

Contoocook Lake Water Quality Trends and Management

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NHDES VLAP Program Coordinator



Presentation

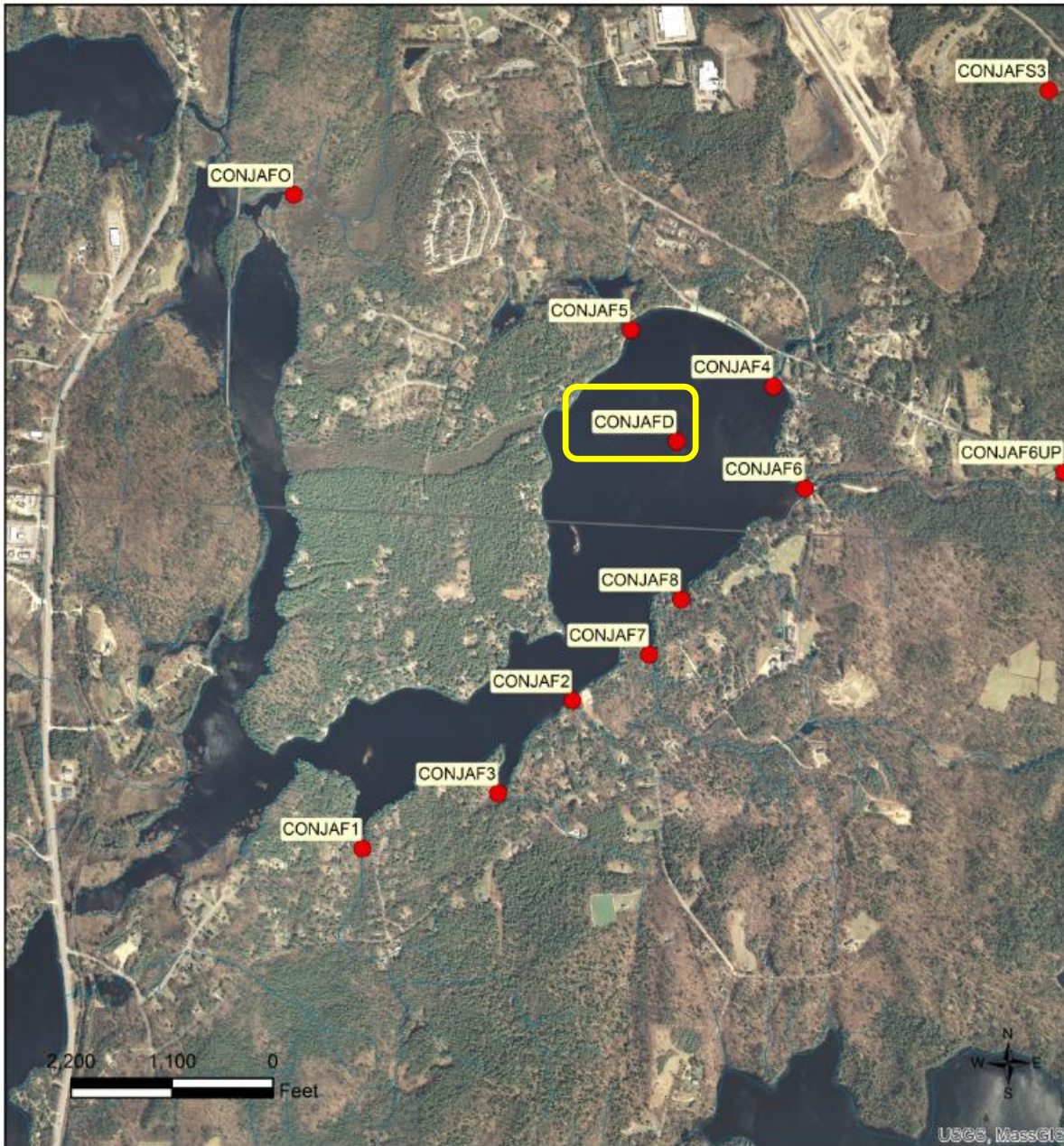
- Water Quality Trends
 - VLAP Report
- Exotics Species Update



Contoocook Lake Sample Stations

CONTOOCOOK LAKE RINDGE VOLUNTEER LAKE ASSESSMENT PROGRAM

| STATIONID | STATION NAME |
|-----------|------------------------|
| CONJAF4 | SQUANTUM INLET |
| CONJAF5 | TAFT INLET |
| CONJAF6 | TOWNLIN INLET |
| CONJAFD | DEEP SPOT |
| CONJAFO | DAM OUTLET |
| CONJAF1 | JOWDER COVE INLET |
| CONJAF2 | COCHRANE INLET E |
| CONJAF3 | COCHRANE INLET W |
| CONJAF7 | WALSH INLET |
| CONJAF8 | WOODBUND INLET |
| CONJAFS3 | SQUANTUM 3 |
| CONJAF6UP | TOWNLIN INLET UPSTREAM |



VLAP Monitoring

Epilimnion — well-mixed surface layer



Metalimnion — transition zone of large temperature change with depth (includes thermocline)

Hypolimnion — cold, unmixed bottom layer

VLAP Monitoring

- Samples analyzed for variety of parameters.
- Indicators of lake health:
 - Chlorophyll-a
 - Transparency
 - Total Phosphorus
 - pH
- Can you swim and recreate?
- Can aquatic life thrive?

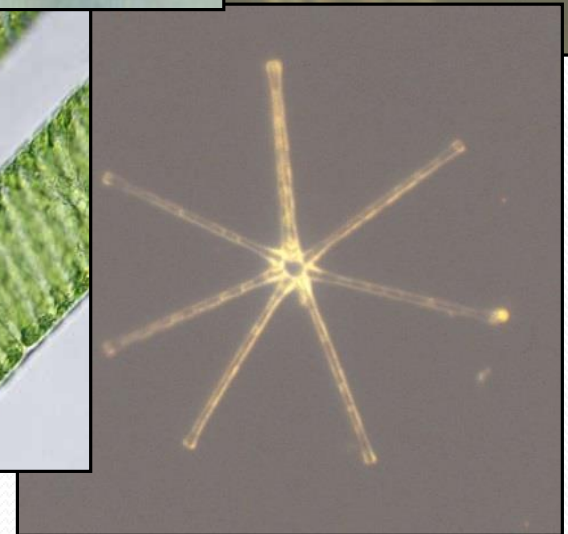
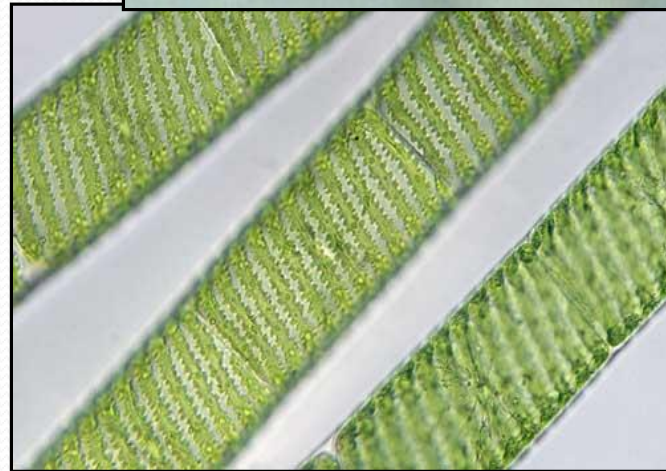
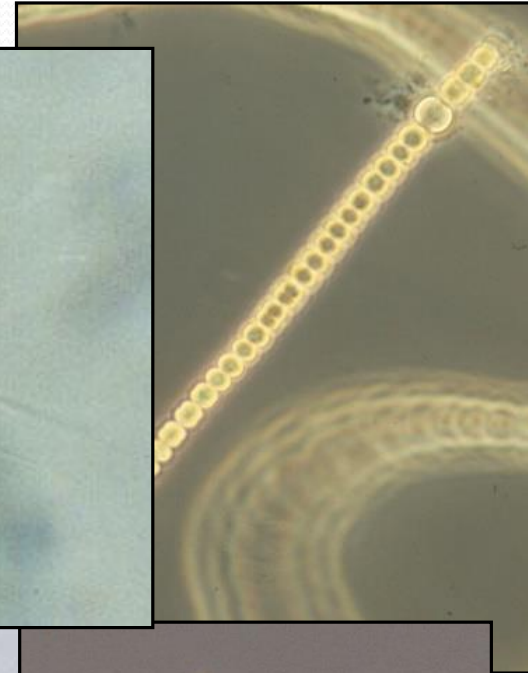


Water Analyses

Chlorophyll-a:

Photosynthetic pigment in plants, algae and cyanobacteria.

- Provides general indication of algal or cyanobacteria abundance.
- High Chl-a concentrations can indicate algal blooms caused by too many nutrients.



Contoocook Lake Deep Spot

Water Quality Trends

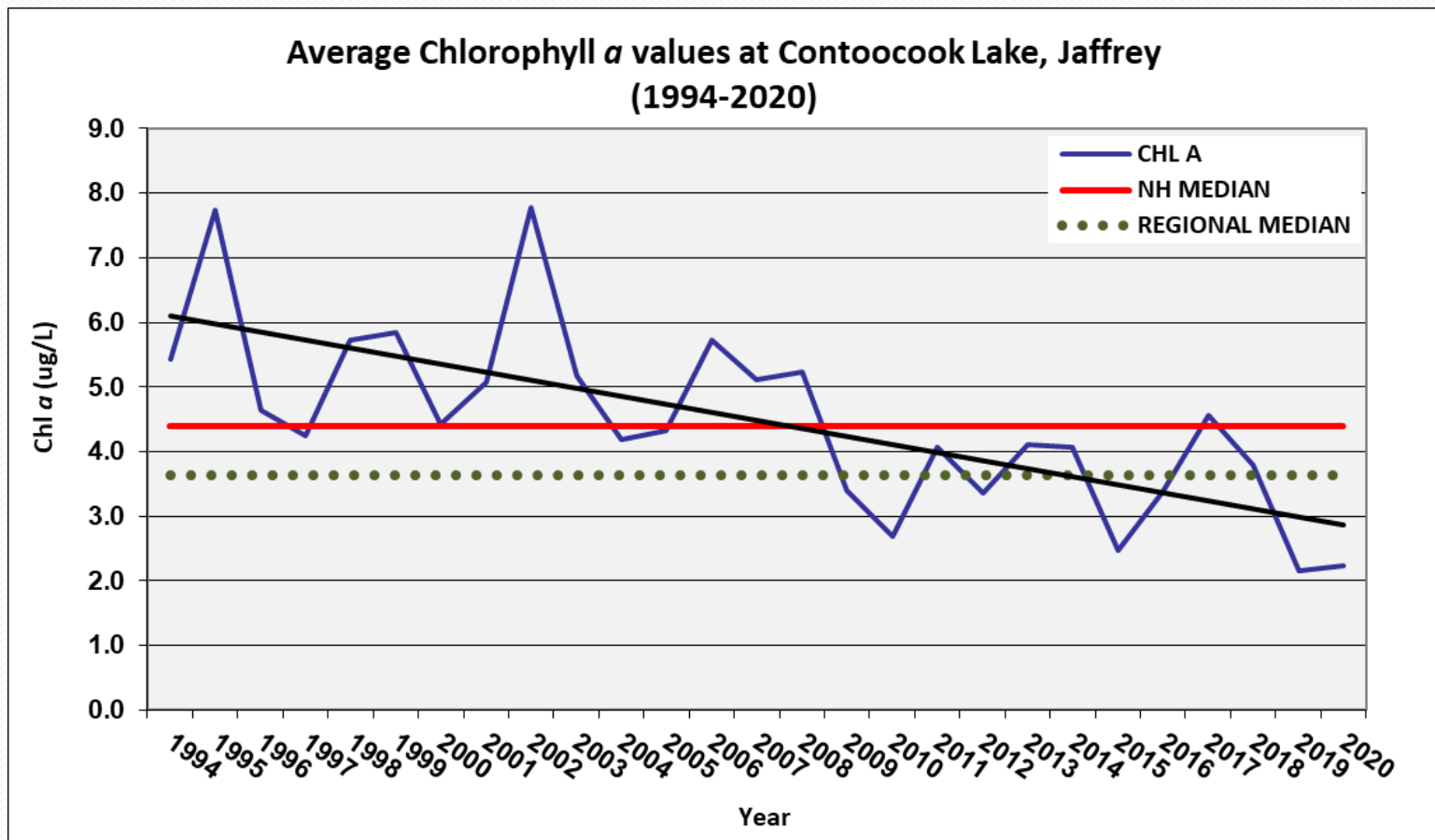
Chlorophyll-a: mean chlorophyll-a concentrations have ranged between 2.16 and 7.77 ug/L

Median: 4.33 ug/l

Regional Median: 3.63 ug/L

Good Range: 0.0 – 5.0 ug/L **Algal blooms:** > 15.0 ug/L

Improving Trend: Data significantly decreasing over time.



