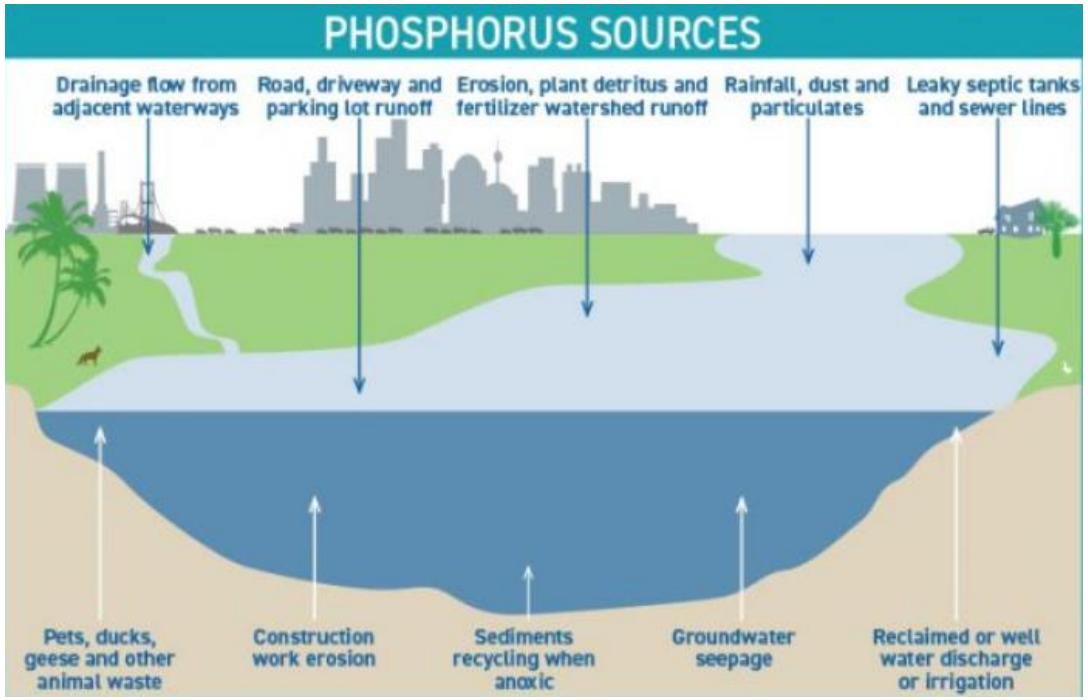
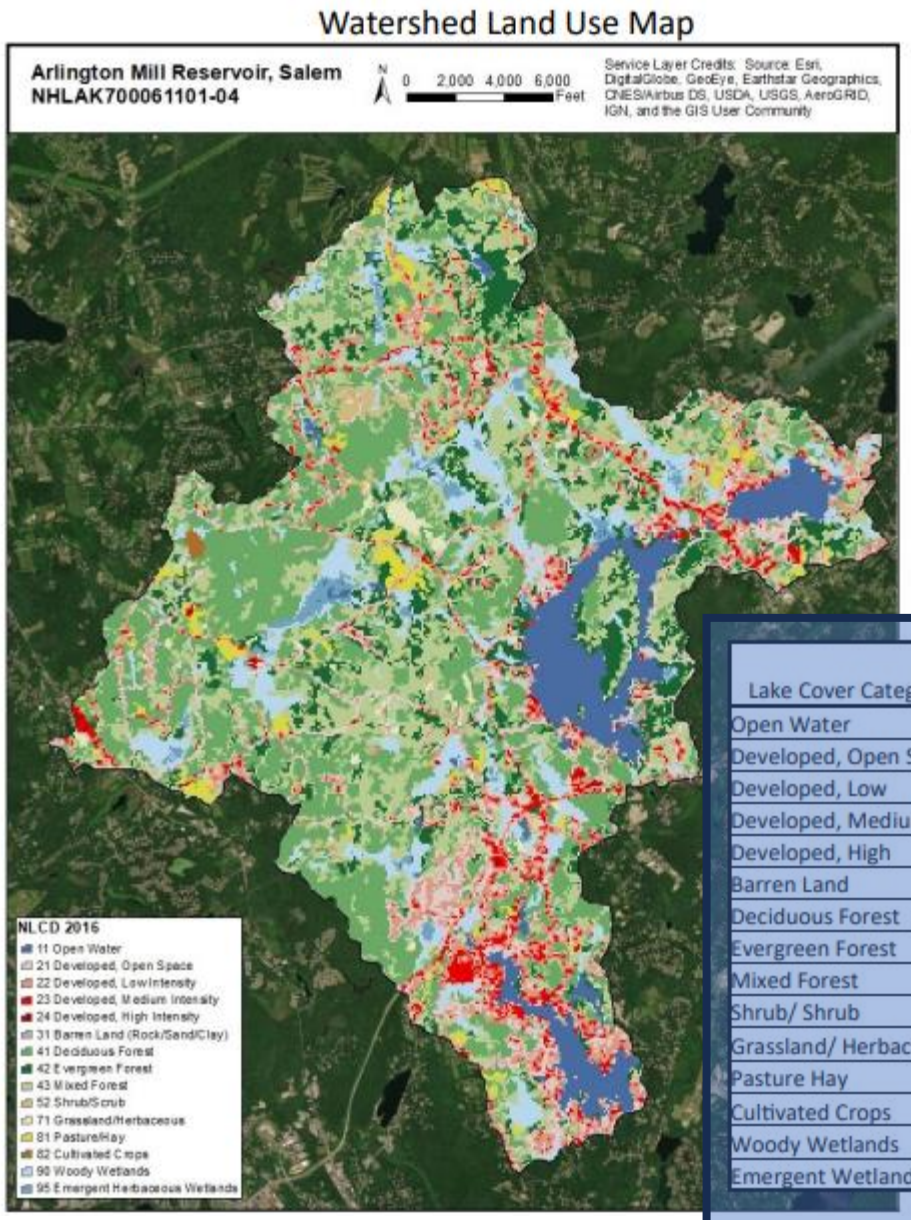


