Erin Stretz
Assistant Director of Science
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Salt & Science

Engaging Citizen Scientists in Understanding the Environmental Impact of Road Salt

Photo: NJDEP

October 29,2024 | ANJEC Stormwater Series

Deborah Kratzer
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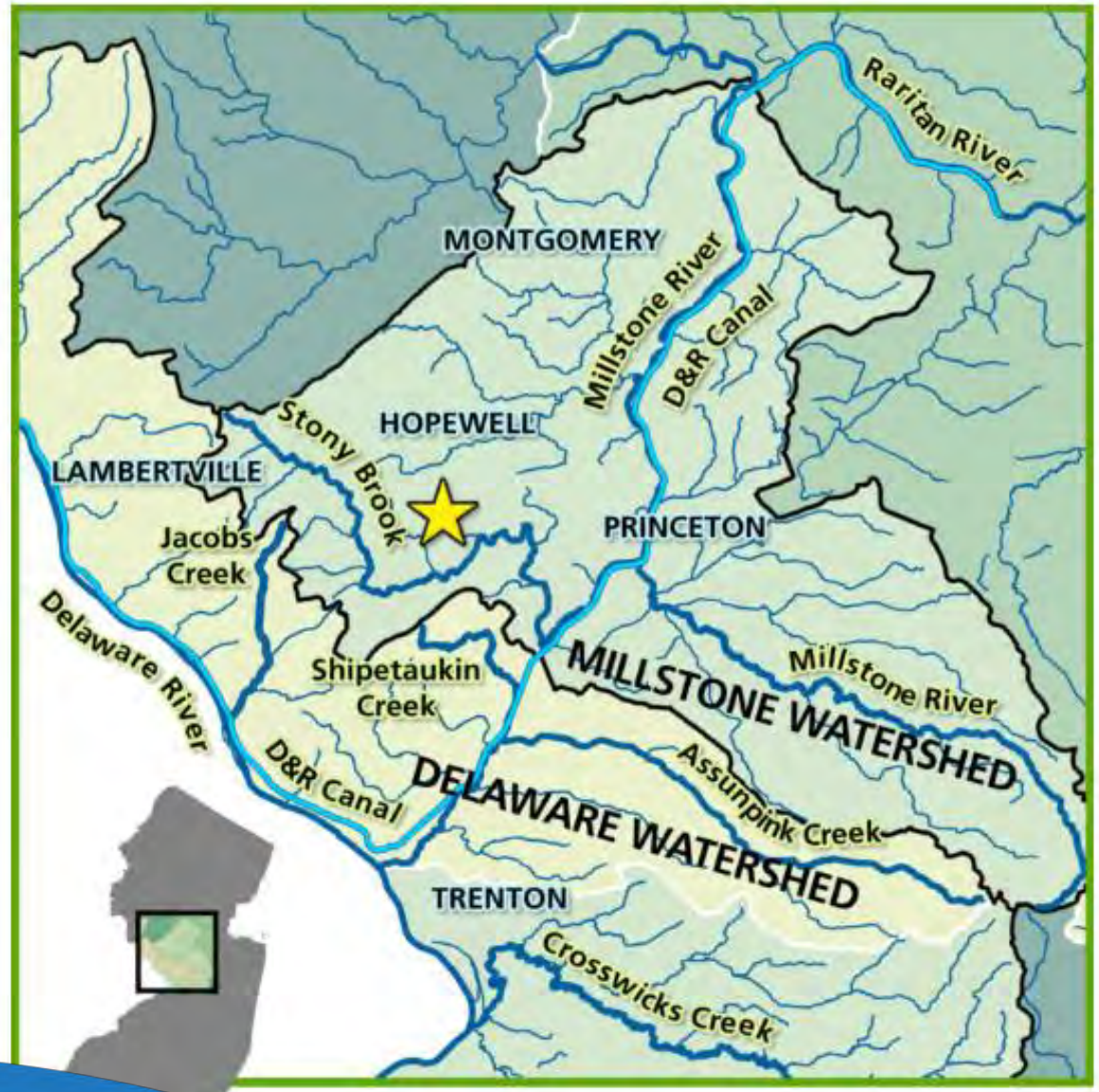
NJDEP Division of Water Monitoring, Standards and Pesticide Control
Bureau of Environmental Analysis, Restoration and Standards

Photo Source: NJDEP

The Watershed Institute

Watershed Center, Pennington, NJ

thewatershed.org



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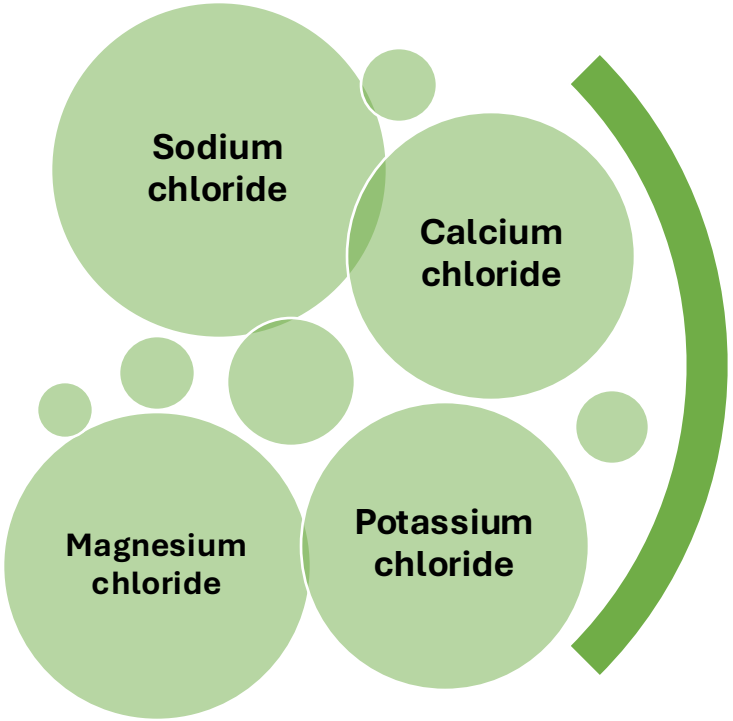
Background on Road Salt

What is Road Salt anyway?



Types of Road Salt

Application Methods

How it Works

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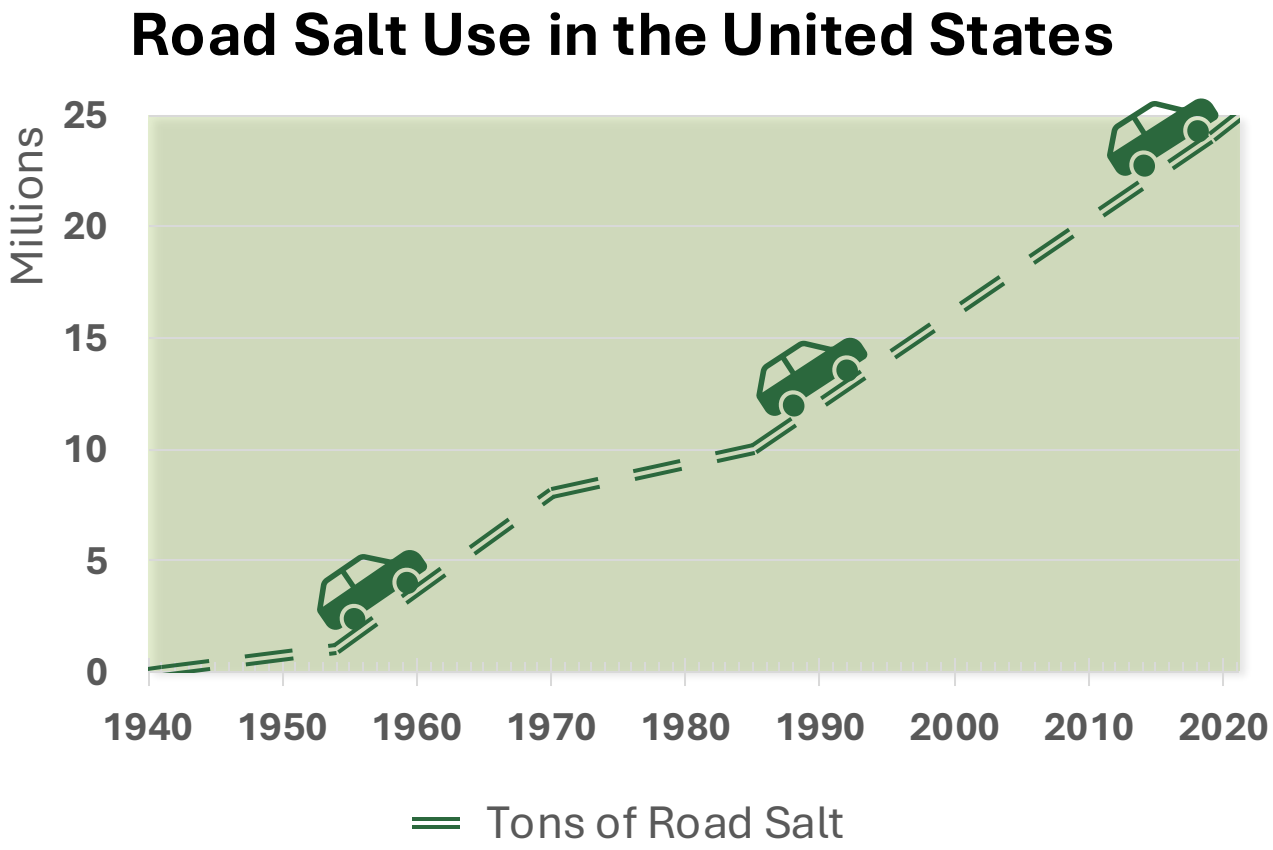
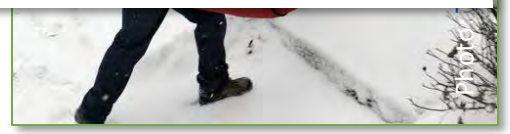
How We Use Road Salt





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Source: Road Salt Use in the United States, https://www.sciencedaily.com/releases/2021/12/211209124519.htm

Where does Road Salt end up?

Plants and Soils

Photo: Alpine Tree NJ

Groundwater

Streams and Lakes

Photo: Chesapeake Stormwater

The Watershed Institute

Salt and Freshwater Life

LETHAL EFFECTS

Above 860 mg/l chloride

- Salt can reach toxic levels and result in **acute mortality**

Fish kill in Lake Varuna, Gaithersburg, MD due to high chloride, Source: Karl Van Neste / Muddy Branch Alliance

SOME NON-LETHAL EFFECTS

Above 50 mg/l chloride

- Rainbow trout hatchlings **30% smaller** in salty water (Hintz & Relyea, 2017)
- Riparian wood frogs birth **more males than females** (Lambert, Stoler, Smylie, Relyea & Skelly, 2016)

Photo: Hintz & Relyea (2017)

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Salt and Lakes

Low DO → High Nutrients → More algal blooms

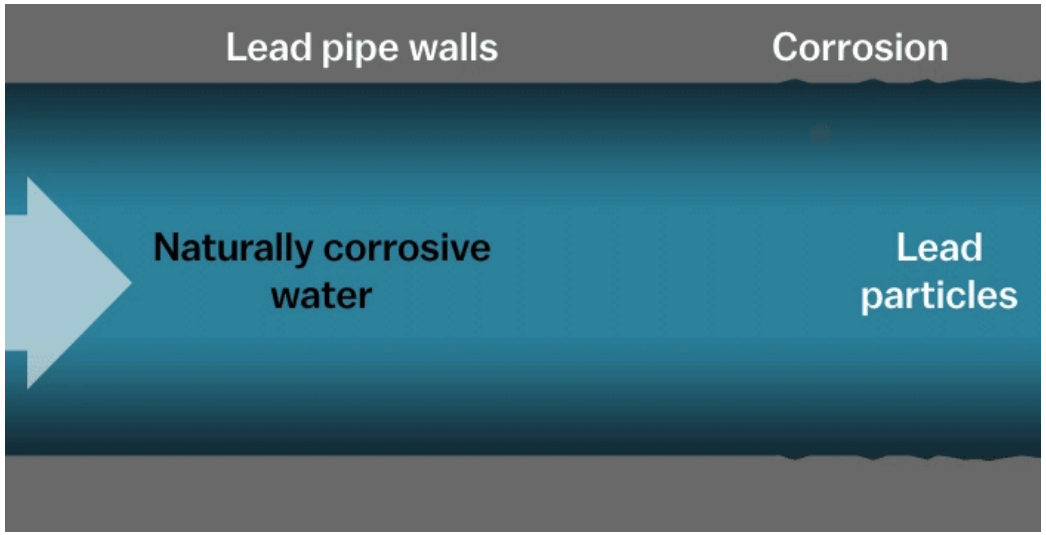
- Salty water sinks, too heavy for seasonal mixing so the water at the bottom of the lake loses dissolved oxygen (DO)
- Low DO conditions can leach nutrients from benthic sediment
- Nutrients feed bacteria and algal blooms, which consume even more DO