Water Analyses

Transparency:

measurement of water clarity.

- Measured using a Secchi Disk.
- Factors affecting transparency:
 - Water color
 - Turbidity: sediments, fine particulate matter, algae
 - Surface conditions



Contoocook Lake Deep Spot

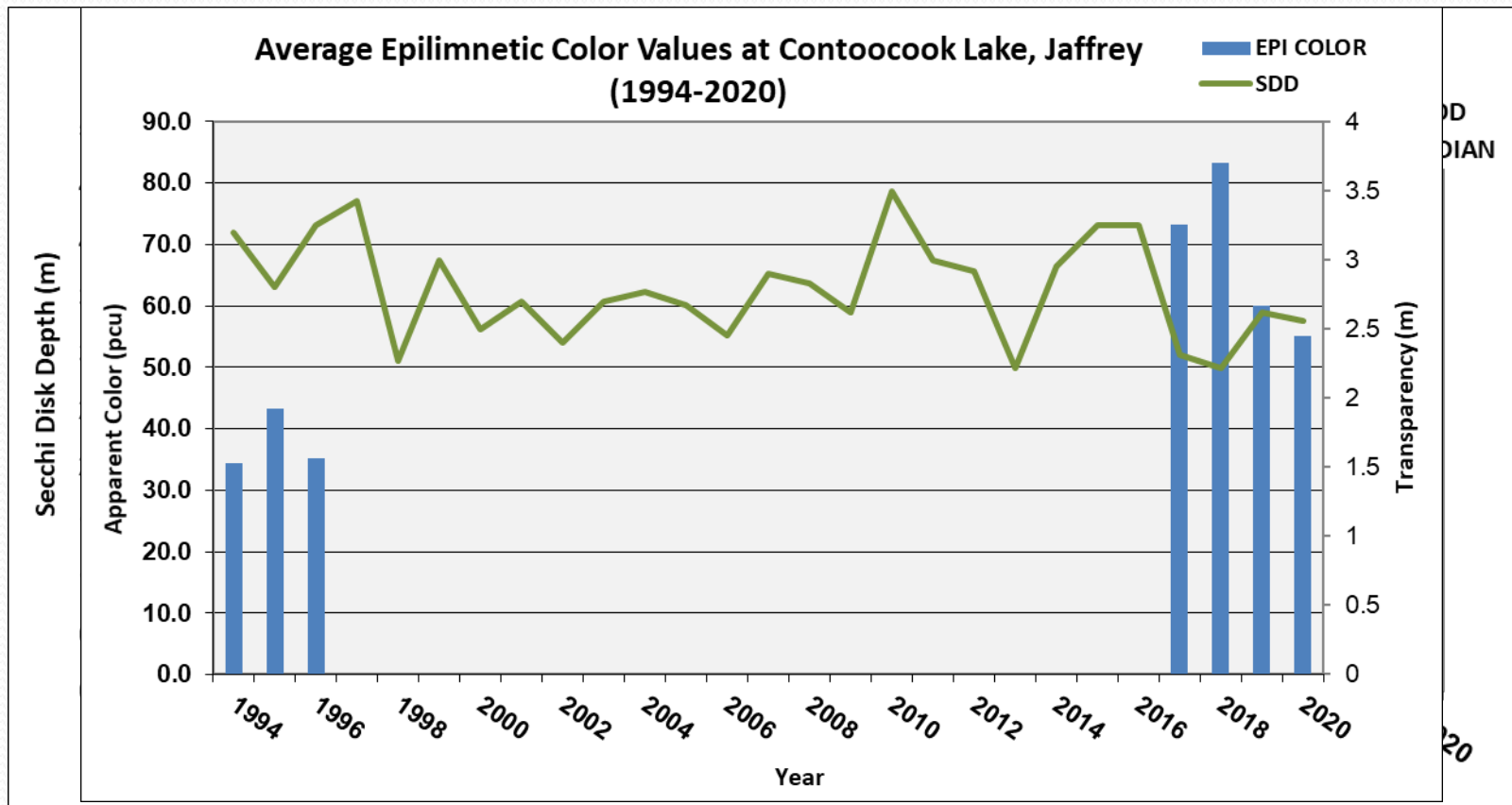
Water Quality Trends

Transparency: mean transparency values have ranged between 2.22 and 3.50 meters.

Median: 2.77 meters **Regional Median:** 3.77 meters

Good Range: 2.0 – 4.5 meters

Stable Trend



Water Analyses

Total Phosphorus: nutrient that promotes plant and algal growth.



Contoocook Lake Deep Spot

Water Quality Trends

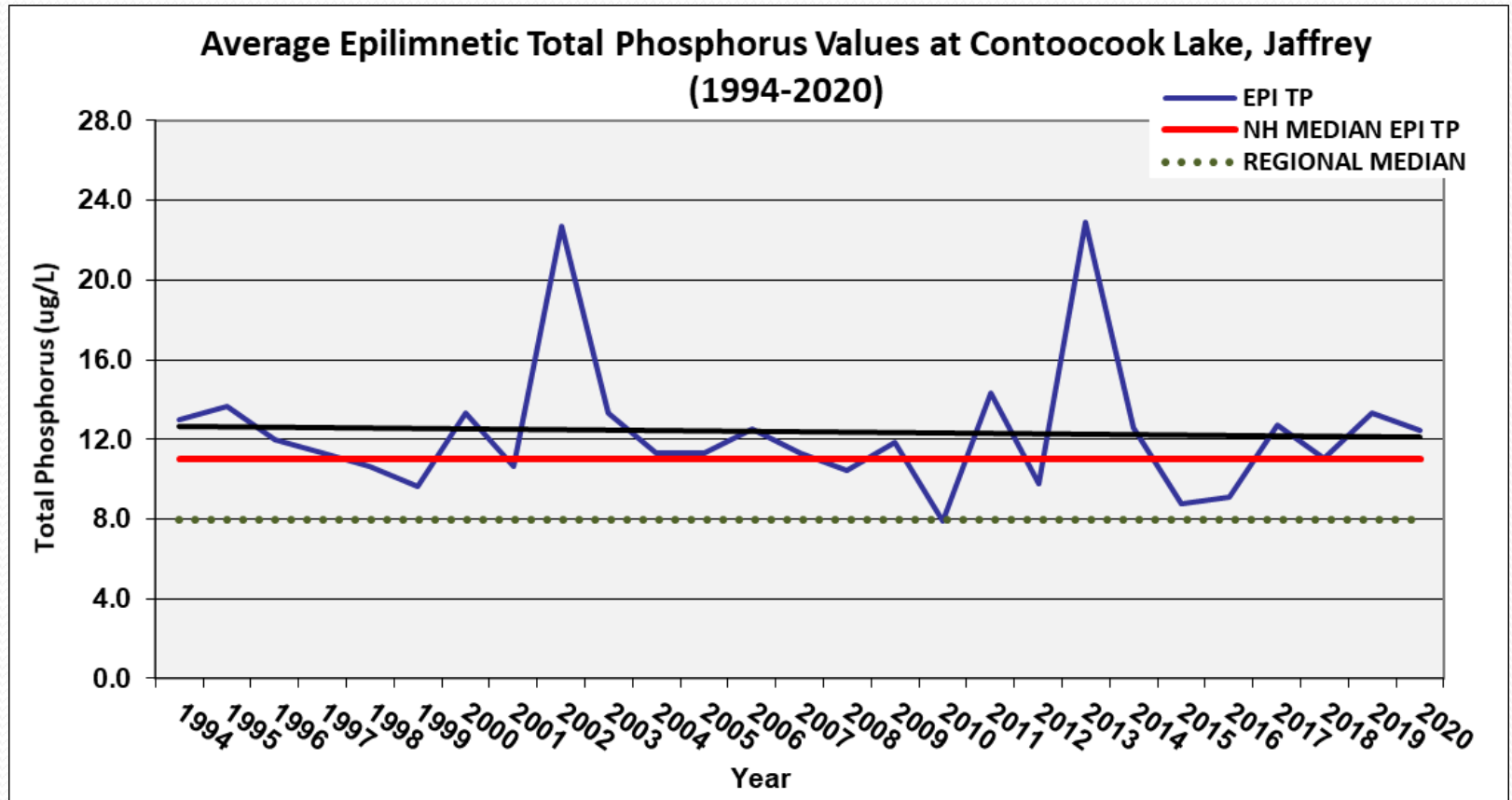
Epilimnetic Total Phosphorus: Mean epilimnetic phosphorus has ranged from 8 ug/L to 23 ug/L.