Diagram Courtesy Solitude lake Management

Arlington Mill Pond Watershed and Land Use



Lake Cover Category	Percent (%) Cover
Open Water	7.2
Developed, Open Space	7.7
Developed, Low	9.4
Developed, Medium	3.6
Developed, High	0.2
Barren Land	0.2
Deciduous Forest	25.5
Evergreen Forest	9.4
Mixed Forest	22.2
Shrub/ Shrub	1.0
Grassland/ Herbaceous	1.2
Pasture Hay	2.2
Cultivated Crops	0.1
Woody Wetlands	8.7
Emergent Wetlands	1.4

Lake Cover Category	Percent (%) Cover
Open Water	7.2
Developed, Open Space	7.7
Developed, Low	9.4
Developed, Medium	3.6
Developed, High	0.2
Barren Land	0.2
Deciduous Forest	25.5
Evergreen Forest	9.4
Mixed Forest	22.2
Shrub/ Shrub	1.0
Grassland/ Herbaceous	1.2
Pasture Hay	2.2
Cultivated Crops	0.1
Woody Wetlands	8.7
Emergent Wetlands	1.4

Developed Land Accounts for ~13.2% of the land use within the watershed.

Nutrient export from developed land is ~8x higher than forested lands

Reality Check

- **The shoreline is heavily developed**
- **Minimal remaining native shoreline vegetation**
- **No sewerage around the lake**
- **10s of stormwater outfalls to lake**
- **High percentage of impervious surface**
- **Heavy recreational use**

→ All contribute high nutrient loads to lake

Arlington Mill Pond Aquatic Vegetation and Management

Slides and Update Provide By

Amy Smagula
NHDES Limnologist and Invasive Species Management Program Manager

History of Invasives in Arlington Pond

- Fanwort detected in 1965
- Brittle naiad* detected in 2018
- Variable milfoil* detected in 2019

Fanwort

Variable milfoil

Brittle naiad

*Note- there is native milfoil and native naiad in the lake, and they can look like the invasives to the untrained eye, so care must be taken to identify plants correctly to see if they are an issue, and if they need to be managed.

Historical Management Efforts

Historical reports of "unofficial" management in the past (prior to 2022)