Photo Source: NJDEP

Salt Contaminates Drinking Water

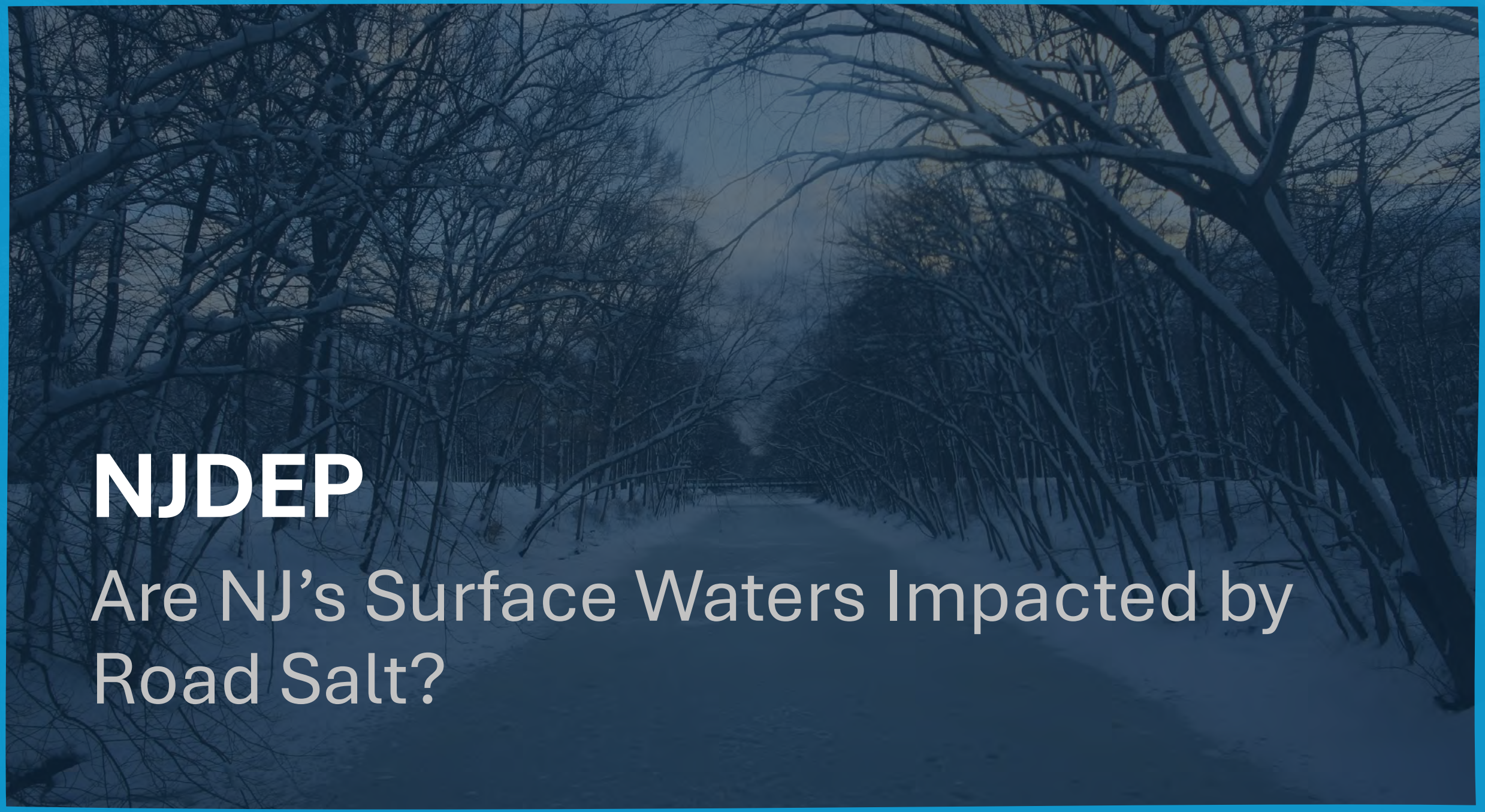
and can add other contaminants to drinking water as well

- **Salt doesn't "go away"** and is not removed by traditional water treatment plants
- It can be dangerous for people on low-sodium diet
- **Salt is corrosive** and can leach lead and copper from pipes (see Flint, Michigan)
  - Not to mention vehicles, roads, bridges, and other infrastructure



Graphic: Vox Visual Guide to Lead Poisoning

The Watershed Institute



NJDEP

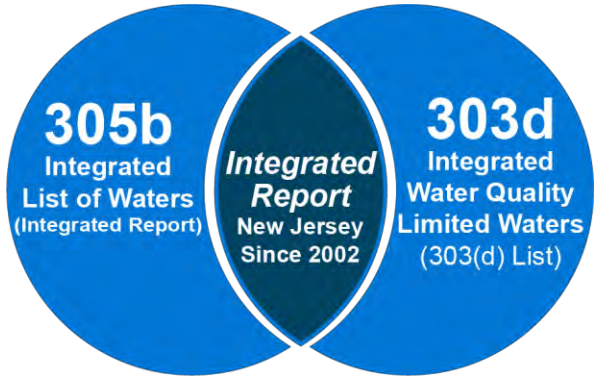
Are NJ’s Surface Waters Impacted by Road Salt?

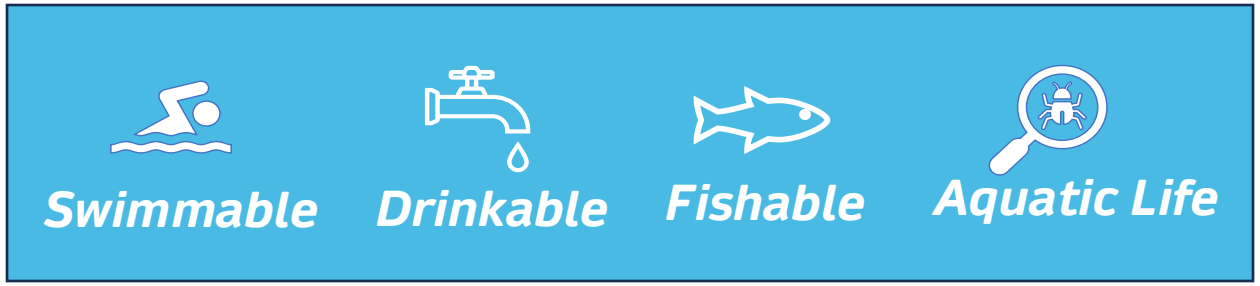
Why does NJDEP measure surface water quality?

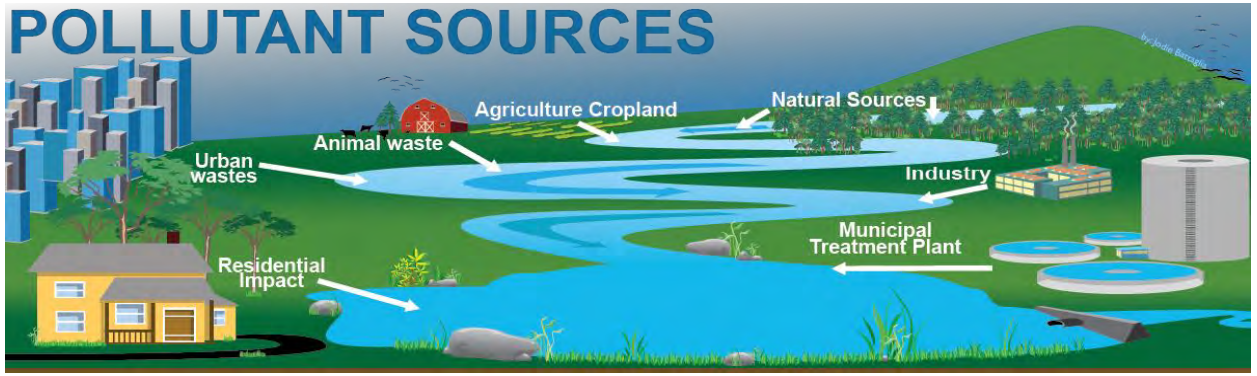
1. The 1972 Federal Clean Water Act
   - Biennial report to the USEPA
   - List the health of all waters
   - List the impaired waters
   - Find current and past Integrated Reports at:
     - NJDEP:https://www.state.nj.us/dep/wms/bears/assessment.htm
     - US EPA: How's My Waterway https://www.epa.gov/waterdata/hows-my-waterway

2. Protect healthy waters
   - Watershed Protection Plans
   - Regulatory and voluntary actions

3. Restore unhealthy waters
   - Identify Pollutant Sources
   - Total Maximum Daily Loads (TMDLs)
   - Watershed Restoration Plans
   - Alternative Restoration Plans
   - Regulatory and voluntary actions







NJDEP: https://dep.nj.gov/wms/bears/

Images: NJDEP

Restoring Unhealthy Waters: What is a TMDL?

- "putting the watershed on a pollution diet"
- Total Maximum Daily Loads (TMDLs) provide the regulatory framework to specify the reductions needed to attain the water quality target, taking into consideration:
  - Point sources of pollutants (WLA = Waste Load Allocation) = NJPDES permittees
  - Nonpoint sources of pollutants (LA = Load Allocation)
  - Margin of Safety (MOS)