Median: 12 ug/L

Regional Median: 8 ug/L

Good Range: 1 – 12 ug/L

Stable Trend



Contoocook Lake Deep Spot

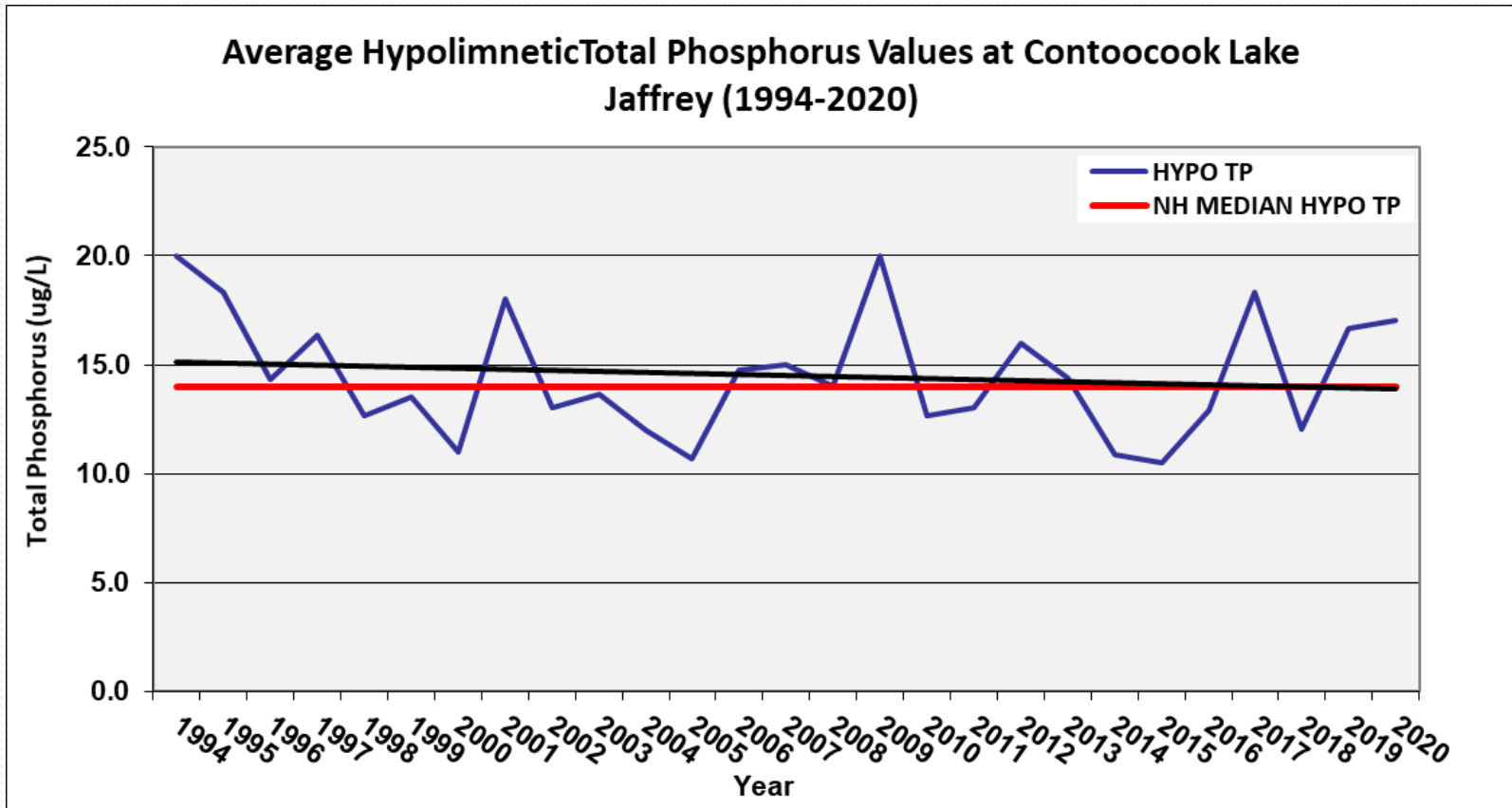
Water Quality Trends

Hypolimnetic Total Phosphorus: Mean hypolimnetic phosphorus has ranged from 11 ug/L to 20 ug/L.

Median: 14 ug/L

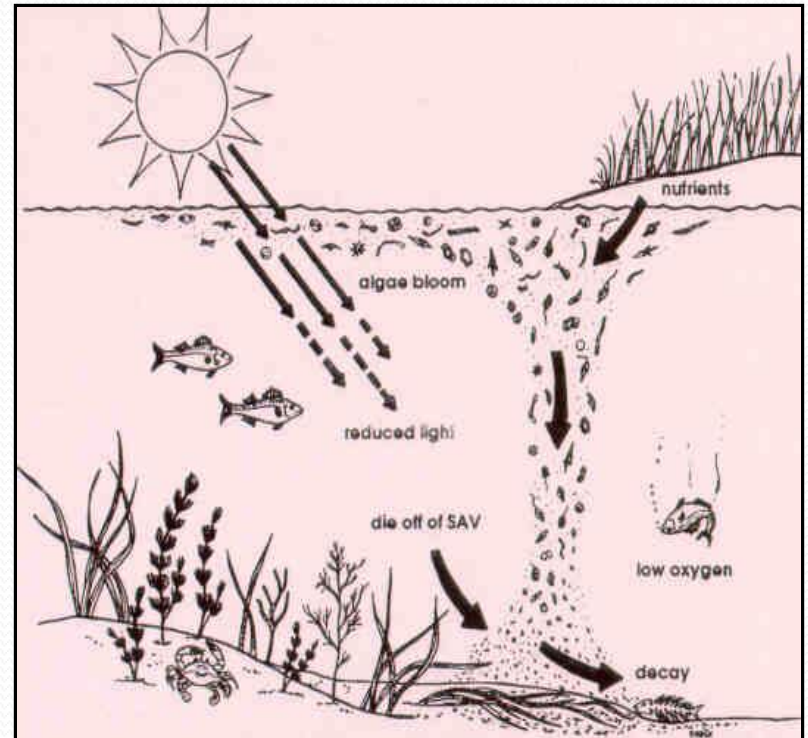
NH Median: 14 ug/L

Stable Trend



Nutrients : Algae : Clarity Relationships

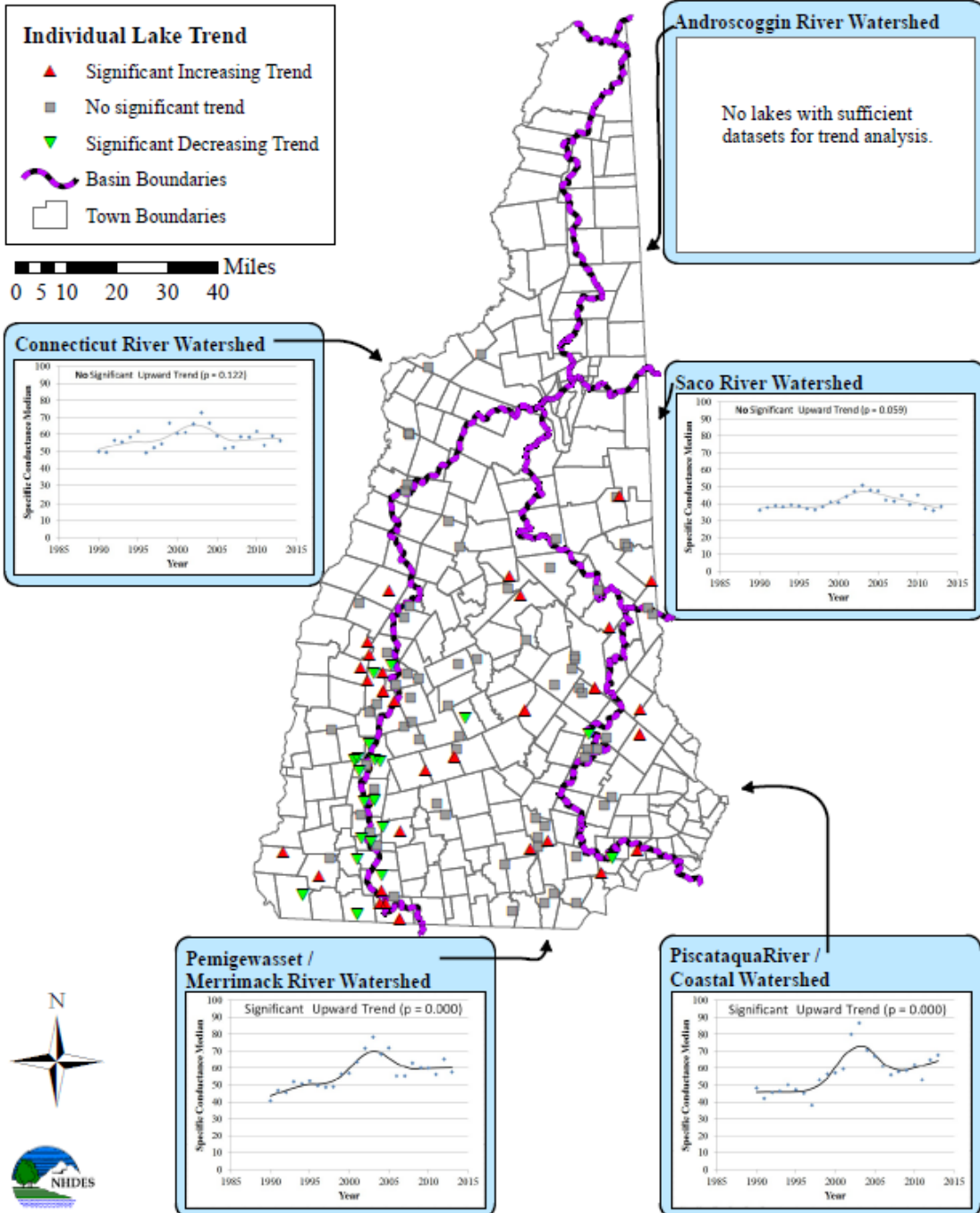
- **Increases in nutrients**
↓
- **Increases in algae**
↓
- **Decreases in lake clarity**
↓
- **Decreases in property values!**



Water Analyses

- **Conductivity:**
Ability of water to conduct electrical current.
- Salts and minerals
- Natural occurring
- Human influences

Lake Conductivity Trends



Contoocook Lake Deep Spot

Water Quality Trends

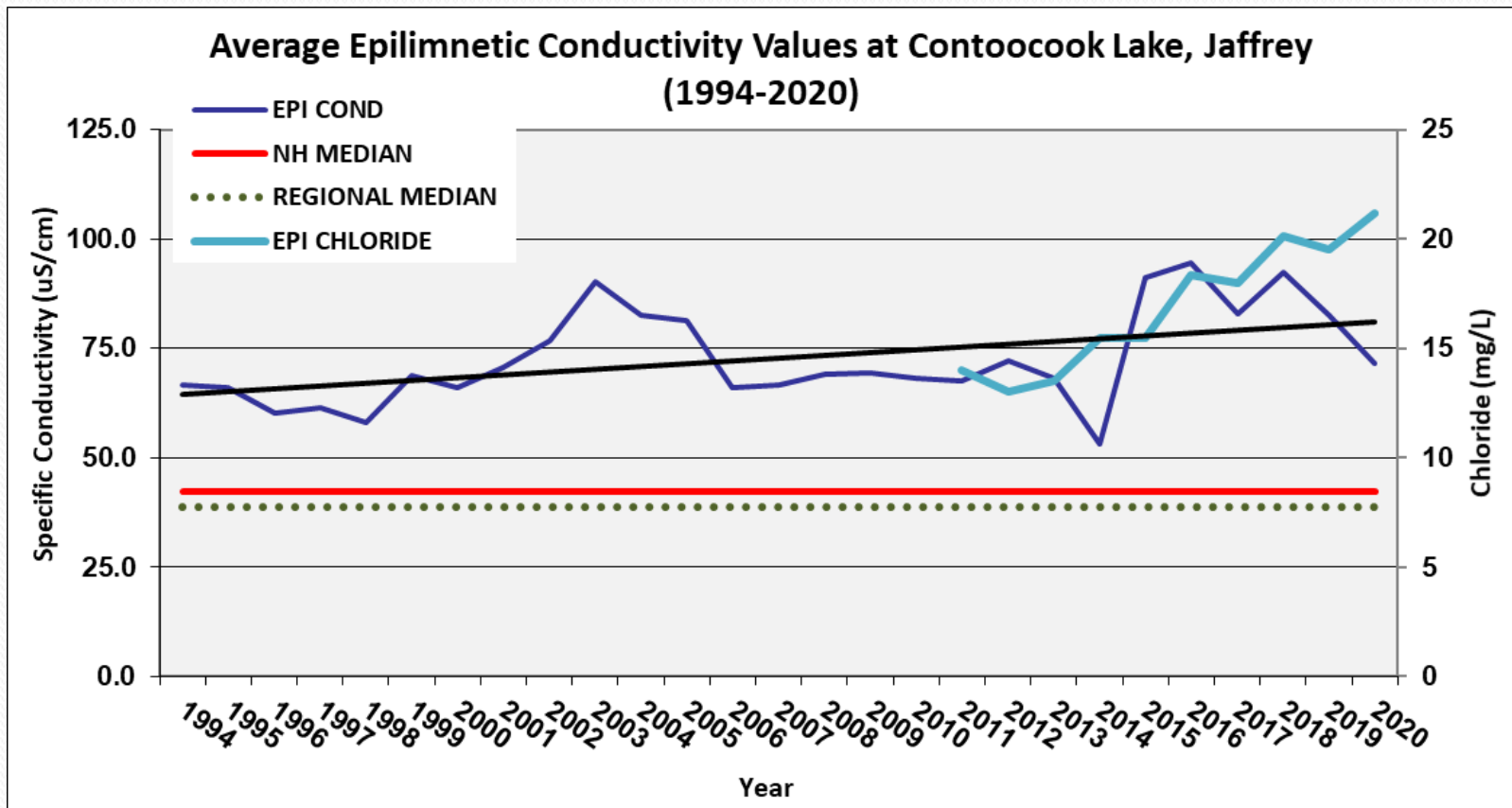
Epilimnetic Conductivity: Mean epilimnetic conductivity has ranged from 53.2 uS/cm to 94.5 uS/cm.