Drawdown

Raking

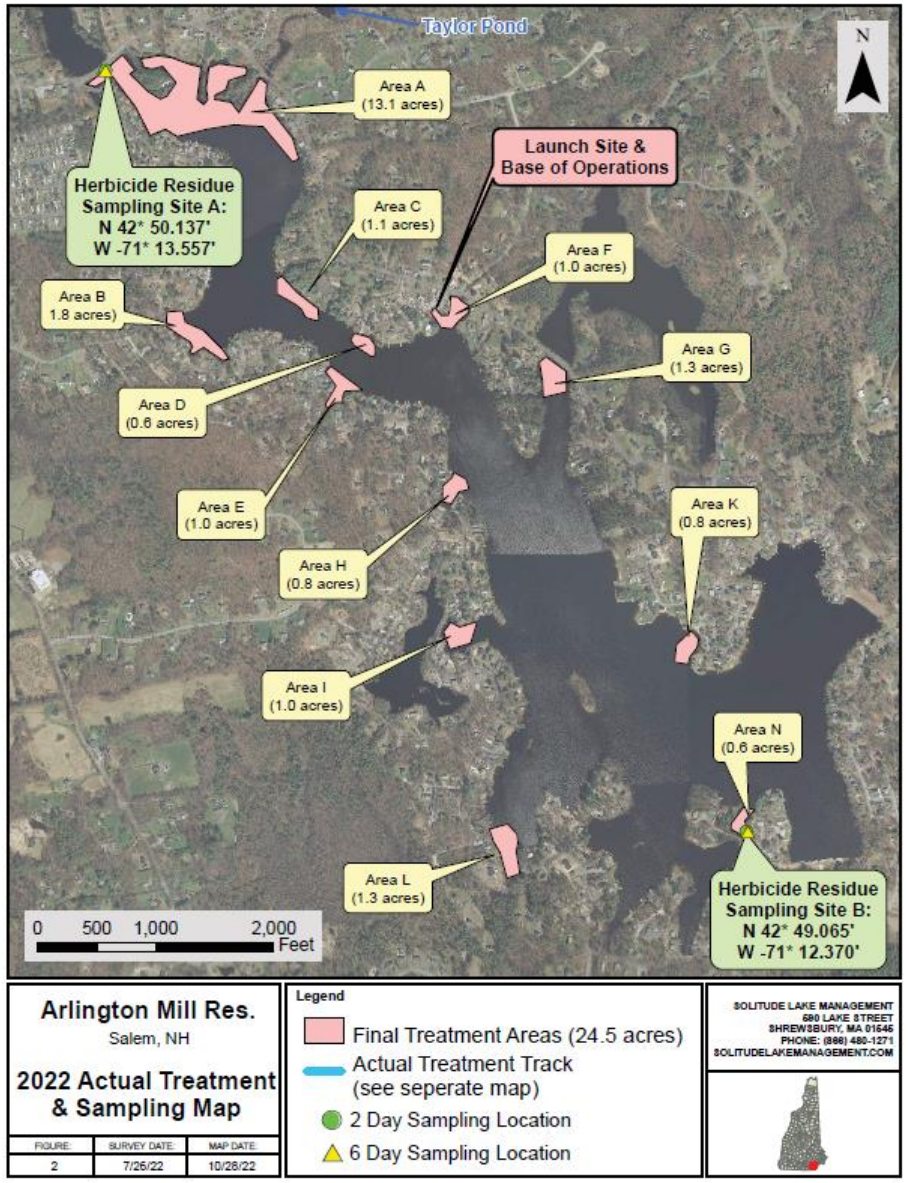
Dredging (not confirmed in our records if this happened)

Official management

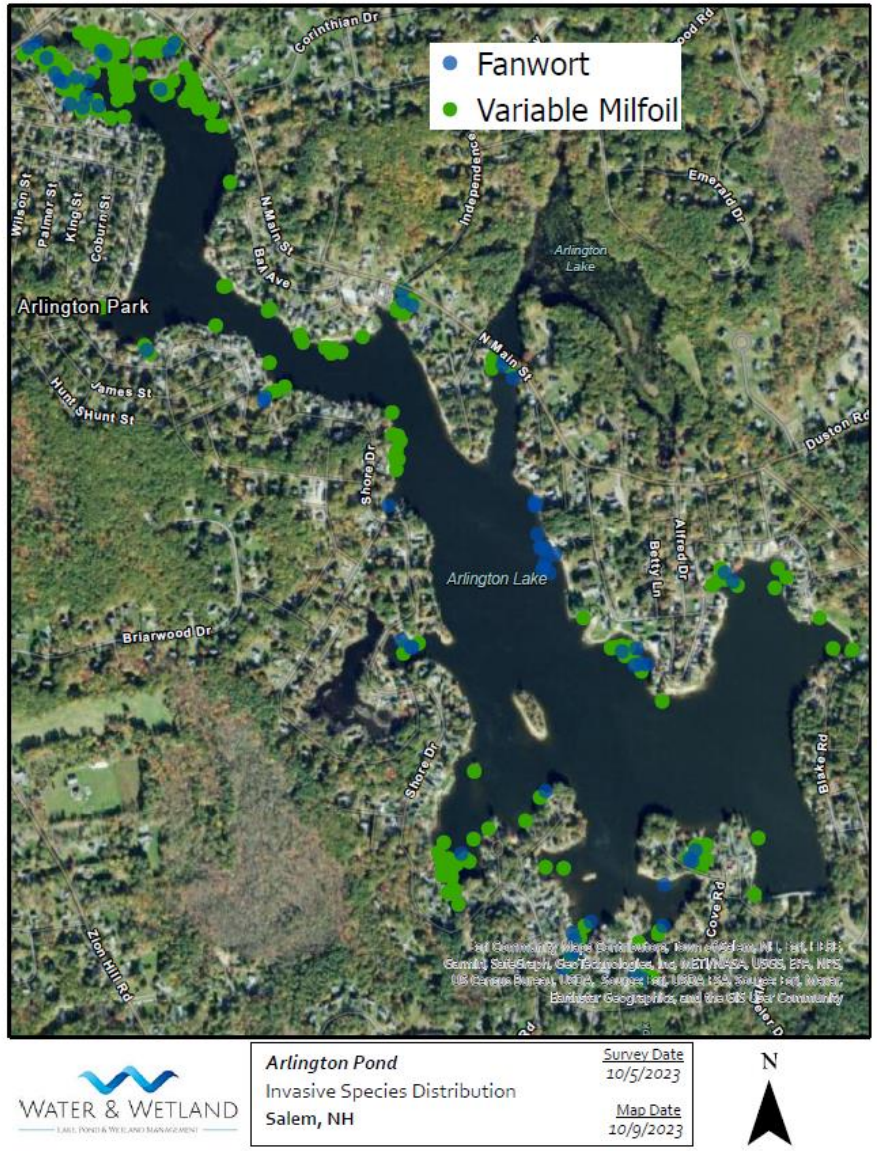
Herbicide treatment in July 2022 for fanwort control only under a permit