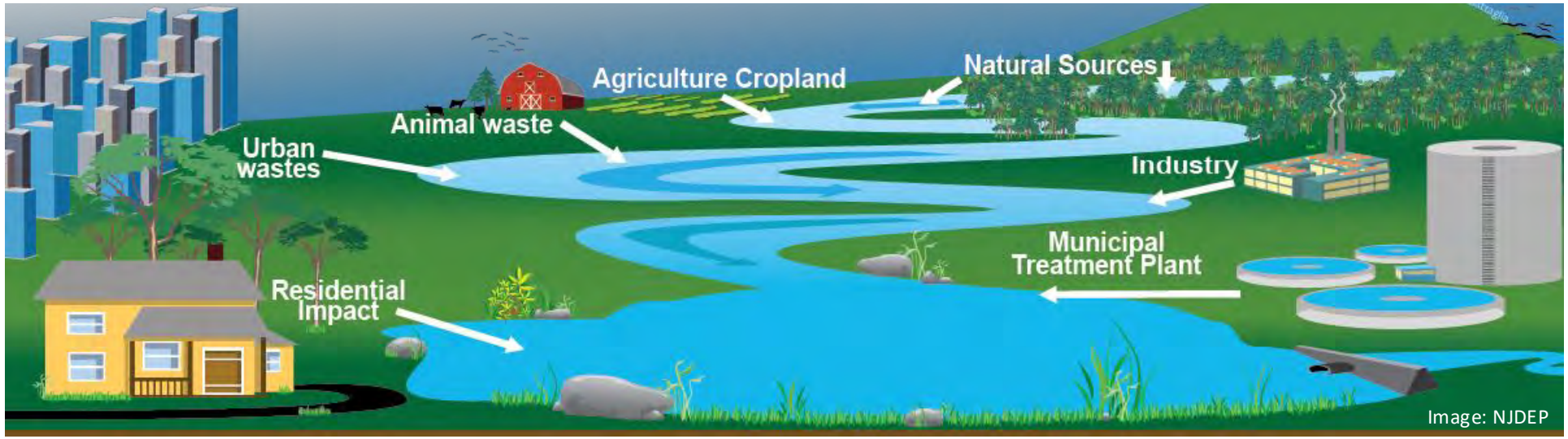
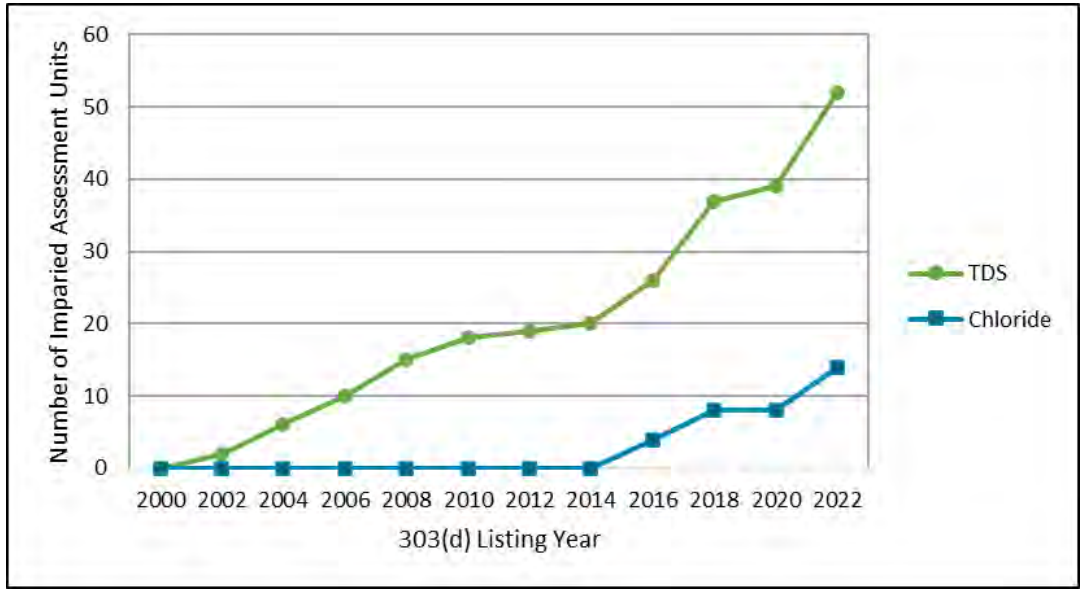


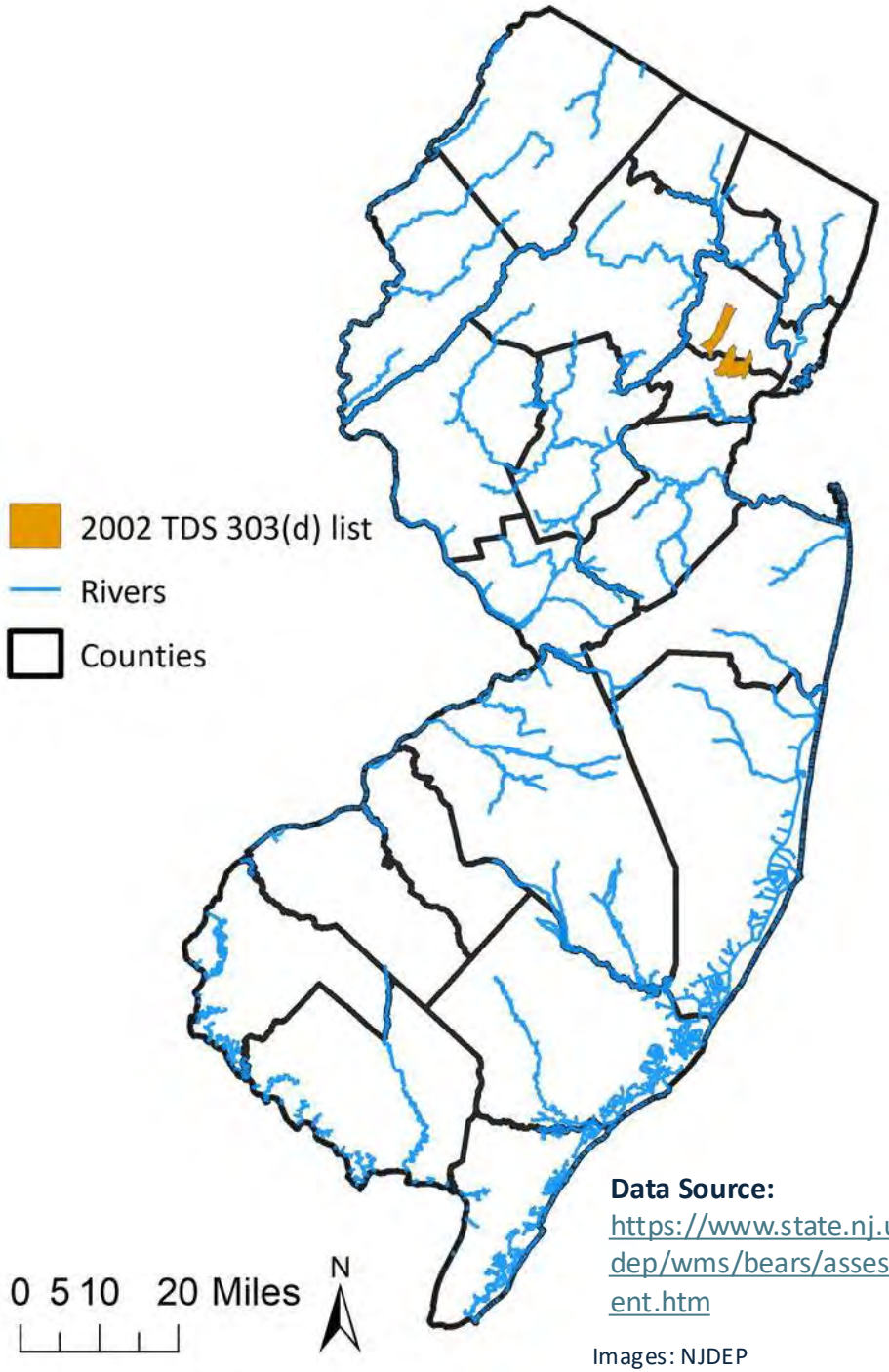
Image: NJDEP

NJDEP TMDLs: https://dep.nj.gov/wms/bears/tmdls/

NJ Integrated Report:
Waters Impaired by High TDS and Chloride

- Biennial Integrated Report
  - Exceedances of TDS began in 2002
  - Exceedances of chloride began in 2016
  - Increasing # exceedances over time
- 2020 303(d) list of impaired water bodies
  - 39 subwatersheds are impaired by TDS
  - 8 subwatersheds are impaired by chloride





Data Source: https://www.state.nj.us/dep/wms/bears/assessment.htm

Images: NJDEP

Waters Impaired by High TDS and Chloride with Municipalities

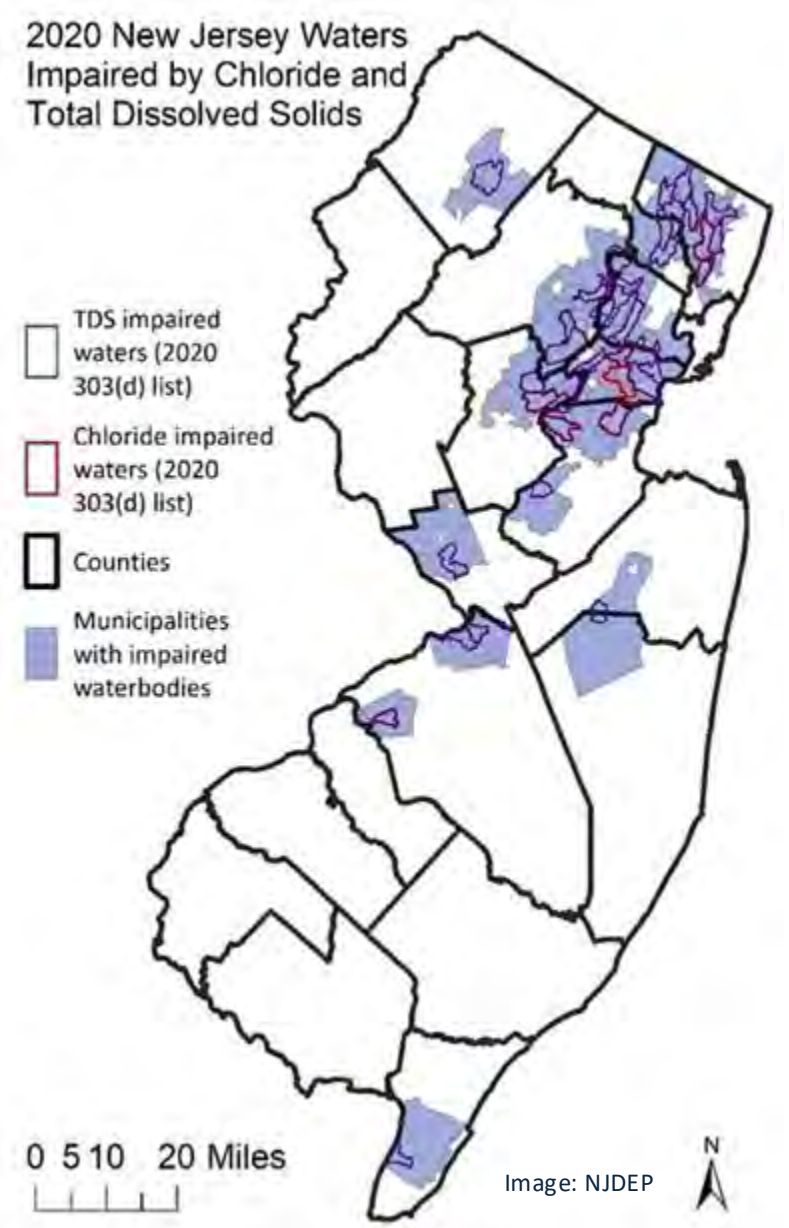
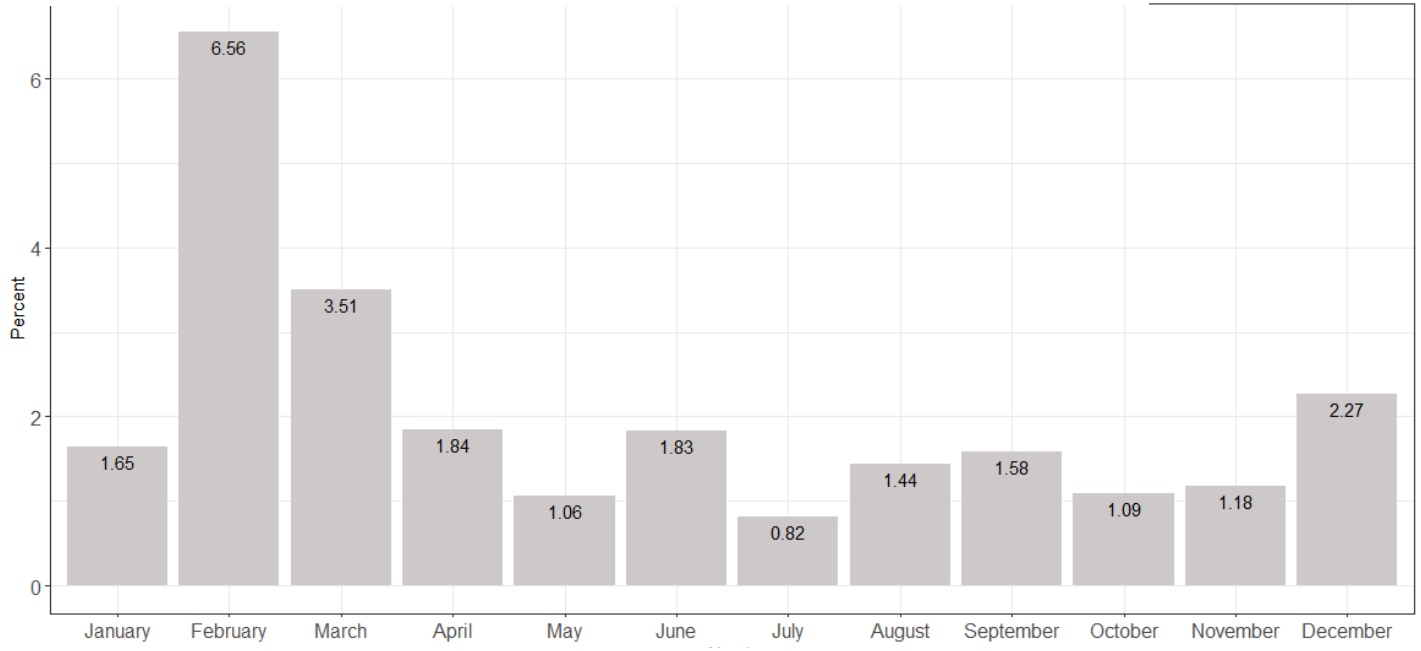