Median: 69.0 uS/cm

Regional Median: 38.7 uS/cm

Good Range: < 100 uS/cm

Worsening trend: Data significantly increasing.



Water Analyses

- **pH:** How acidic is the water?
- Naturally occurring
- Human influences



Contoocook Lake Deep Spot

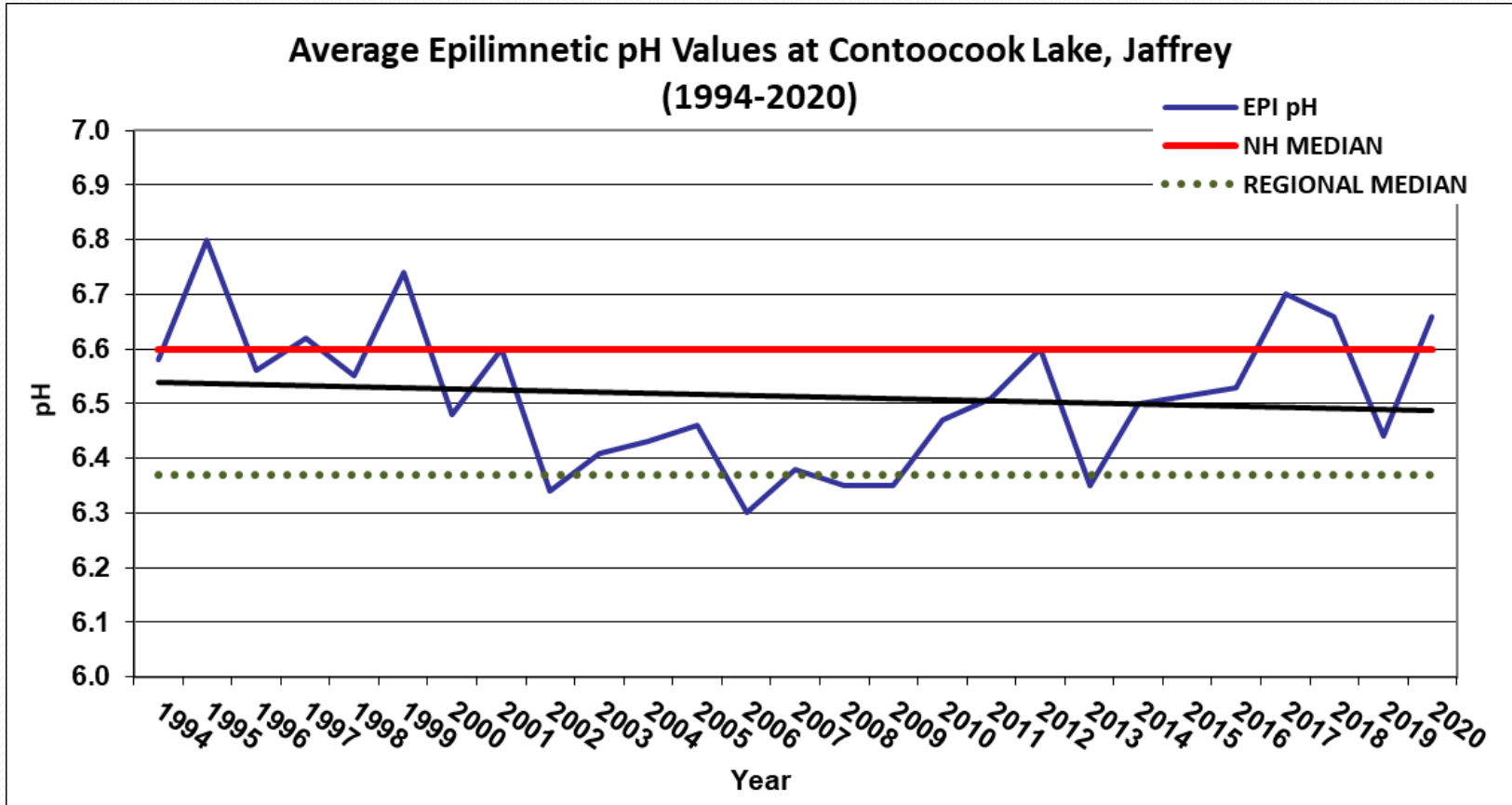
Water Quality Trends

Epilimnetic pH: Mean epilimnetic pH has ranged from 6.30 to 6.80

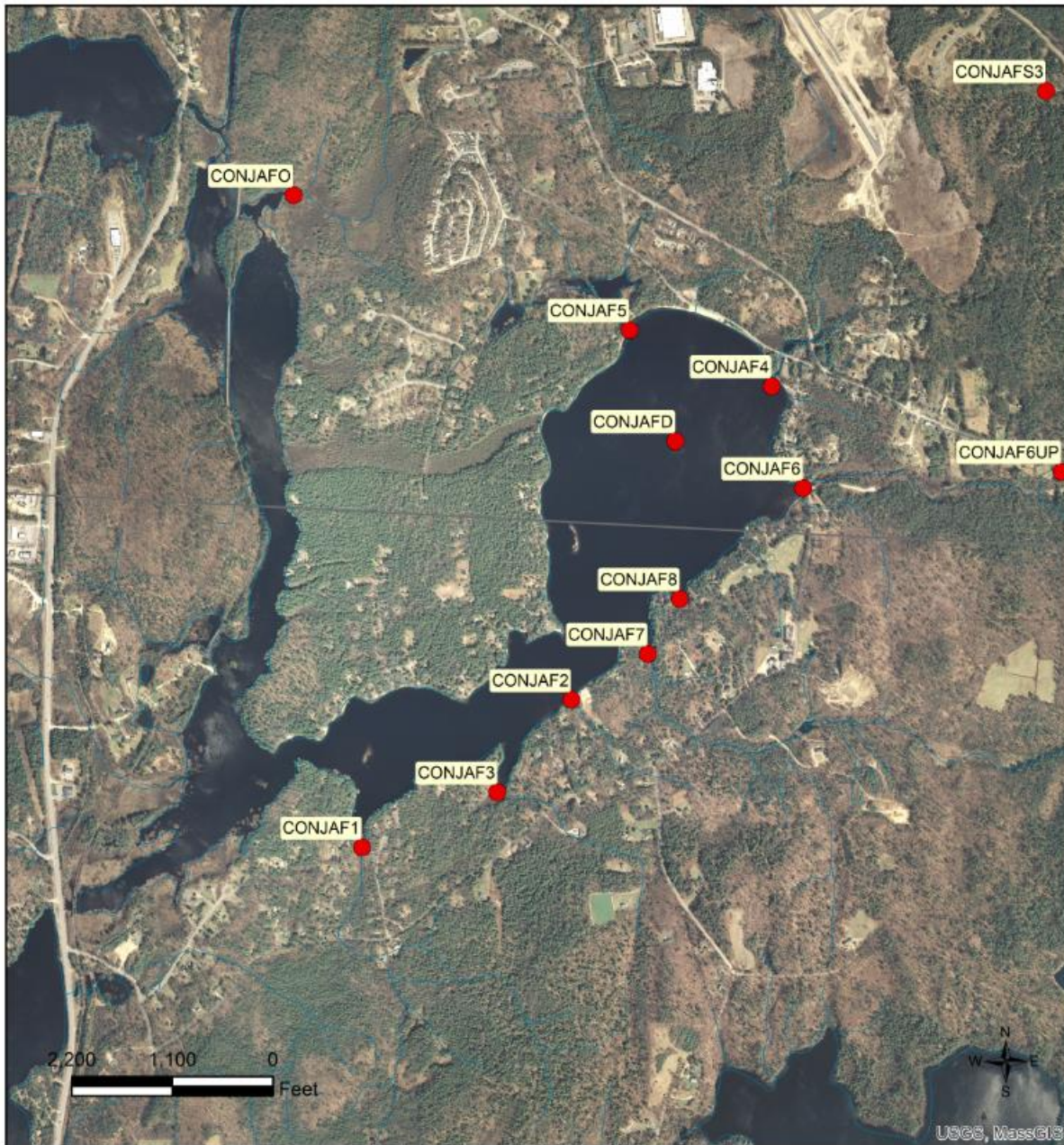
Median: 6.50 **Regional Median:** 6.37

Good Range: 6.5 – 8.0

Stable Trend



Contoocook Lake Tributaries



CONTOOCOOK LAKE RINDGE

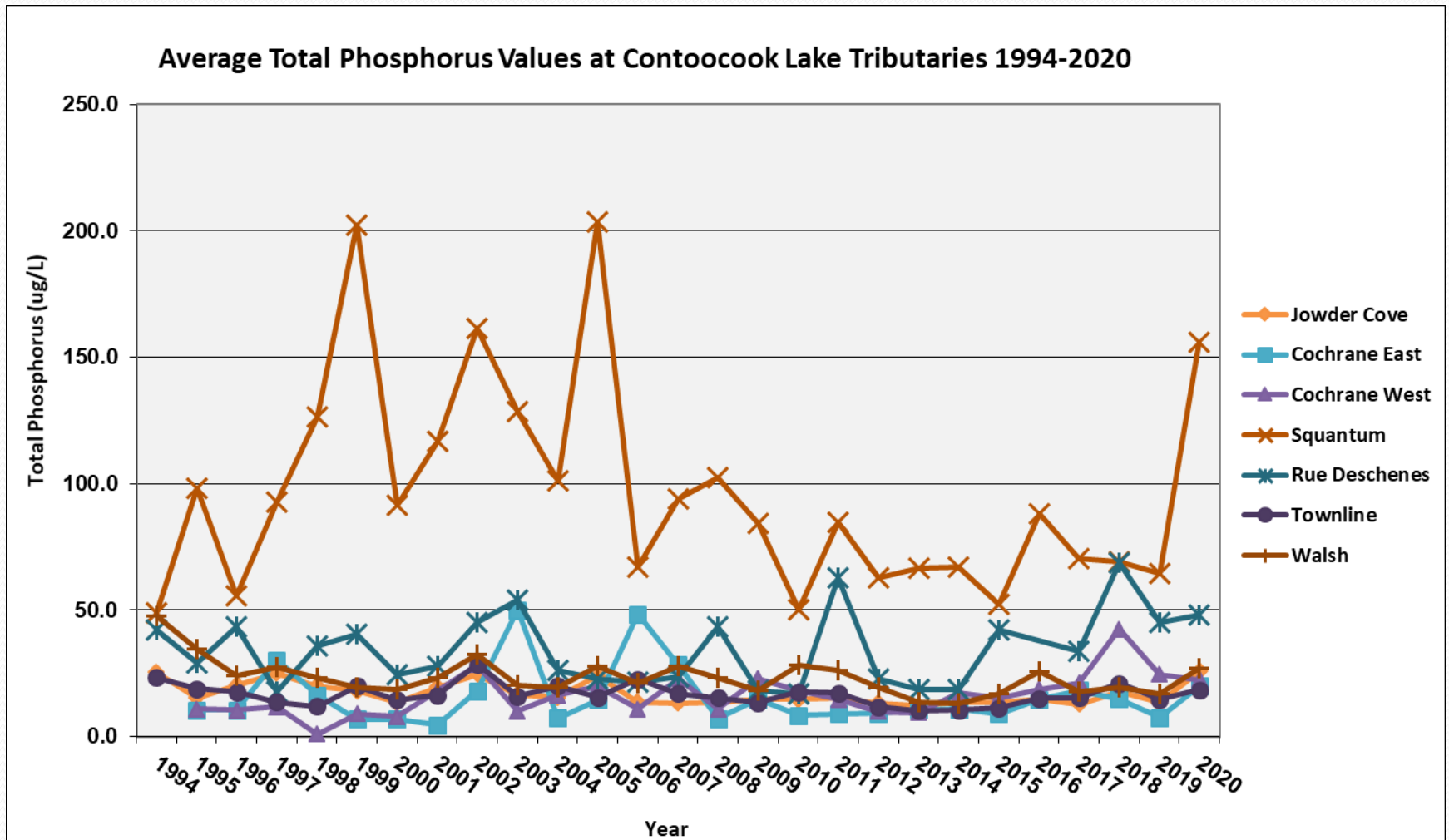
VOLUNTEER LAKE ASSESSMENT PROGRAM

| STATIONID | STATION NAME |
|-----------|------------------------|