- Local reports from 2023 suggest management did not provide good control and regrowth was noted/reported by local entities
  - Fanwort was only target species, not all three
  - Fanwort control is challenging, and regrowth is common
- Request from local entities was to treat again in 2024 but due to concerns large and persistent cyanobacteria blooms in 2024, treatment is not recommended

2022 Treatment of Arlington Pond by SOLitude Lake Management for fanwort only (7/26/22)



Aquatic Invasive Plant Map (variable milfoil and fanwort) from Fall 2023 *(survey performed by Water & Wetland at the request of the lake association)*



Management Considerations

- Management of one invasive species successfully is challenging- management of three different invasive species that each grows and responds differently is very challenging

- Management needs to be timely, strategic, and integrated

  - Timely- management timing may need to be targeted to each species
    - *It is not a one-size fits all*
    - *Each plant starts growth at a different time in the growing season (milfoil after ice out, fanwort in June, brittle naiad in July)*
    - *Management of one leads to expansion of the other(s), especially with milfoil and fanwort*

  - Strategic- Strategic management is based on science and best management practices, as recommended by biologists who are trained in this work. Most plants have individual strategies for management.

  - Integrated- Management should incorporate multiple techniques as appropriate. Large areas should be treated, small areas can be dived on or diver-assisted suction harvesting can be used on those.

Management Recommendations

NHDES will survey aquatic invasive plants this summer, in June or July

- We will share the map with the lake association for diving
- We know you had a contractor map in 2023, but NHDES would like to see the growth for ourselves to best strategize on management

After the NHDES survey we will be able to provide information on:

- Scope of infestation of each invasive plant
- Recommendations for herbicide treatment (2025 or beyond depending on condition of lake)
- Recommendations for diving (can begin in 2024 after NHDES survey, with guidance form NHDES)

Interested SCUBA divers may obtain specialty Weed Control Diver certifications if they wish to volunteer to work on invasives in Arlington, or contractors can be utilized for diving

- Both volunteer and contract divers must be in regular communication with NHDES Exotic Species Program for guidance/reporting/etc.

Realities

Infestations are established in Arlington Mill Pond

There is no urgency to manage as most available habitat already has invasives and growth does not appear to be expanding beyond historic ranges

Best to pause, assess and proceed strategically for best outcomes

NHDES will prepare management recommendations for 2024 and beyond, and include those into a Long-Term Management Plan that can guide efforts and planning for future years (usually 5 years at a time)

Cyanobacteria and Aquatic Plant Management

At this time there is no well-defined cause and effect relationship with aquatic invasive plant management and cyanobacteria blooms

All plants compete with algae for nutrients, so the fewer the plants in a lake, the more nutrients algae can take up

Sometimes herbicide treatments can lead to plugs of nutrient release in lakes that could be used by algae or cyanobacteria, so a large-scale herbicide treatment could trigger a bloom

Report a cyanobacteria bloom to NHDES

David Neils, david.e.neils@des.nh.gov, (603) 271-8865
NHDES, Chief Aquatic Biologist/ Director, Jody Connor Limnology Center