Image: NJDEP

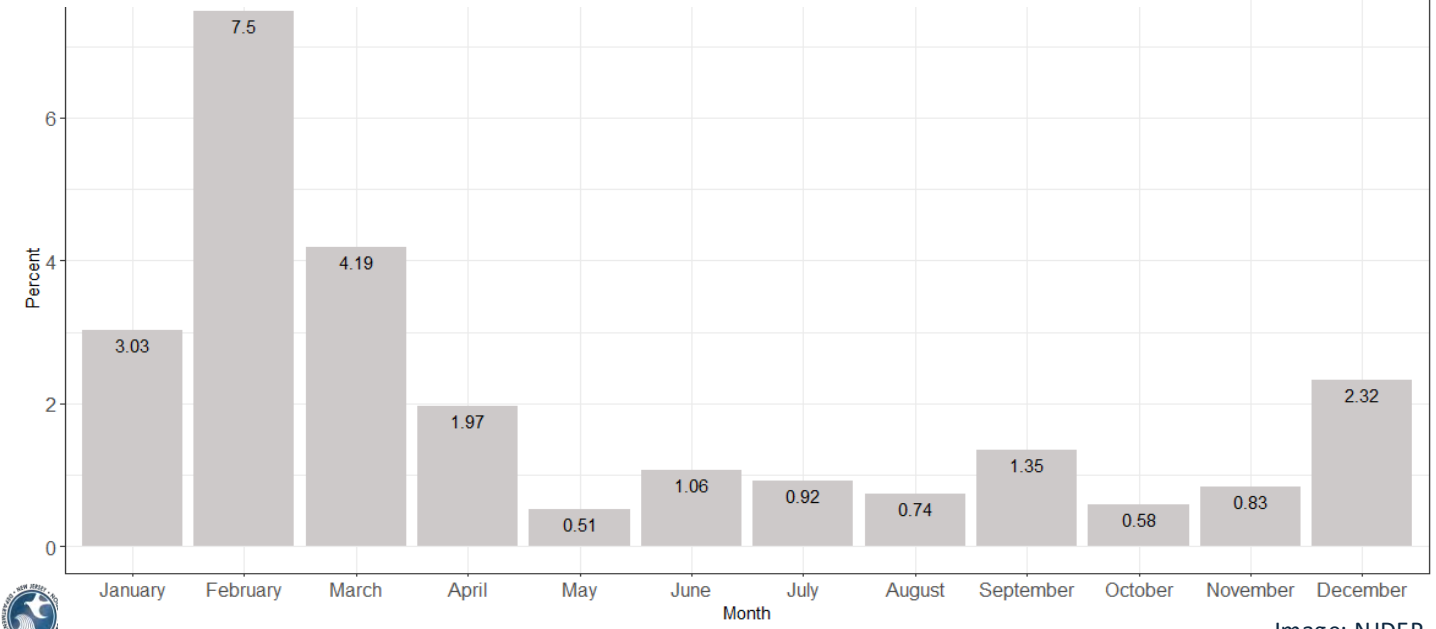
- 129 municipalities at least partially contain an impaired waterbody

Data Source: https://www.state.nj.us/dep/wms/bears/assessment.htm

% of Samples with TDS > 500 mg/L



% of Samples with Chloride > 230 mg/L



Data Source: NJDEP quality-assured, freshwater water quality assessment dataset)

Image: NJDEP

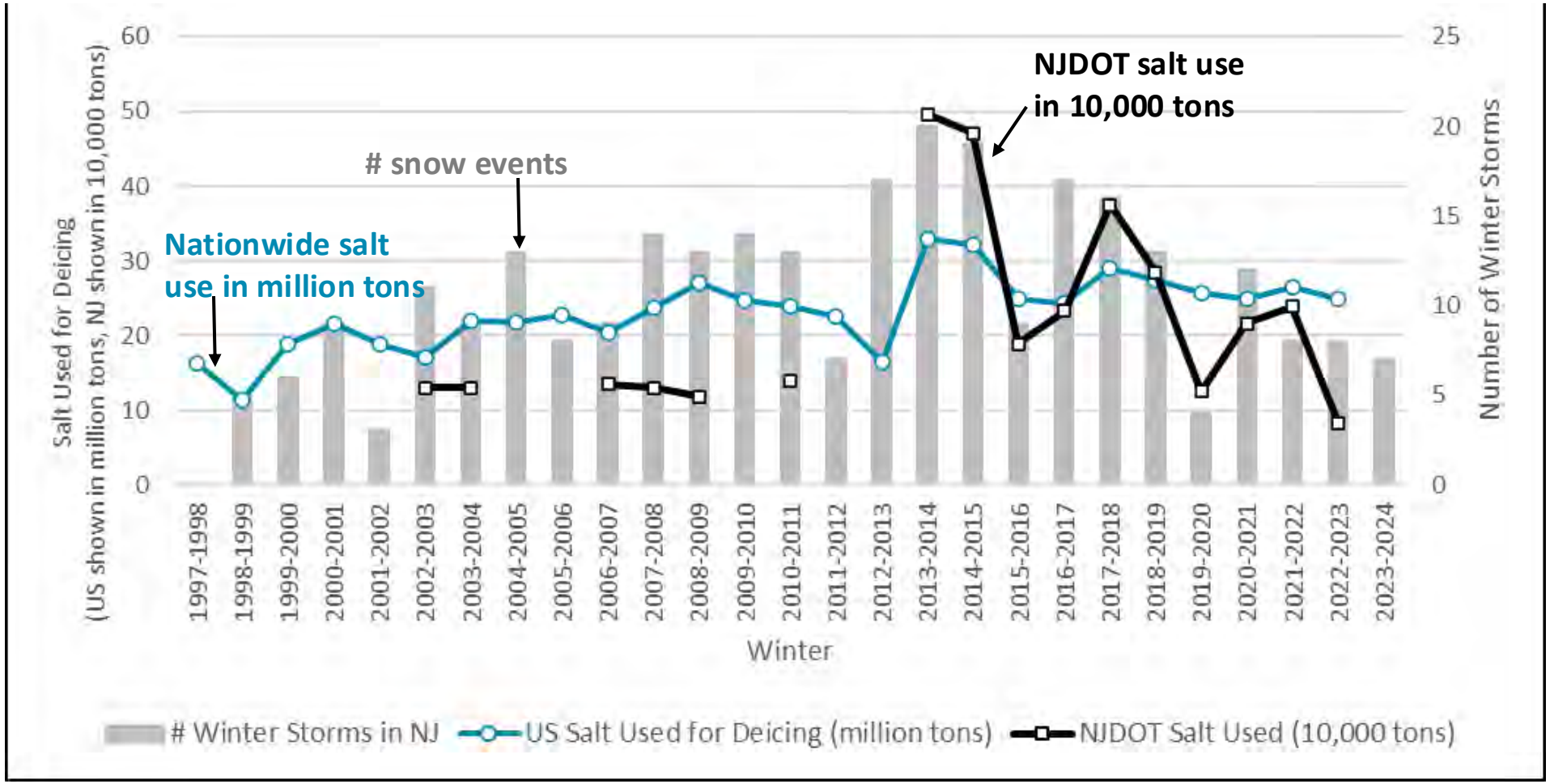
Identifying Pollutant Sources

- Salt can come from numerous sources
- Are exceedances seasonal?
- Looked at statewide data from 1997-2023
- *Top:* % TDS exceedances by month
- *Bottom:* % chloride exceedances by month

Data Source: https://www.waterqualitydata.us/

Exactly How Much De-icing Salt Are We Using?

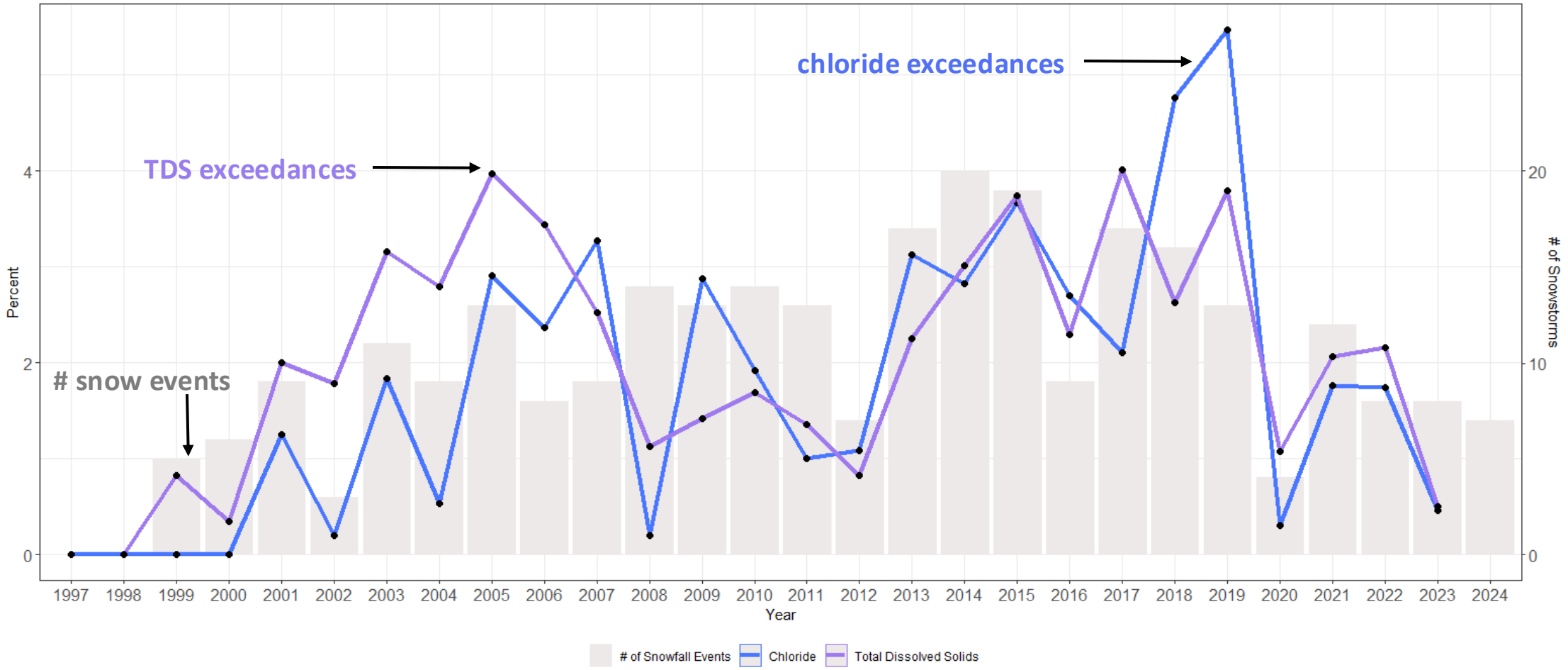
Salt Used for De-icing vs. Number of Winter Storms (1997-2023)



Data Sources: https://www.state.nj.us/transportation/about/winter/expenditures.shtm; https://climate.rutgers.edu/stateclim_v1/winter/20022003/winter20022003.html; https://dex.cocorahs.org/stations/NJ-MC-17; https://www.usgs.gov/centers/national-minerals-information-center/salt-statistics-and-information