| CONJAF4 | SQUANTUM INLET |
| CONJAF5 | TAFT INLET |
| CONJAF6 | TOWNLIN INLET |
| CONJAFD | DEEP SPOT |
| CONJAF0 | DAM OUTLET |
| CONJAF1 | JOWDER COVE INLET |
| CONJAF2 | COCHRANE INLET E |
| CONJAF3 | COCHRANE INLET W |
| CONJAF7 | WALSH INLET |
| CONJAF8 | WOODBOUND INLET |
| CONJAFS3 | SQUANTUM 3 |
| CONJAF6UP | TOWNLIN INLET UPSTREAM |

Contoocook Lake Tributaries

Water Quality Trends: Total Phosphorus (TP)

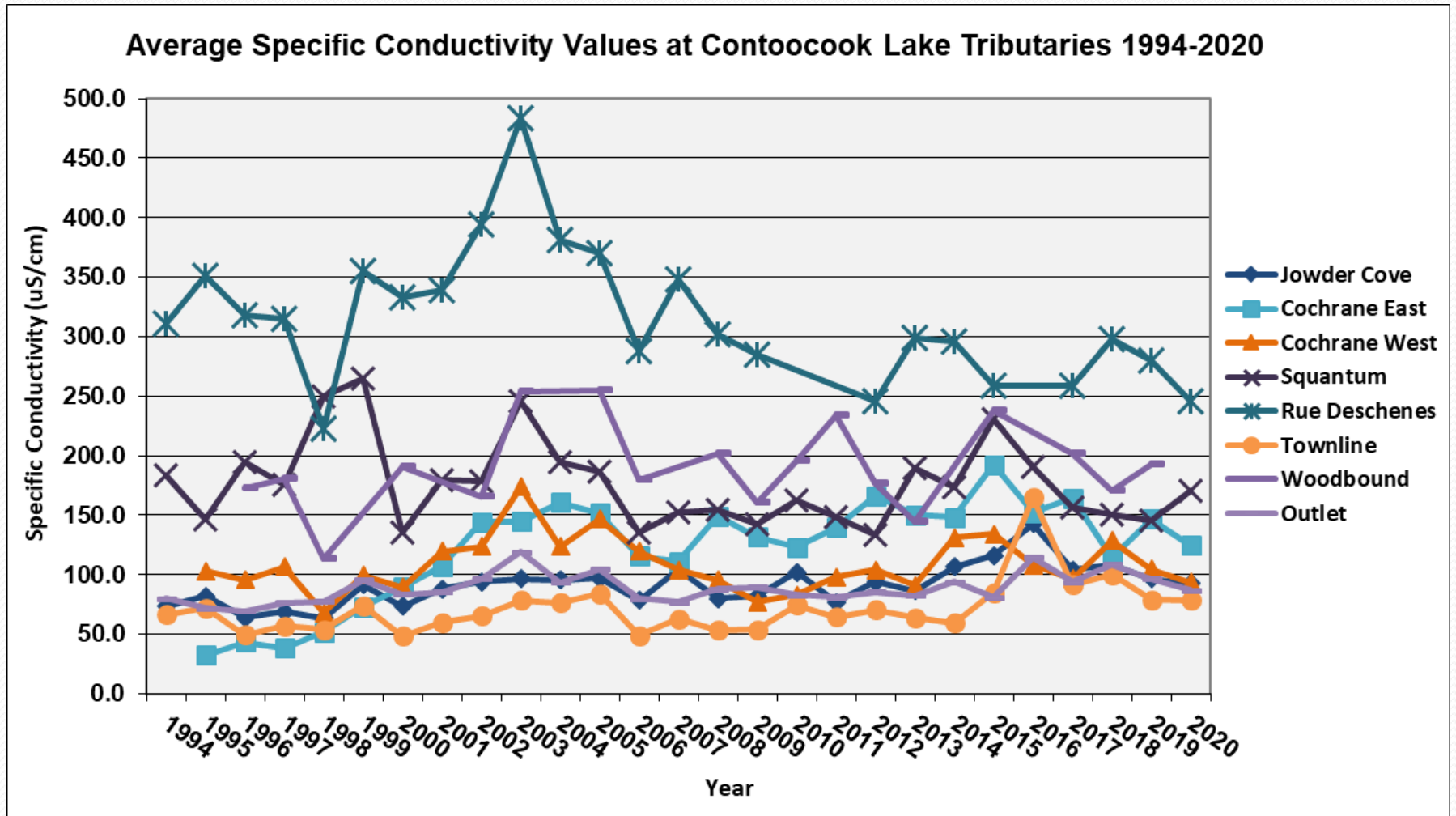
Medians: Ranged from 11 ug/L (Cochrane East) to 31 ug/L (Rue D.)



Contoocook Lake Tributaries

Water Quality Trends: Conductivity

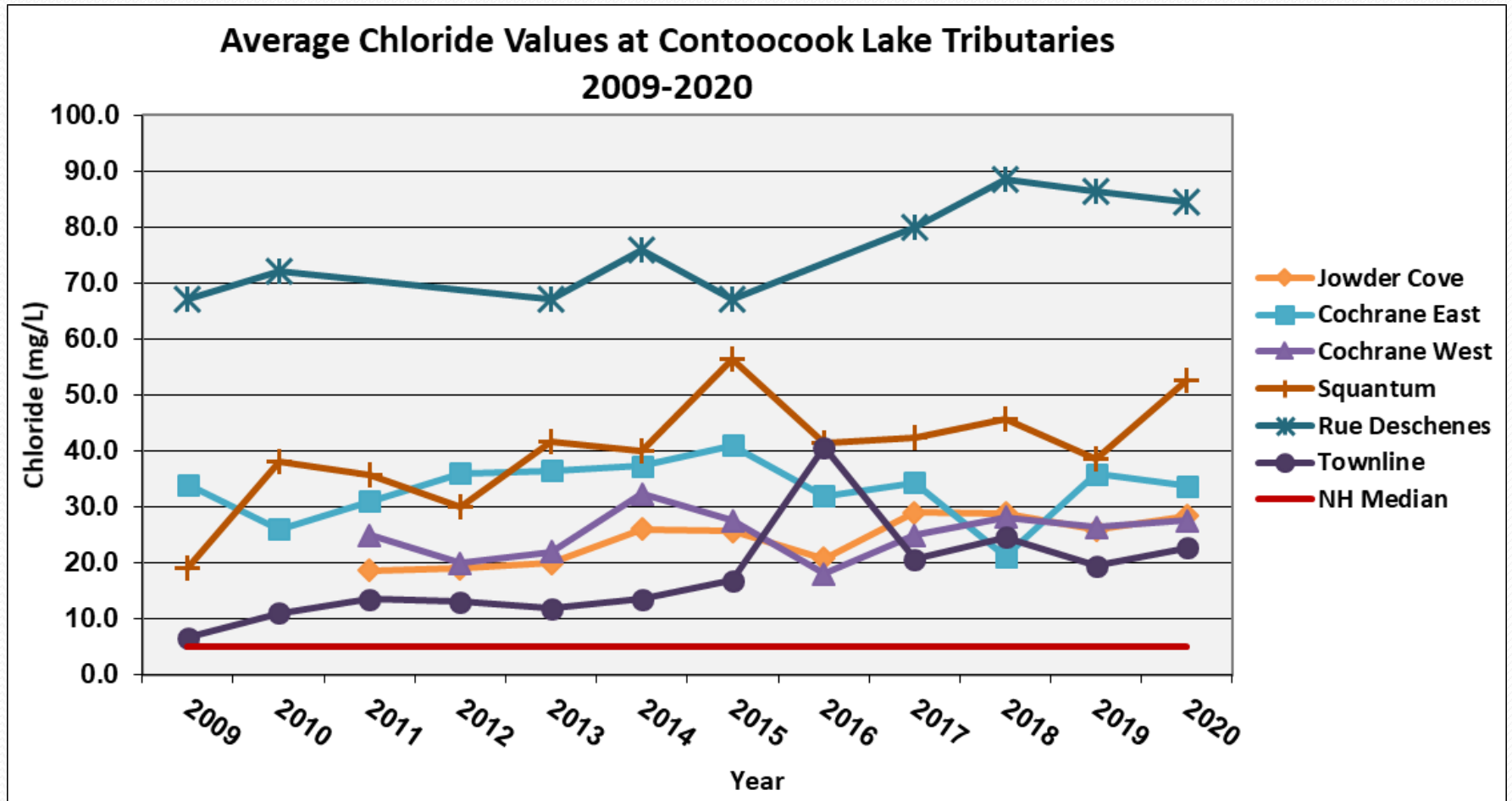
Medians: Range from 31.0 uS/cm (Walsh Inlet not on graphic) to 306.0 uS/cm (Rue D.).