Image: NJDEP

Statewide Data: TDS & Chloride Exceedances (1997-2023) with Number of Winter Storms



Data Source: NJDEP quality-assured, freshwater water quality assessment dataset)

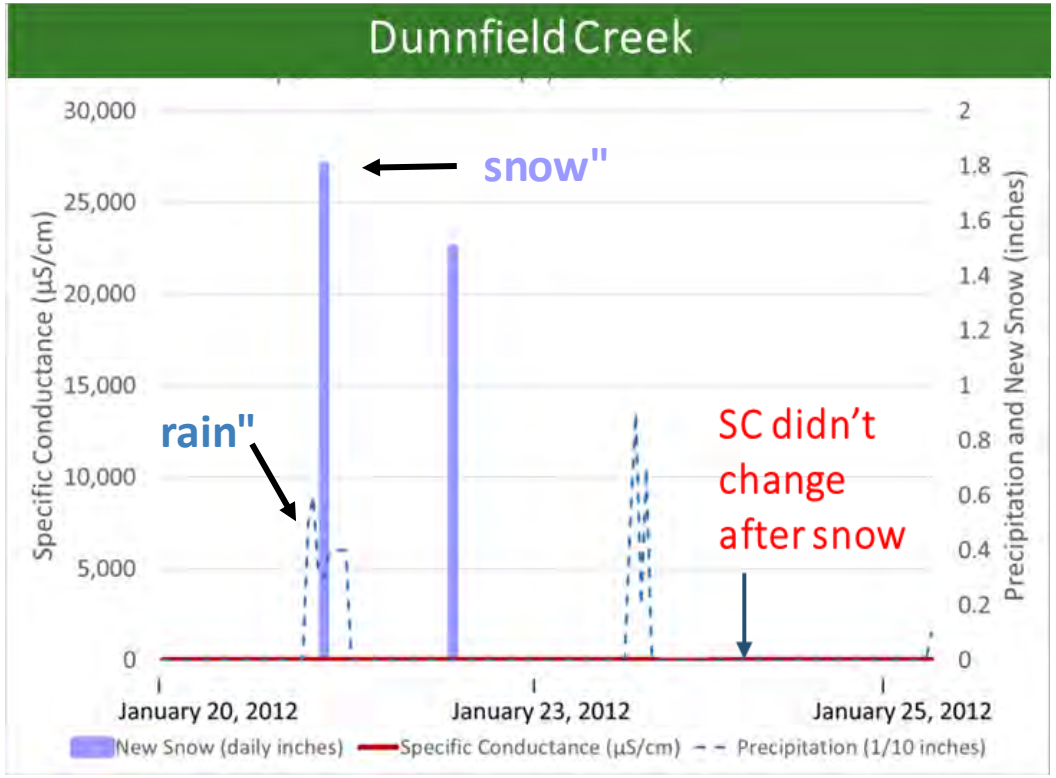
Image: NJDEP

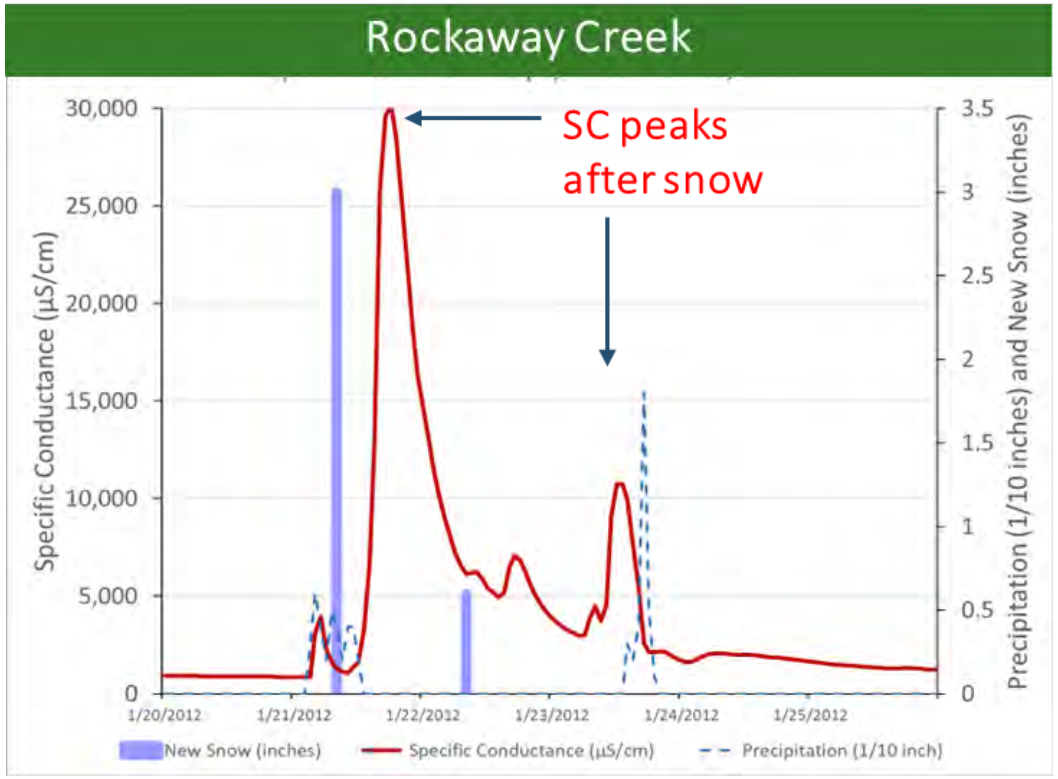
Data Sources: https://www.waterqualitydata.us/; https://climate.rutgers.edu/stateclim_v1/winter/20022003/winter20022003.html; https://dex.cocorahs.org/stations/NJ-MC-17;

Using Continuous Specific Conductance Data to Compare Undeveloped and Developed Watershed

Specific conductance (SC) at two sites In the same 5-day period, same Y axis scale

- Reference site (below left) shows almost no change
- Developed site (below right) shows high values after snow (and road salt application) and melting



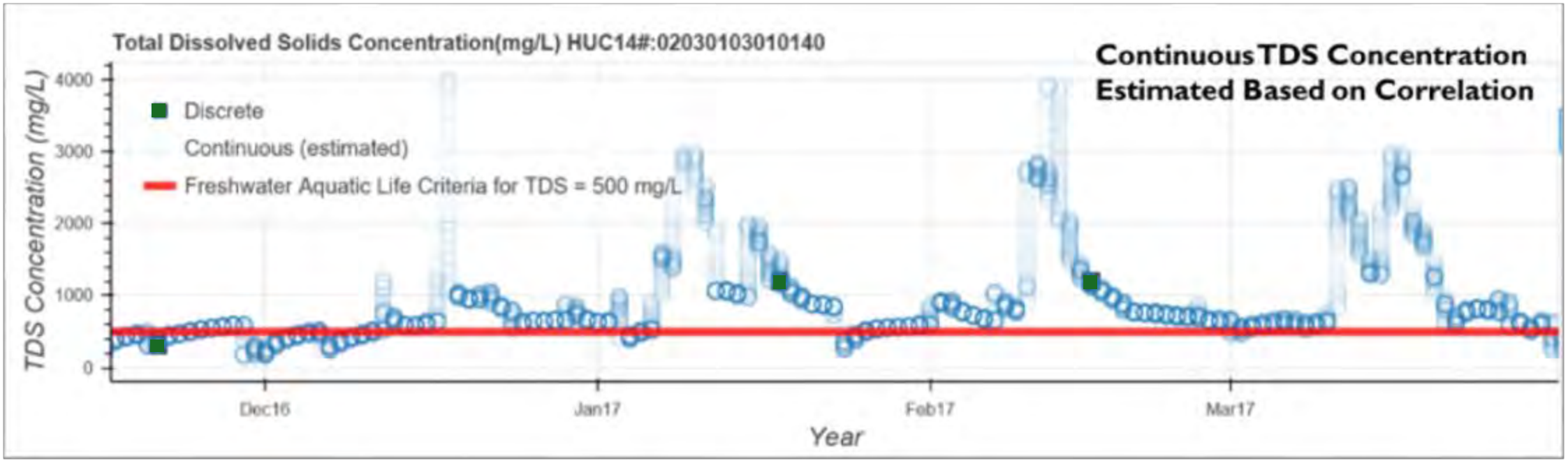


Data Sources: NJDEP DWM&S Continuous Data http://njdep.rutgers.edu/continuous/ and weather data

Images: NJDEP

Using Continuous Specific Conductance Data to Estimate Impairments

- Specific conductance (SC)
  - Can be used as a surrogate to estimate total dissolved solids and chloride
  - Easy and inexpensive to measure in the field
  - Continuous data gives a more complete picture than grab samples
  - *Example Below:* Estimating TDS based on SC shows that TDS exceeds the SWQS much more frequently, lasting longer, and the peaks are higher than evident from grab samples.



Summary

Water Quality

- ↑ TDS and Cl in our surface waters
- ↑ # of impaired waterbodies from TDS and Cl
- Using SC to estimate shows:
  - More frequent
  - Higher peaks
  - Longer duration

Therefore, action is needed to restore water quality.

Pollutant Source

- ↑ Use of de-icing salt
- Exceedances are happening mostly in winter
- High concentrations after winter storms

Therefore, we can conclude that road salt use is the main pollutant source.

NJ Salt Watch

NJ Watershed Watch Network

NEW JERSEY
WATERSHED WATCH
NETWORK

The Watershed Institute

DEPARTMENT OF ENVIRONMENTAL PROTECTION
NEW JERSEY

Aiming to maximize high quality non-agency freshwater data to contribute to comprehensive regulatory assessments

NJ Salt Watch Launched in December 2020

Using Hach chloride test strips based on protocol from **Izaak Walton League's Salt Watch** program

SALT WATCH™
IZAAK WALTON LEAGUE OF AMERICA

What did we need to provide?

- **Simple** procedures that were inclusive for most ages and levels of experience
- **Accessibility** from any location during the pandemic
- **Cost-effective** strategy that maximizes participation

What did we want to receive?

- **Greater geographic and temporal coverage of chloride data** during critical weather periods
- **Increased awareness and sense of ownership** over road salt issues

HOW IT WORKS: Getting Started as a Participant

- **Register online** to order an NJ Salt Watch kit to be delivered by mail **njwatershedwatch.org/roadsalt**
- Order any reasonable number of **test strips** you can commit to using up
- Select any **freshwater** nontidal stream, river, lake, or pond in New Jersey to return to **3-5 times between Nov-Apr**
- Pay attention to the weather to collect data **before and after a winter storm/runoff event**