Contoocook Lake Tributaries

Water Quality Trends: Chloride

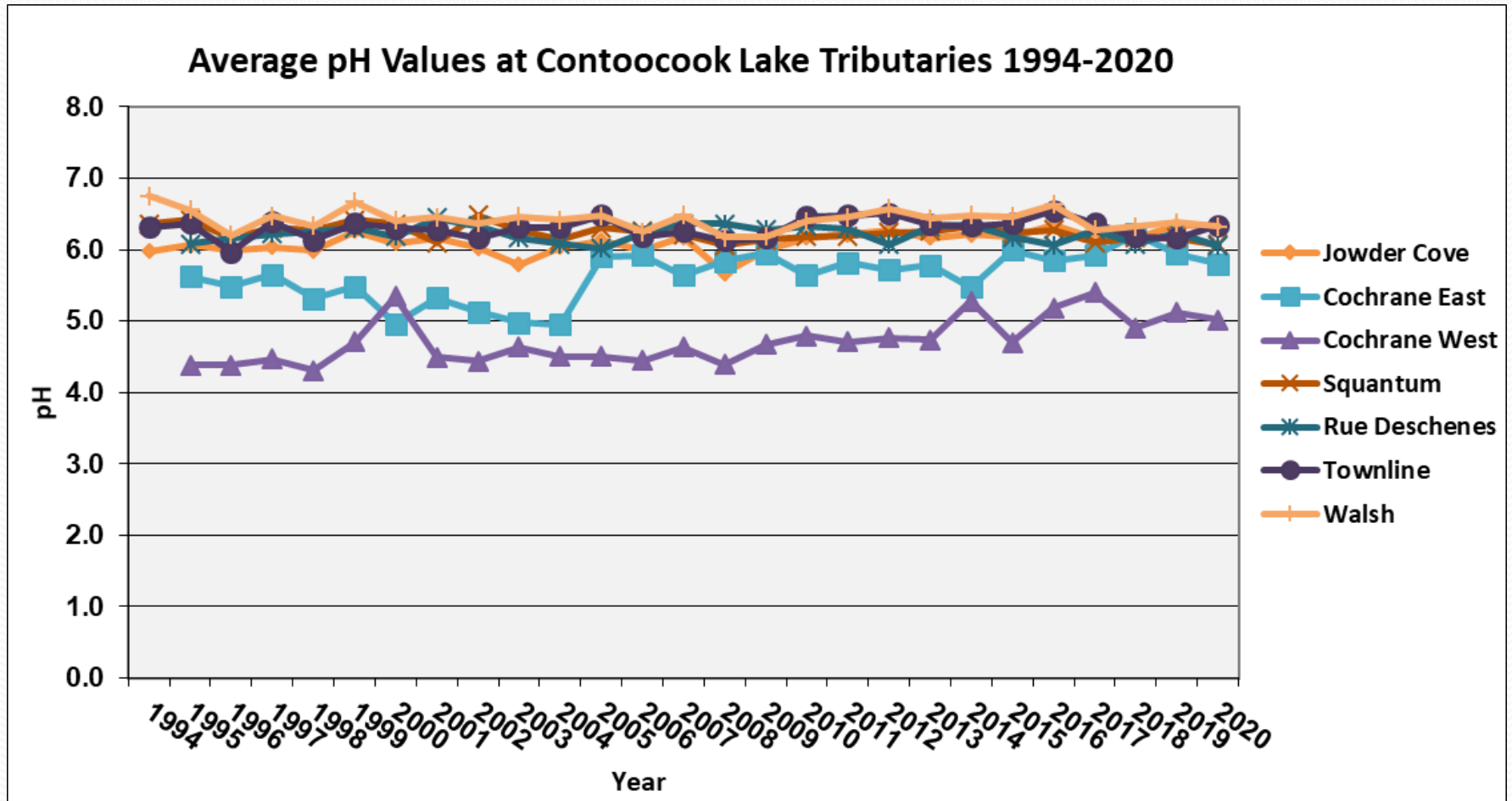
Medians: Range from 15.0 mg/L (Townline) to 76.0 mg/L (Rue D.).



Contoocook Lake Tributaries

Water Quality Trends: pH

Medians: Range from 4.63 (Cochrane West) 6.45 (Walsh)



VLAP Reports

2020 Contoocook Lake Report

- Morphometric data.
- Waterbody report card and impairment status.
- Sample station map.

MORPHOMETRIC DATA

| | | | | | |
|-----------------------|--------|---------------------------|-----------|-----------------------------------|------|
| Watershed Area (Ac.): | 5,888 | Max. Depth (m): | 6.4 | Flushing Rate (yr ¹): | 6.8 |
| Surface Area (Ac.): | 380 | Mean Depth (m): | 2.2 | P Retention Coef: | 0.5 |
| Shore Length (m): | 11,700 | Volume (m ³): | 1,944,000 | Elevation (ft): | 1009 |

TROPIC CLASSIFICATION

| Year | Trophic class |
|------|---------------|
| 1988 | MESOTROPHIC |
| 2006 | MESOTROPHIC |

KNOWN EXOTIC SPECIES

| |
|------------------|
| Variable Milfoil |
| |
| |

The Waterbody Report Card tables are generated from the DRAFT 2020 305(b) report on the status of N.H. waters, and are based on data collected from 2010-2019. Detailed waterbody assessment and report card information can be found at www.des.nh.gov/water/rivers-and-lakes/water-quality-assessment

| Designated Use | Parameter | Category | Comments |
|----------------------------|-------------------------|--------------|--|
| Aquatic Life | Phosphorus (Total) | Good | Sampling data is better than the water quality standards or thresholds for this parameter. |
| | pH | Slightly Bad | Data periodically exceed water quality standards or thresholds for a given parameter by a small margin. |
| | Oxygen, Dissolved | Encouraging | Limited data for this parameter predicts water quality standards or thresholds are being met; however more data are necessary to fully assess the parameter. |
| | Dissolved oxygen satura | Encouraging | Limited data for this parameter predicts water quality standards or thresholds are being met; however more data are necessary to fully assess the parameter. |
| | Chlorophyll-a | Good | Sampling data is better than the water quality standards or thresholds for this parameter. |
| Primary Contact Recreation | Escherichia coli | No Data | No data for this parameter. |
| | Chlorophyll-a | Very Good | All sampling data meet water quality standards or thresholds for this parameter. |

BEACH PRIMARY CONTACT ASSESSMENT STATUS

| | | | |
|-------------------------------|------------------|------|---|
| CONTOOCCOOK LAKE - TOWN BEACH | Escherichia coli | Good | Sampling data commonly meet water quality standards or thresholds for this parameter. |
|-------------------------------|------------------|------|---|

VLAP SAMPLE STATION MAP: This map depicts the location of routine sampling stations discussed on page two of the report.



CONTOOCCOOK LAKE RINGE VOLUNTEER LAKE ASSESSMENT PROGRAM

| STATIONID | STATION NAME |
|-----------|-------------------------|
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| CONJAF5 | TAPT INLET |
| CONJAF6 | TOWNLINE INLET |
| CONJAFD | DEEP SPOT |
| CONJAFD | DAM OUTLET |
| CONJAF1 | JOWDER COVE INLET |
| CONJAF2 | COCHRANE INLET E |
| CONJAF3 | COCHRANE INLET W |
| CONJAF7 | WALSH INLET |
| CONJAF8 | WOODBOND INLET |
| CONJAF53 | SQUANTUM 3 |
| CONJAF6UP | TOWNLINE INLET UPSTREAM |

Source: This data layer is derived from NDES data and is not a certified revision. NDES is not responsible for the use or interpretation of this information. Not certified by NDES. NHDES Watershed Management Bureau Date: 3/17/2021



VLAP Reports

2020 Contocook Lake Report

- Current year data summary.
- Trend analysis.
- Observations and recommendations.

RECOMMENDED ACTIONS: Great job sampling in 2020! Lake quality is representative of mesotrophic, or average, conditions and the improving chlorophyll levels are encouraging. However, lake phosphorus levels tend to fluctuate above the threshold for mesotrophic lakes and conductivity levels have increased. Encourage local road agents and private winter maintenance companies to obtain Voluntary Salt Applicator License through the Green SnowPro Certification program. Jowder Cove Inlet experienced elevated phosphorus levels and volunteers noted a white scum on the water's surface in the lake. Investigate potential upstream sources of phosphorus to the Inlet and report any surface scums to the NHDES Harmful Algal Bloom Program. HA@des.nh.gov. Squantum Inlet phosphorus levels were extremely elevated in 2020 and this station has a history of elevated levels due to wetland impacts that were likely exacerbated by drought conditions. The lake association should work with the Town to determine who is responsible for maintaining the culvert located at Taft Inlet and establish a regular cleaning schedule to maintain flow. Efforts should be made to address stormwater runoff and erosion within the watershed and property owners should be encouraged to implement improvement projects as detailed in NHDES' "NH Homeowner's Guide to Stormwater Management". Keep up the great work!

- OBSERVATIONS** (Refer to Table 1 and Historical Deep Spot Data Graphics)
- ▲ **CHLOROPHYLL-A:** Chlorophyll level was low in June and decreased slightly in August. Average chlorophyll level remained stable with 2019 and was less than the state median and the threshold for mesotrophic lakes. Historical trend analysis indicates significantly decreasing (improving) chlorophyll levels since monitoring began.
 - ▲ **CONDUCTIVITY/CHLORIDE:** Epilimnetic (upper water layer), Hypolimnetic (lower water layer), Cochrane Inlet E, Cochrane Inlet W, Outlet, Jowder Cove Inlet, Townline Inlet, and Townline Upstream conductivity and chloride levels were greater than the state medians yet less than a level of concern. However, historical trend analysis indicates significantly increasing (worsening) epilimnetic conductivity levels since monitoring began. Squantum Inlet and Taft Inlet conductivity and chloride levels were much greater than the state medians yet chloride levels did not exceed the state chronic chloride standard. Walsh Inlet conductivity and chloride levels were very low and less than the state medians.
 - ▲ **COLOR:** Apparent color measured in the epilimnion indicates the water was moderately tea, or brown, colored in June and August.
 - ▲ **TOTAL PHOSPHORUS:** Epilimnetic and Hypolimnetic phosphorus levels were elevated in June and decreased to a low to moderate range in August. Average epilimnetic phosphorus level decreased slightly from 2019, was slightly greater than the state median, and was approximately equal to the threshold for mesotrophic lakes. Historical trend analysis indicates relatively stable epilimnetic phosphorus levels since monitoring began. Jowder Cove Inlet phosphorus levels were elevated in June and August. Cochrane Inlet E and Walsh Inlet phosphorus levels were elevated in August during low flow conditions. Cochrane Inlet W, Townline Inlet, Townline Inlet Upstream and Outlet phosphorus levels fluctuated within average ranges for those stations. Squantum Inlet phosphorus levels were extremely elevated in June and August. Taft Inlet phosphorus level was elevated in June and the turbidity of the sample was also elevated, and lab data noted moderate color, sediment and organic material in the sample.
 - ▲ **TRANSPARENCY:** Transparency measured with (VS) and without (NVS) the viewscope was within an average range for the lake in June and then increased (improved) in August. Average NVS transparency remained stable with 2019 and was slightly lower than the state median. Historical trend analysis indicates relatively stable NVS transparency since monitoring began.
 - ▲ **TURBIDITY:** Epilimnetic, Hypolimnetic, Jowder Cove Inlet, Cochrane Inlet W, Townline Inlet, and Townline Inlet Upstream turbidity levels fluctuated within a low range for those stations. Cochrane Inlet E, Squantum Inlet, Taft Inlet, Walsh Inlet, and Outlet turbidity levels were slightly elevated to elevated in June following a significant storm during drought conditions and several samples were colored and contained sediment and/or organic material.
 - ▲ **pH:** Epilimnetic and Townline Inlet Upstream pH levels were within the desirable range 6.5-8.0 units. Historical trend analysis indicates stable epilimnetic pH levels since monitoring began. Jowder Cove Inlet, Townline Inlet and Walsh Inlet pH levels were slightly less than desirable. Hypolimnetic, Cochrane Inlet E and W, Outlet, Squantum Inlet, and Taft Inlet pH levels were slightly acidic and potentially critical to aquatic life.