Photo Source: NJ Water Supply Authority

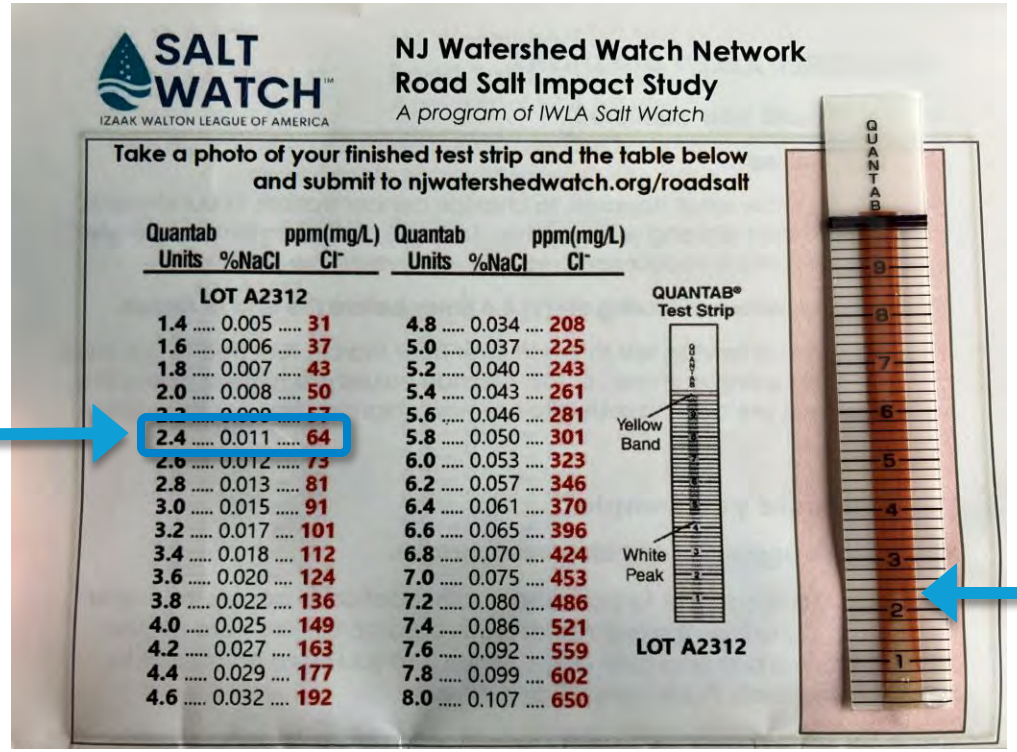
HOW IT WORKS: Sampling and Testing

Rinse sampling container and **collect** a water sample

Video Credit: Izaak Walton League of America

Dip the chloride **test strip** into the water until the top strip turns black

HOW IT WORKS: Reading and Entering Data

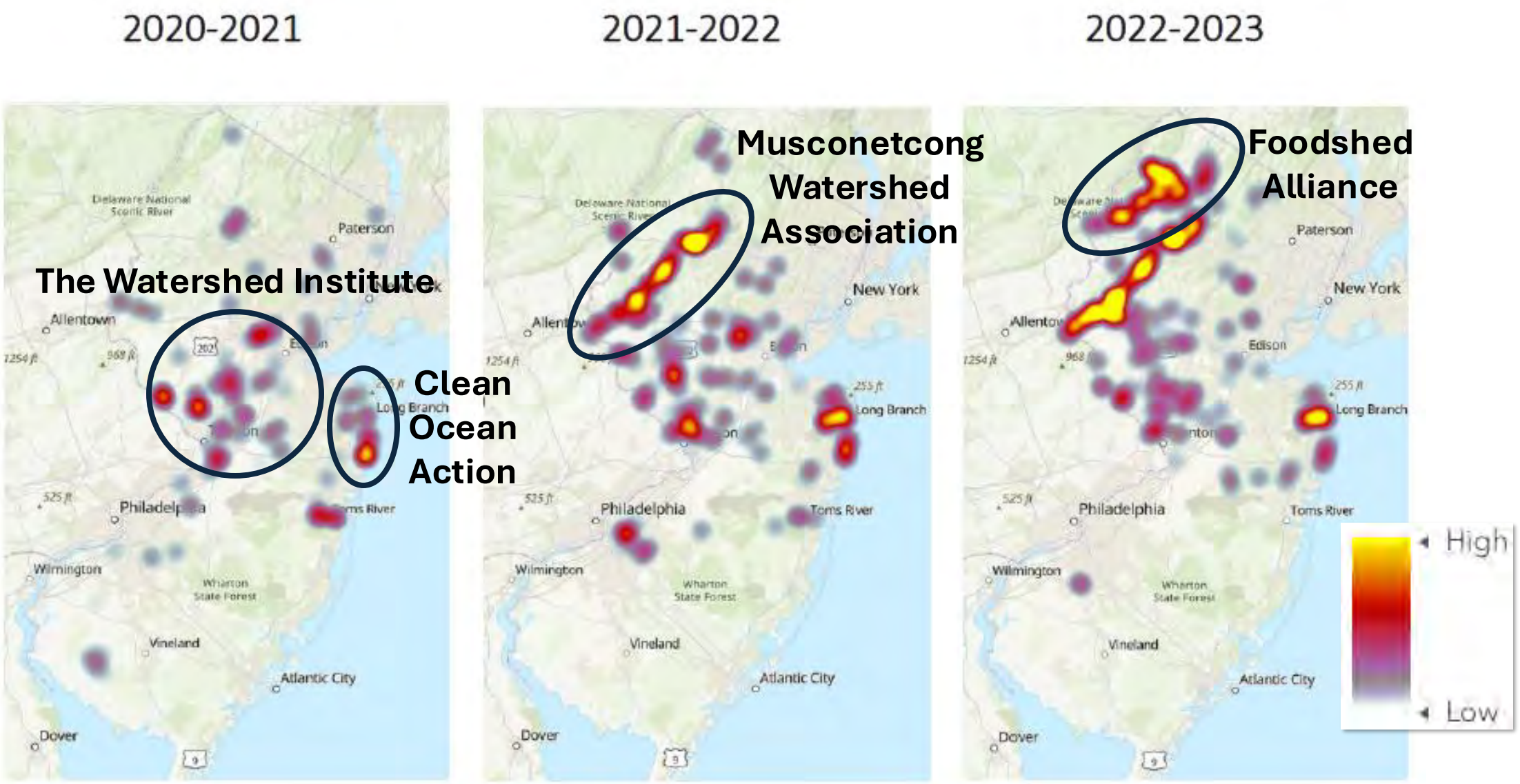


Reference Quantab unit on the **calibration table** to read the chloride measurement

Record chloride data, location, and weather observations in digital **Survey123 form**