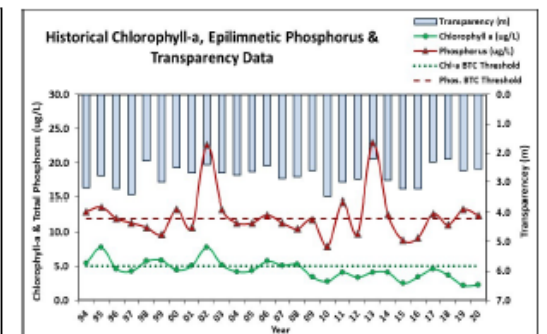
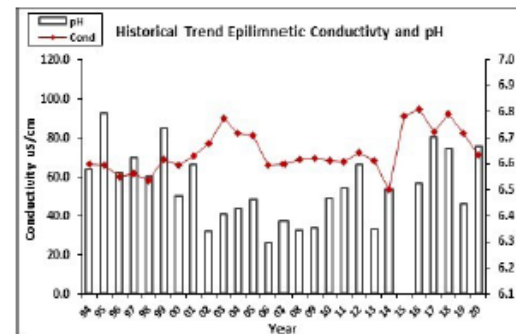
| Station Name | Table 1. 2020 Average Water Quality Data for CONTOCCOOK LAKE - JAFFREY | | | | | | | | | |
|-------------------------|--|--------------|---------------|-----------|-------------|--------------|----------|------|-----------|------|
| | Alk. mg/l | Chlor-a ug/l | Chloride mg/l | Color pcu | Cond. us/cm | Total P ug/l | Trans. m | | Turb. ntu | pH |
| | | | | | | | NVS | VS | | |
| Epilimnion | 6.7 | 2.24 | 21 | 55 | 71.4 | 12 | 2.56 | 2.94 | 0.59 | 6.66 |
| Hypolimnion | | | | | 76.2 | 17 | | | 1.08 | 6.09 |
| Cochrane Inlet E | | | 34 | | 124.6 | 20 | | | 1.60 | 5.80 |
| Cochrane Inlet W | | | 28 | | 93.6 | 23 | | | 1.32 | 5.02 |
| Dam Outlet | | | | | 87.2 | 16 | | | 0.84 | 5.72 |
| Jowder Cove Inlet | | | 28 | | 92.5 | 26 | | | 0.76 | 6.32 |
| Squantum Inlet | | | 53 | | 171.0 | 156 | | | 1.44 | 6.07 |
| Taft Inlet | | | 84 | | 245.5 | 48 | | | 10.28 | 6.05 |
| Townline Inlet | | | 23 | | 78.3 | 19 | | | 1.02 | 6.34 |
| Townline Inlet Upstream | | | 14 | | 50.8 | 13 | | | 0.46 | 6.56 |
| Walsh Inlet | | | 2 | | 25.4 | 27 | | | 2.06 | 6.32 |

NH Water Quality Standards: Numeric criteria for specific parameters. Results exceeding criteria are considered a water quality violation.
 Chloride: > 230 mg/L (chronic)
 E. coli: > 88 cts/100 mL – public beach
 E. coli: > 406 cts/100 mL – surface waters
 Turbidity: > 10 NTU above natural level
 pH: between 6.5-8.0 (unless naturally occurring)

NH Median Values: Median values for specific parameters generated from historic lake monitoring data.
 Alkalinity: 4.5 mg/L
 Chlorophyll-a: 4.39 ug/L
 Conductivity: 42.3 uS/cm
 Chloride: 5 mg/L
 Total Phosphorus: 11 ug/L
 Transparency: 3.3 m
 pH: 6.6

HISTORICAL WATER QUALITY TREND ANALYSIS

| Parameter | Trend | Explanation | Parameter | Trend | Explanation |
|-----------------|-----------|---|-------------------------|-----------|--|
| Conductivity | Worsening | Data significantly increasing. | Chlorophyll-a | Improving | Data significantly decreasing. |
| pH (epilimnion) | Stable | Trend not significant; data show low variability. | Transparency | Stable | Trend not significant; data moderately variable. |
| | | | Phosphorus (epilimnion) | Stable | Trend not significant; data moderately variable. |



Waterbody Report Card

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BEACH PRIMARY CONTACT ASSESSMENT STATUS

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|-------------------------------|------------------|------|---|

Orange/Red = “impaired”

Nutrient Thresholds

- Nutrient thresholds were developed to assess the ability of a waterbody to support aquatic life.
- The thresholds are based on a waterbody's trophic classification.
- Contoocook Lake Best Trophic Class = **MESOTROPHIC**
- Use the best trophic classification to determine nutrient impairments.

| | Total Phosphorus (ug/L) | Contoocook Lake Median Epi TP | Chlorophyll-a (ug/L) | Contoocook Lake Median Chl-a |
|--------------------|-------------------------|-------------------------------|----------------------|------------------------------|
| Oligotrophic | < 8.0 | | < 3.3 | |
| Mesotrophic | ≤ 12.0 | 12 | ≤ 5.0 | 4.33 |
| Eutrophic | ≤ 28 | | ≤ 11 | |

Watershed Management: Stormwater



Watershed Management: Stormwater

Stormwater runoff
causes or contributes to over

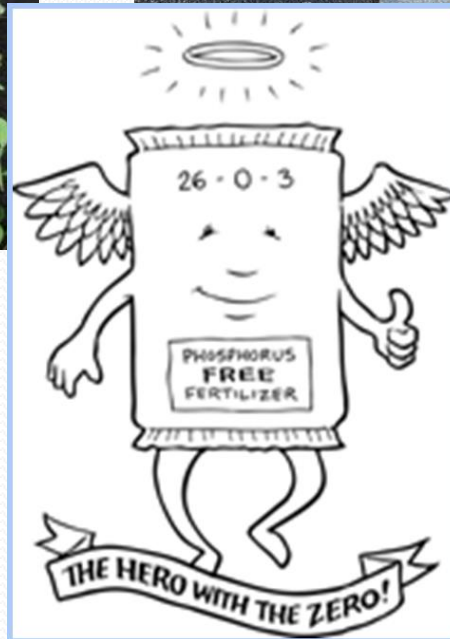
90%

of the water pollution problems in NH.



Watershed Management: Stormwater

- Taking Action



For more information on
stormwater...



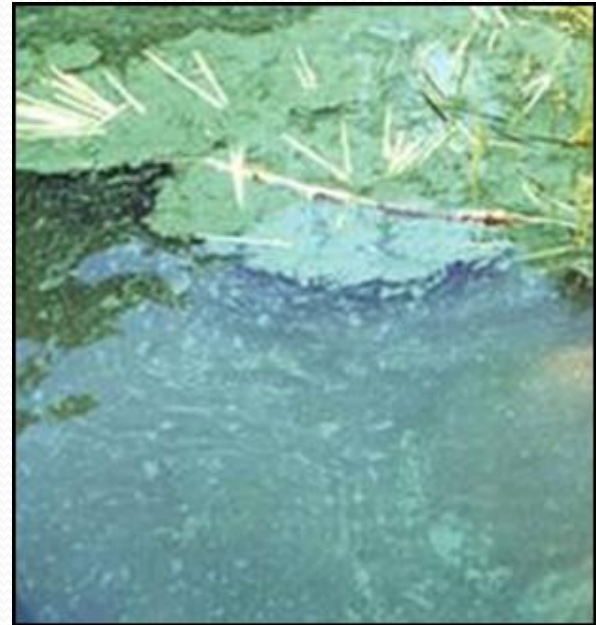
- <https://www4.des.state.nh.us/SoakNH/>

Hot Topics for NH Lakes

- Exotic Aquatic Species (aka, Aquatic Invasive Species)



- Cyanobacteria (aka, Blue-Green Algae)



State of the State of AIS in NH

Aquatic Invasive Species (AIS) Infestation in New Hampshire

Legend

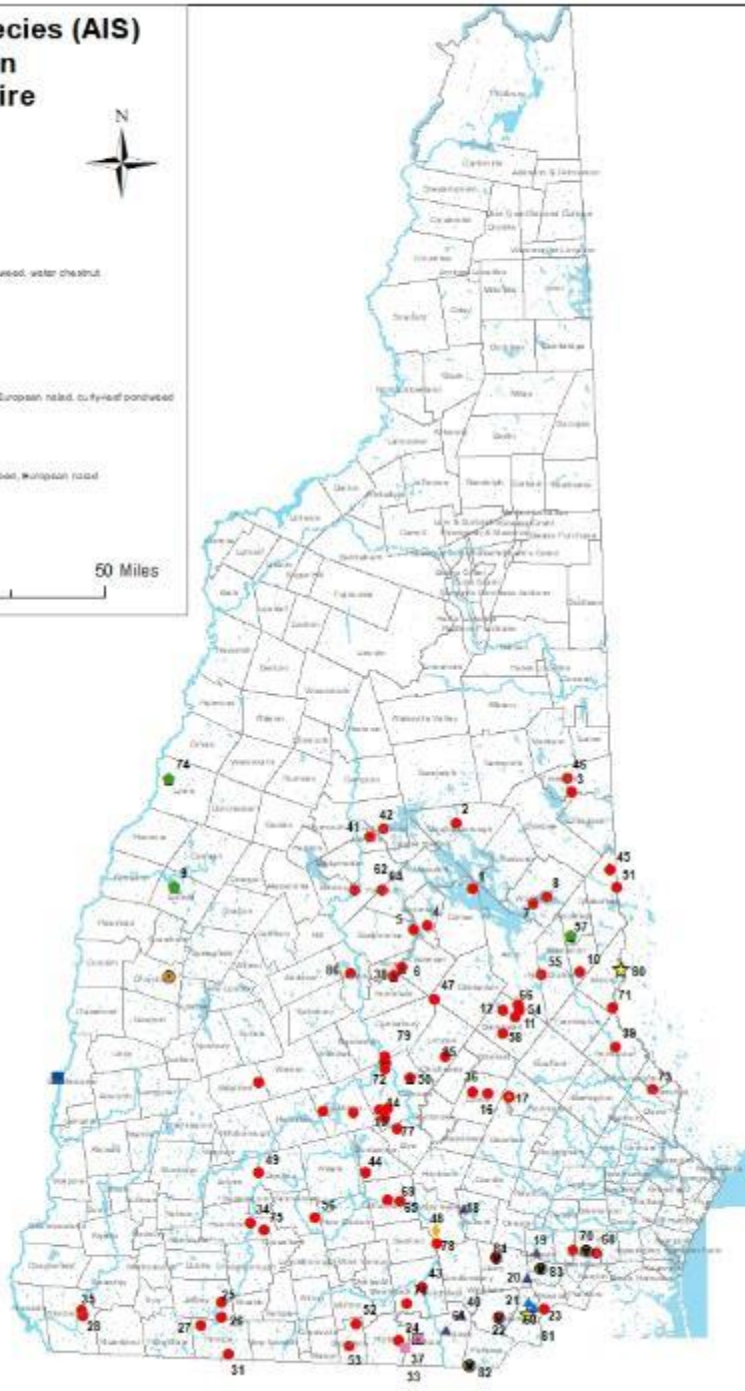
AIS Infestations

Type

- Asian clam
- Brazilian elodea
- Curlyleaf pondweed
- Kurilian nitella
- European related: European nitellid, D. demo, curly-leaf pondweed, water chestnut
- European related
- Porwort
- Variable nitellid
- Variable nitellid, Asian clam
- Variable nitellid, Curly-leaf pondweed
- Variable nitellid, European nitellid, fanwort, water chestnut, European related, curly-leaf pondweed
- Variable nitellid, European related
- Variable nitellid, curly-leaf pondweed
- Variable nitellid, fanwort
- Variable nitellid, fanwort, Kurilian nitella, curly-leaf pondweed, European related
- Town boundaries polygons
- NH Hydrography polygons
- State Boundary



0 12.5 25 50 Miles



Map prepared by NH DES
Exotic Species Program
Updated October 2017

Numbers correspond to separate
key which lists waterbody
name and town.