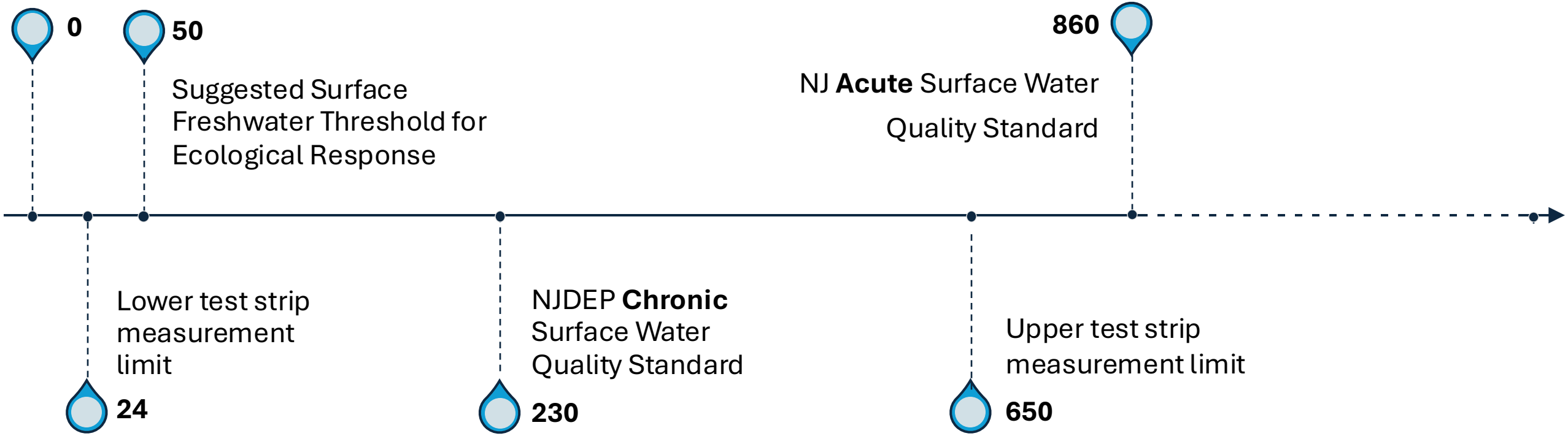
The Watershed Institute

NJ Salt Watch Activity Over Space-Time



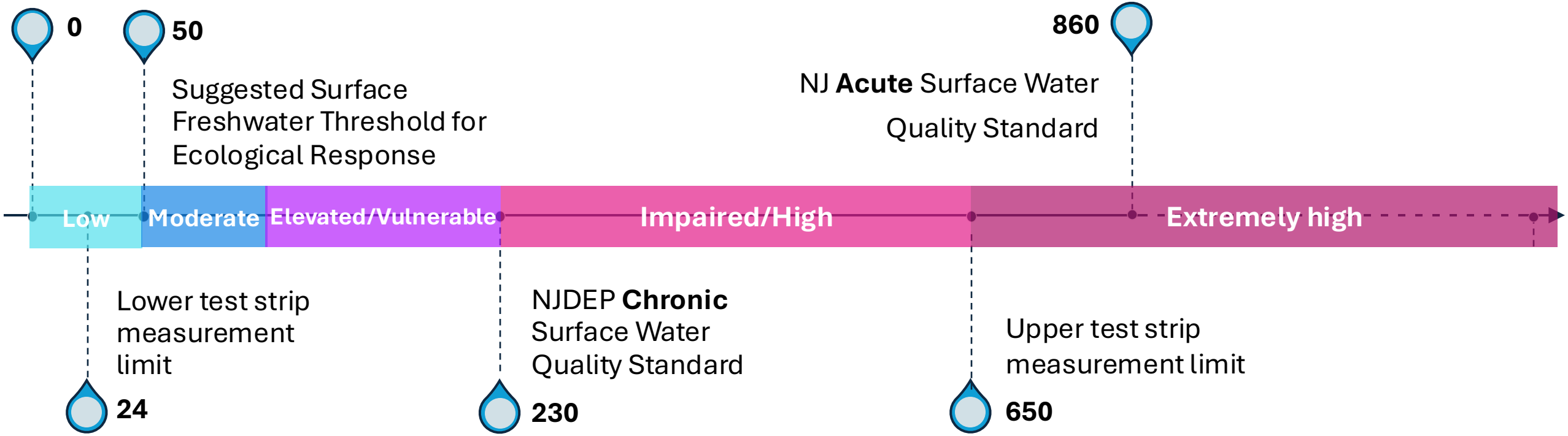
Assessing Freshwater Chloride Levels

NEW JERSEY SURFACE WATER QUALITY STANDARDS

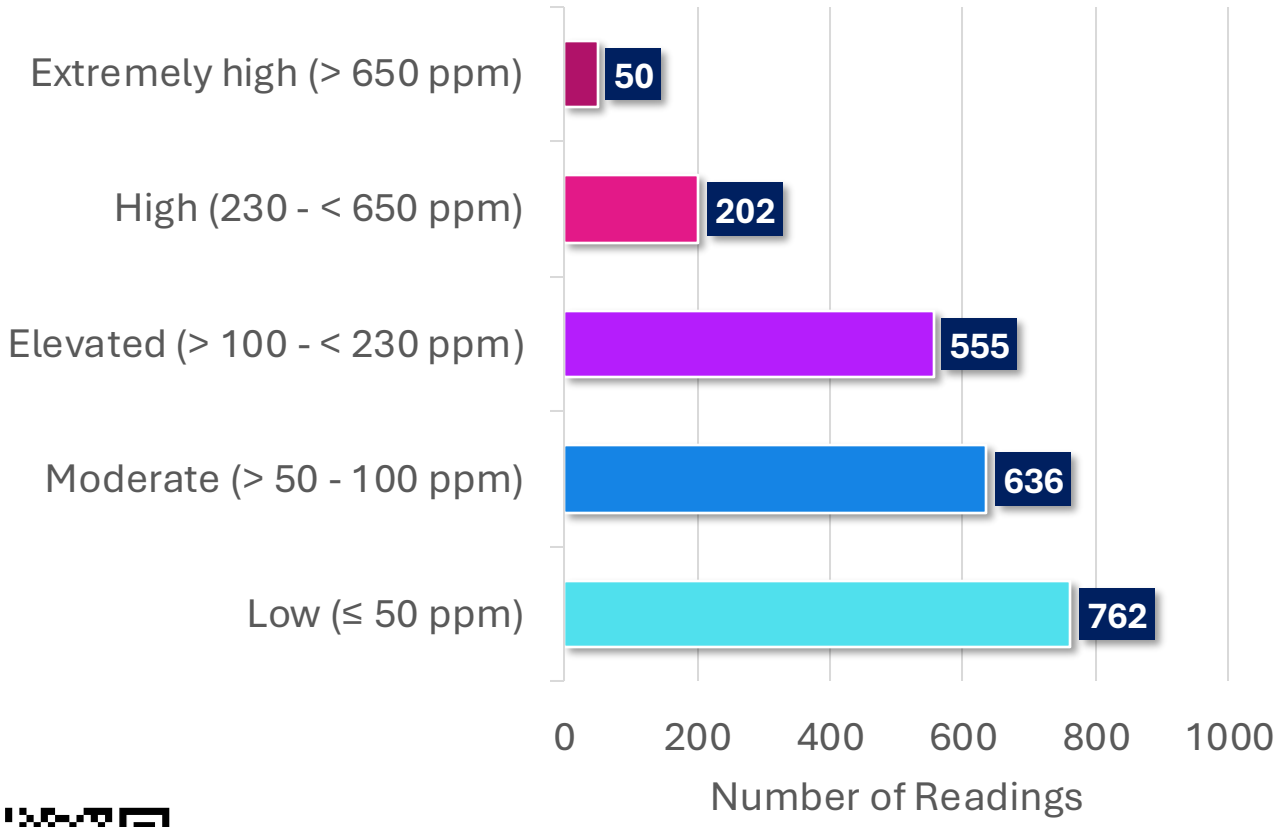


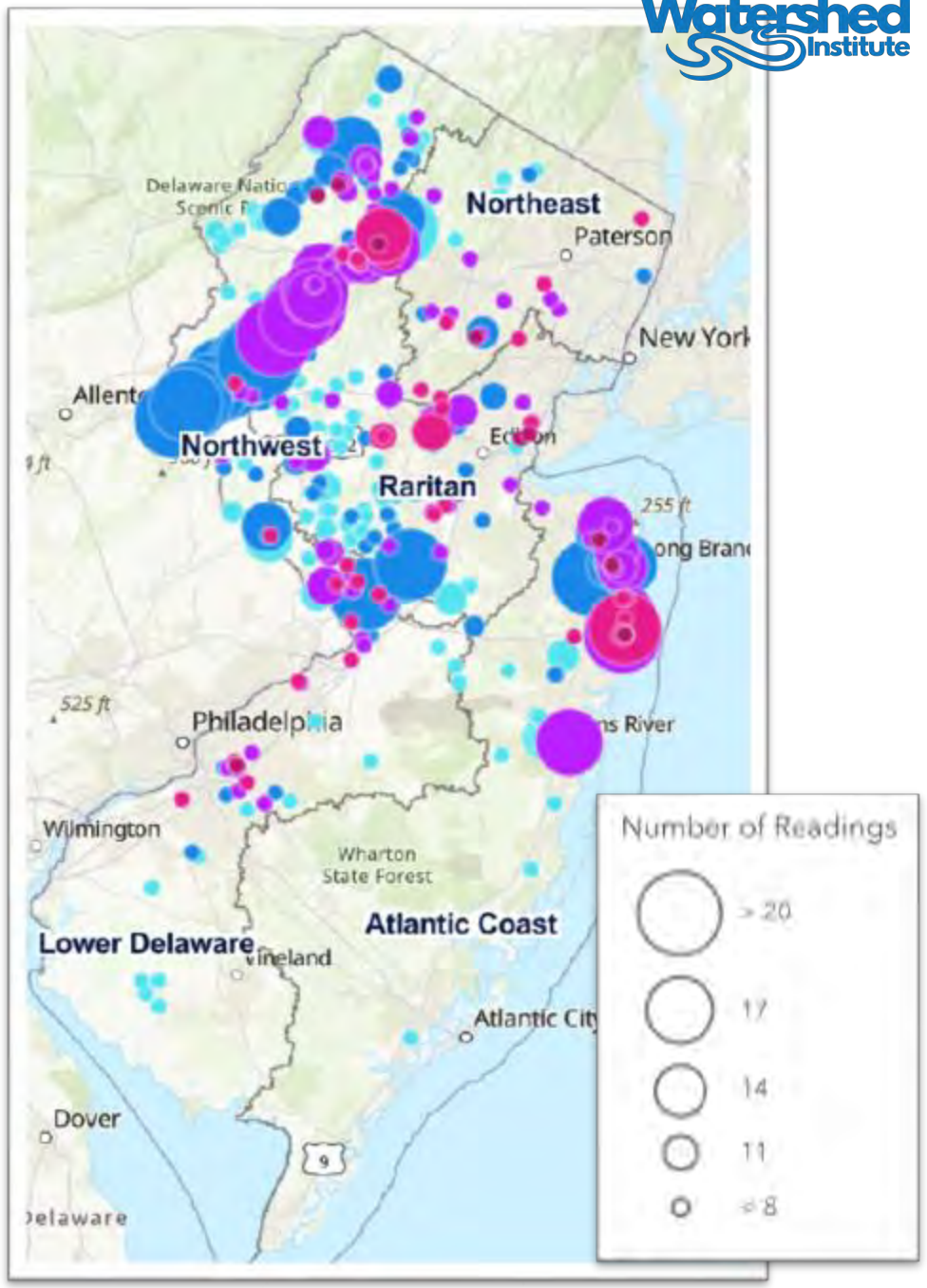
Assessing Freshwater Chloride Levels

NJ SALT WATCH 5-POINT ASSESSMENT



NJ Salt Watch 2020-2023





Scan here to view the NJ Salt Watch story map

Weather Conditions

Relative Impact to Chloride Concentration

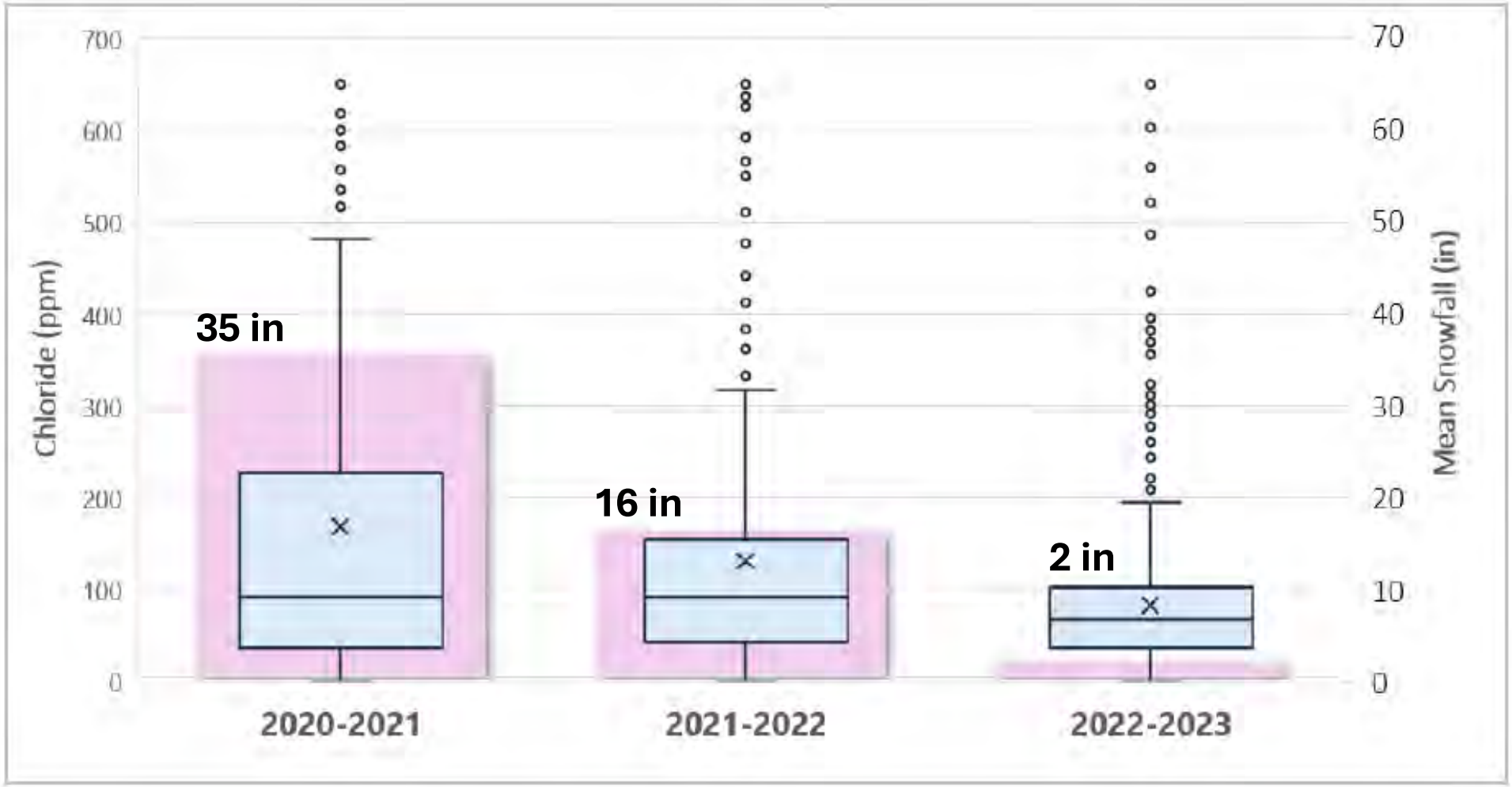
High

Low

		Mean Chloride (ppm)
Snow (n=216)	• Recent road salt application is likely • Initial runoff and scatter of rock salt	**153**
Snowmelt (n=263)	• Aqueous salt drains from roads and sidewalks	**135**
Rain (n=981)	• Rinses away remaining salts • Mobilizes salts in soils • Dilutes chloride concentration	**116**
Dry (n=586)	• Baseline conditions	**100**

NJ Salt Watch

Snowfall and Chloride by Year



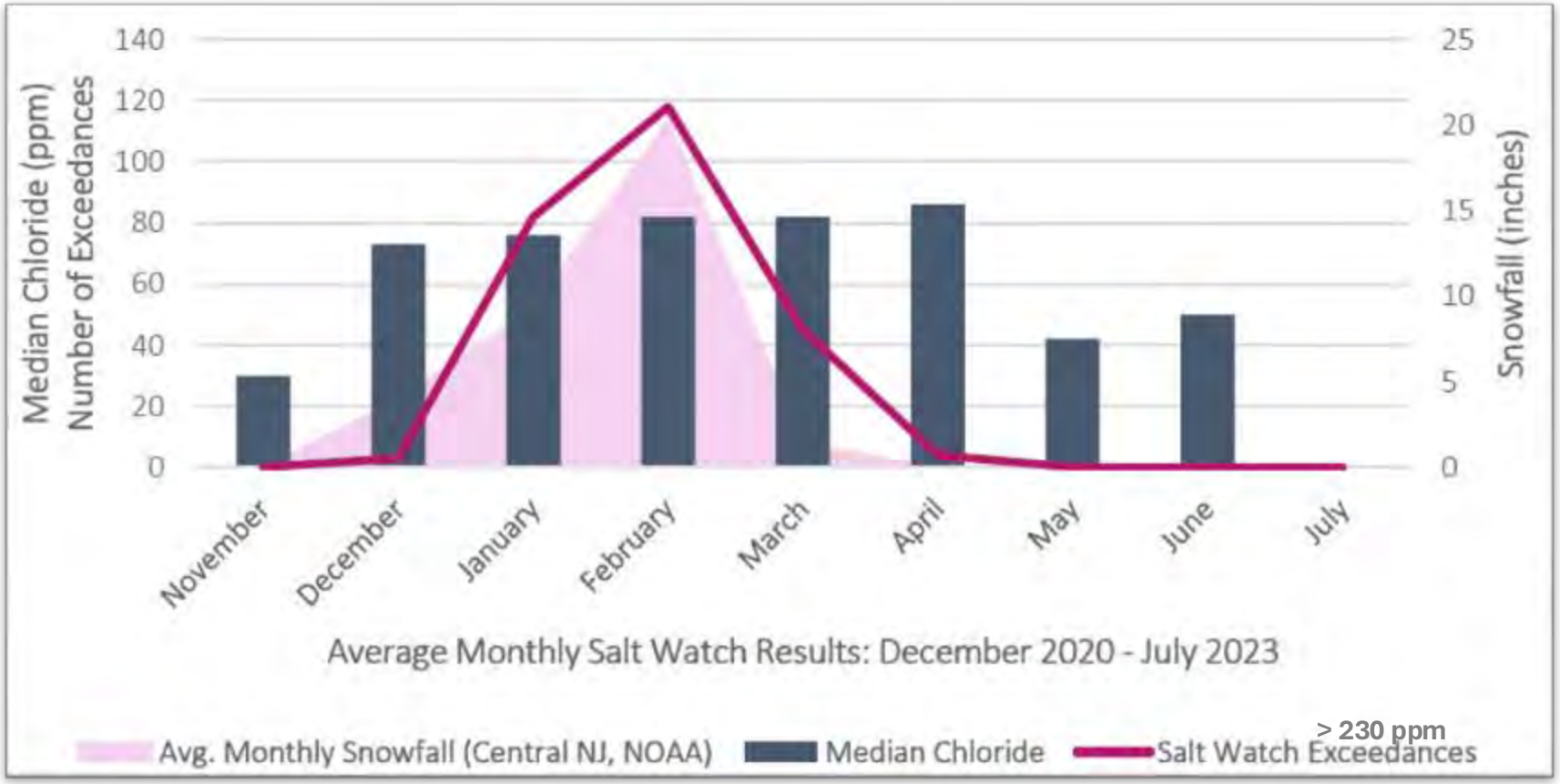
Chloride distribution varies with annual snowfall totals