Exotic Aquatic Species in NH

91 infested waterbodies

- 11 Rivers
- 80 Lakes and Ponds

117 infestations

- Some waterbodies have more than one species, a few have as many as 6 different invasives

New Species of Concern



Hottonia palustris



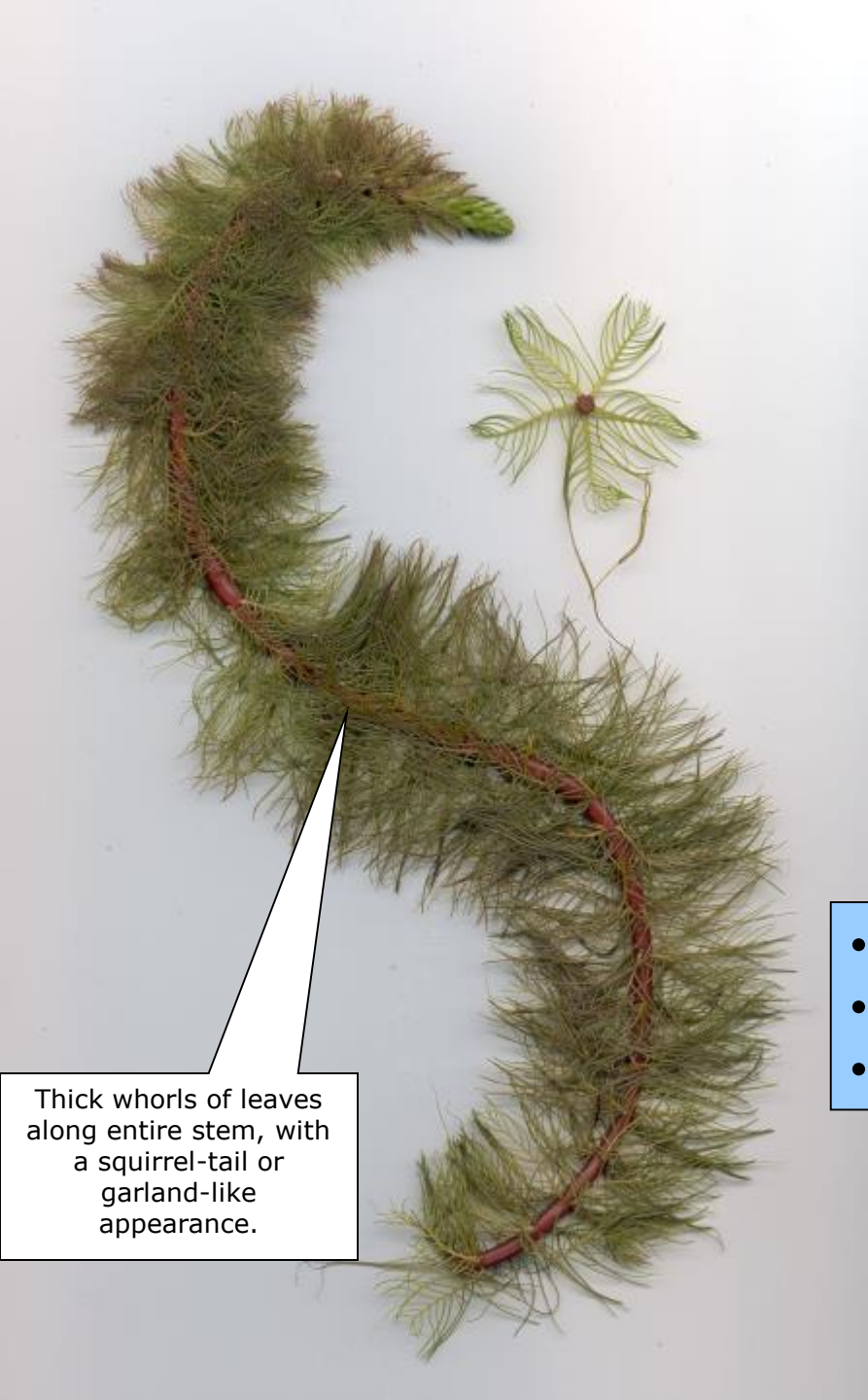
HYDRILLA IN THE CONNECTICUT RIVER



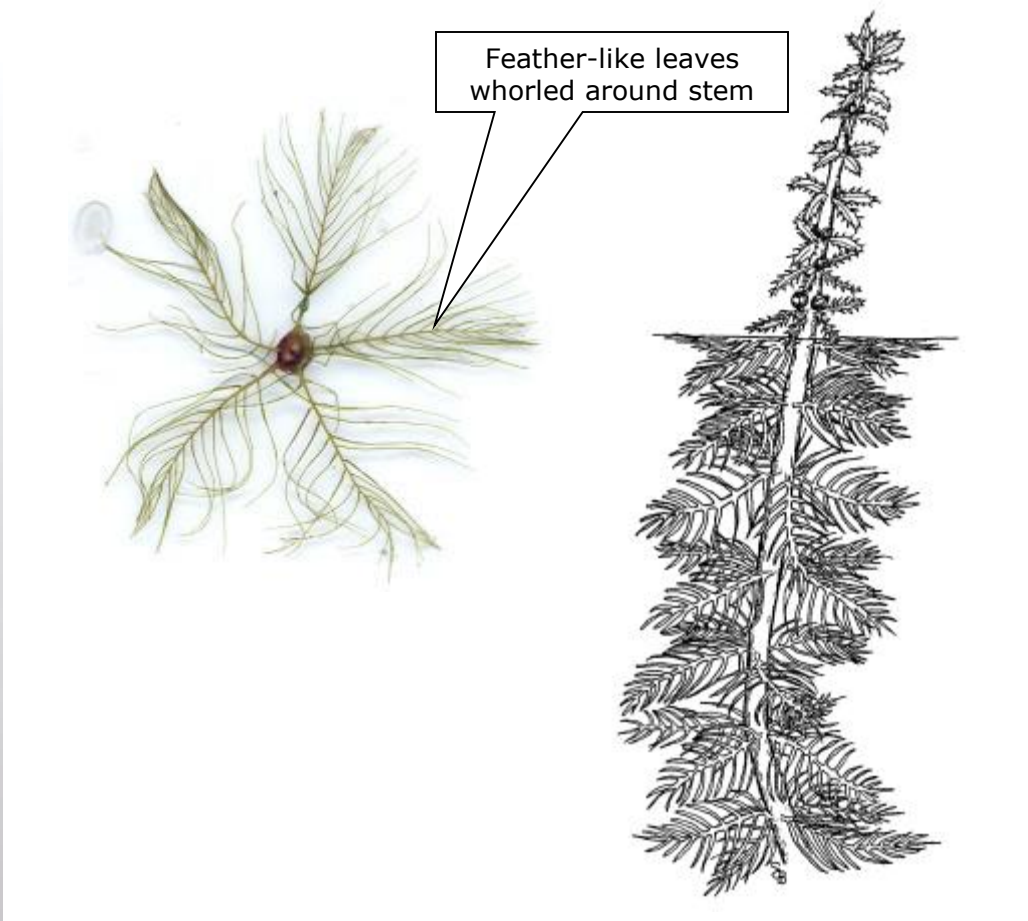
New Weed Control Diver Instructor

- Ted Aldrich has retired from teaching and contract diving
- Aquatic Specialties (David Coyle) has begun teaching Weed Control Diver courses in New Hampshire for those interested
 - scuba@aquaticspecialties.net

Key Species of Concern for Contoocook




Thick whorls of leaves along entire stem, with a squirrel-tail or garland-like appearance.



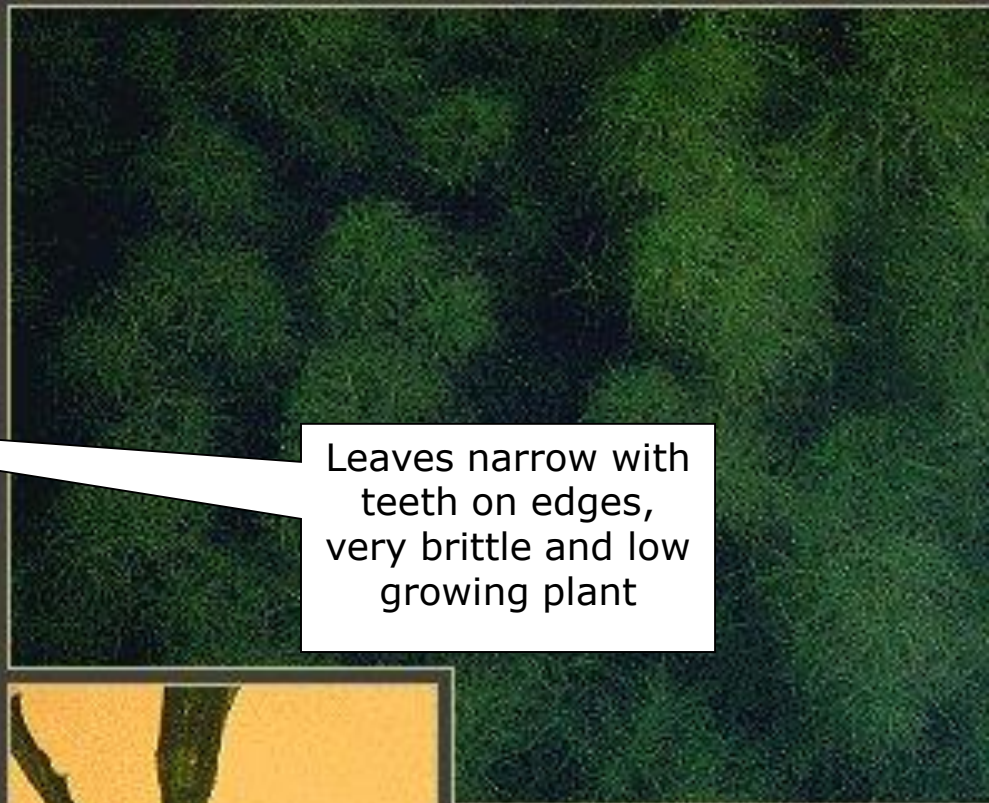
Feather-like leaves whorled around stem

- Variable milfoil- *Myriophyllum heterophyllum*
- Native to southern and central U.S., not to NH
- In over seventy waterbodies in NH

Variable milfoil ID tips

An underwater photograph showing a dense thicket of milfoil plants. The stems are thin and brownish, with feathery, green leaf-like structures. A callout box with a green background and white text points to a specific stem. The background is dark blue, suggesting an underwater environment.

Think of a “squirrel’s tail” when you look at the stems of growth. You will often see the stem and then the fluffy tubular growth around it. There may be a single stem, or a few in a clump.



Leaves narrow with teeth on edges, very brittle and low growing plant





Small narrow leaves whorled around stem. Note teeth on leaf edge for hydrilla.



- Hydrilla- *Hydrilla verticillata*
- Native to South America
- Not yet found in NH (but found in MA and ME)

Spiny water flea



Zebra mussel



Ohio Sea Grant

Chinese mystery snail



Common Aquatic Invasive Animals

Asian clam



Things you can do

- Keep up with Weed Watching and report any areas of new growth to Amy Smagula
- Continue to allocate funding locally, and seek state grant funds, to manage milfoil in Contoocook Lake
- Look for any new types of invasive plants or animals that may be a concern, and report them

THANK YOU!

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Photo courtesy of Kittie Wilson