Monthly Variations in Snowfall and Chloride

- Elevated median chloride from Dec to Apr
- Chloride exceedances follow snowfall amounts

The Watershed Institute

NJ Salt Watch Median Chloride, Chloride Exceedances, and Mean Snowfall by *Month*

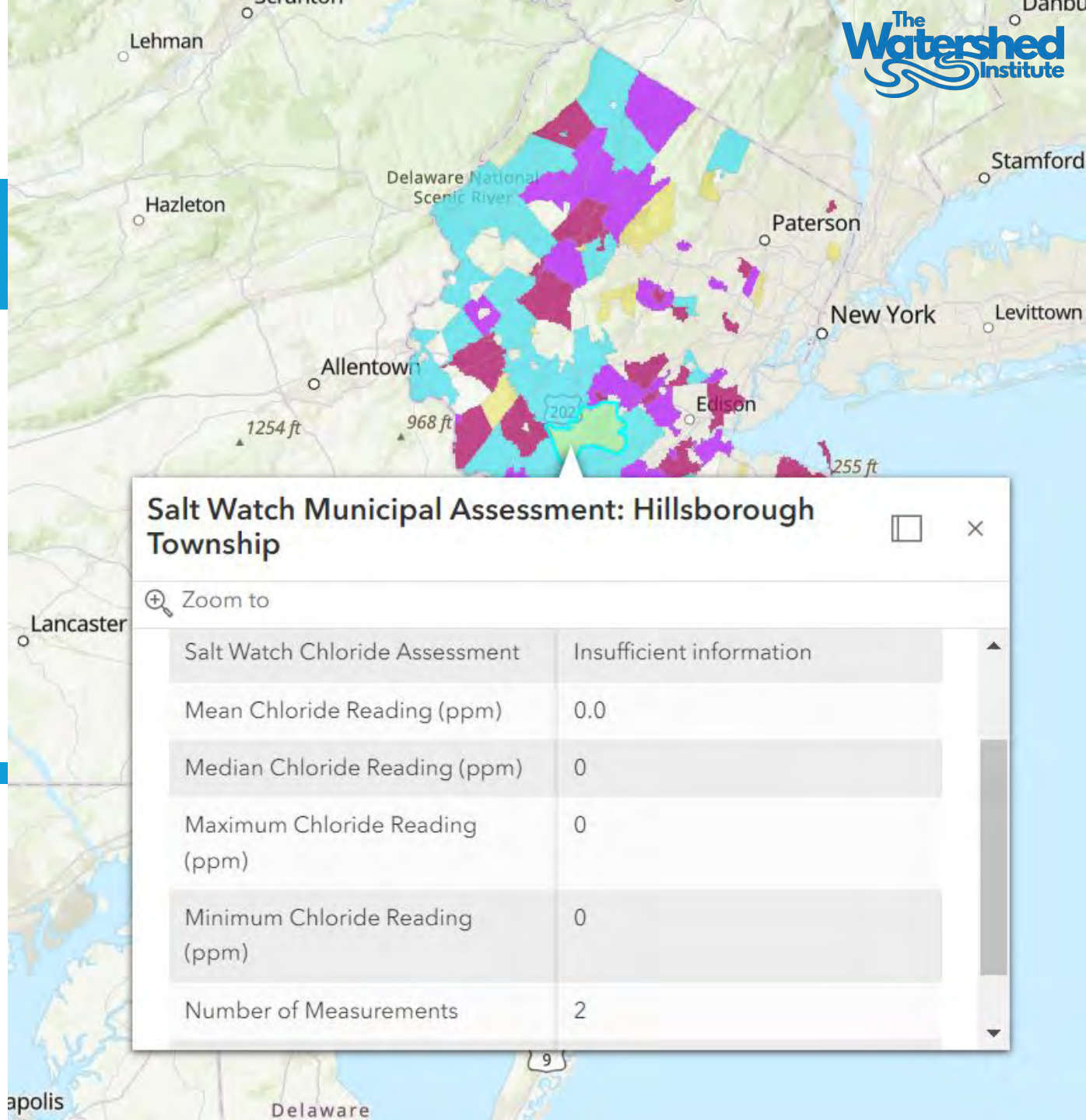


NJ Salt Watch

Municipal Assessment

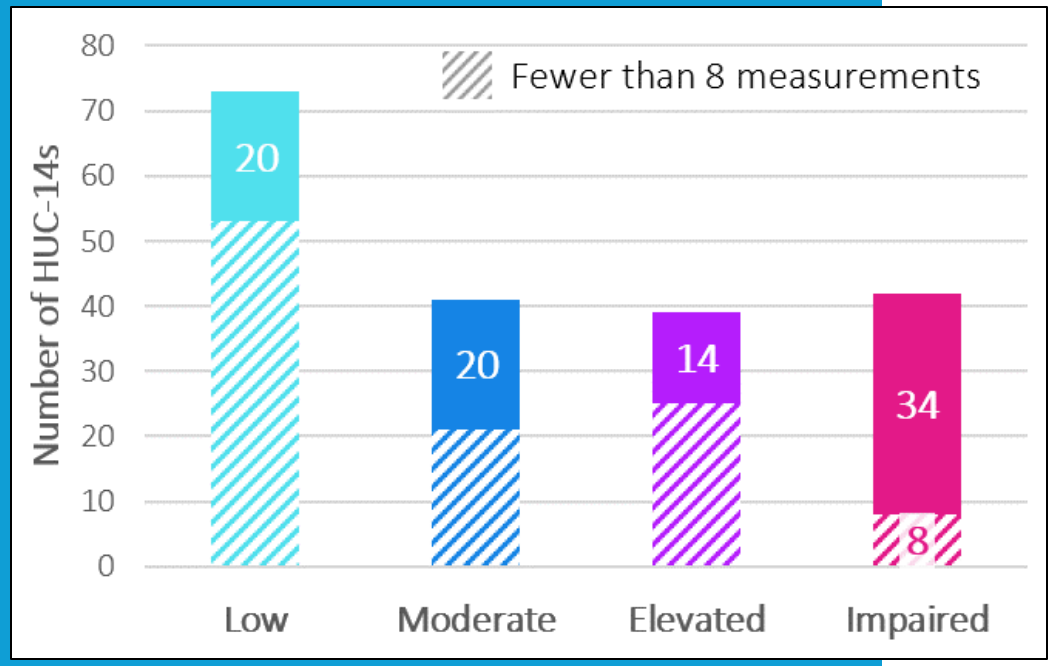
- **High:** > 2 exceedances
- **Vulnerable:** 1 exceedance, if not an outlier
- **Low:** No exceedances
- **Insufficient info:** <3 measurements

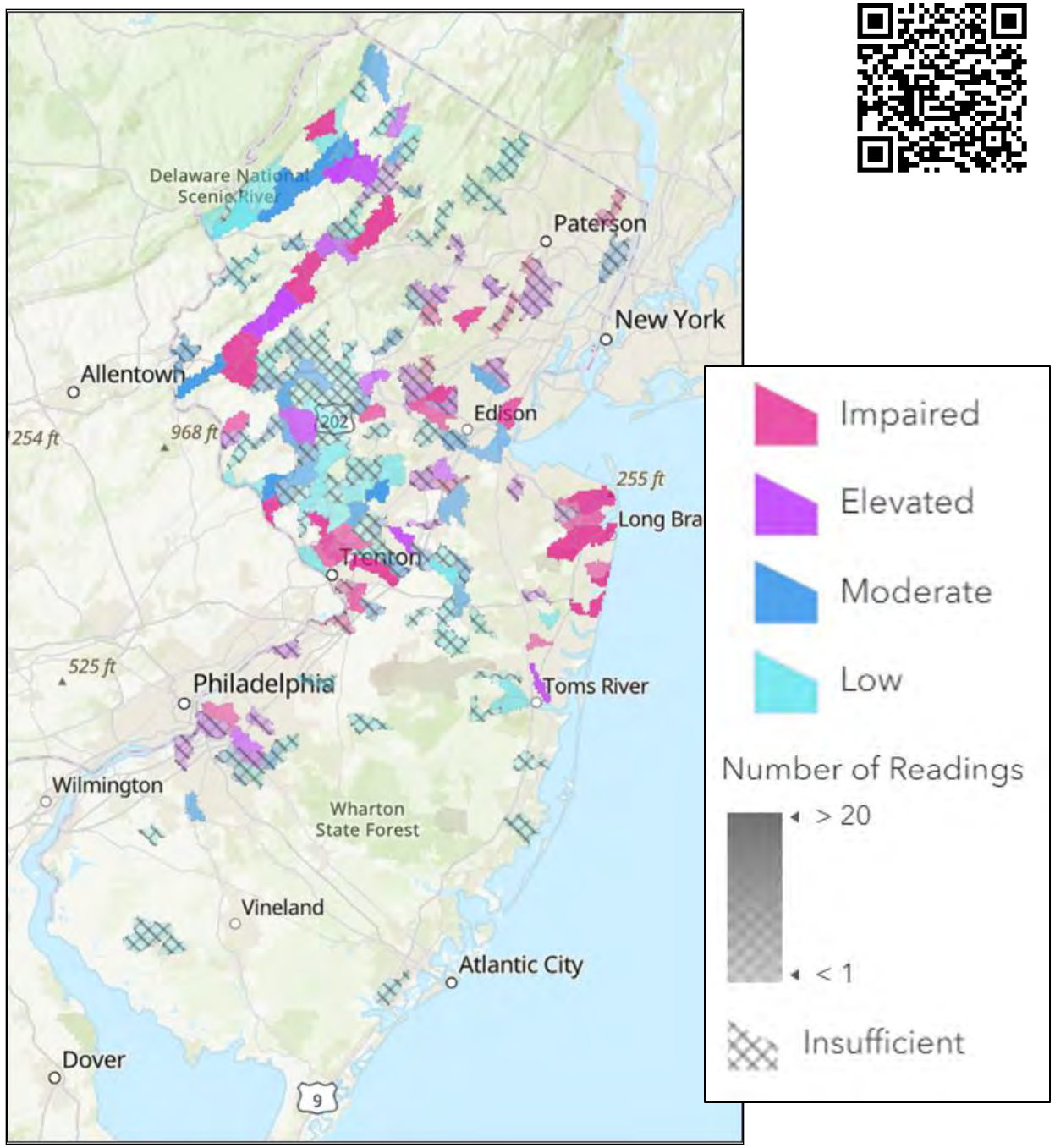
Scan here to view the NJ Salt Watch story map



NJ Salt Watch

HUC-14 Subwatershed Assessment





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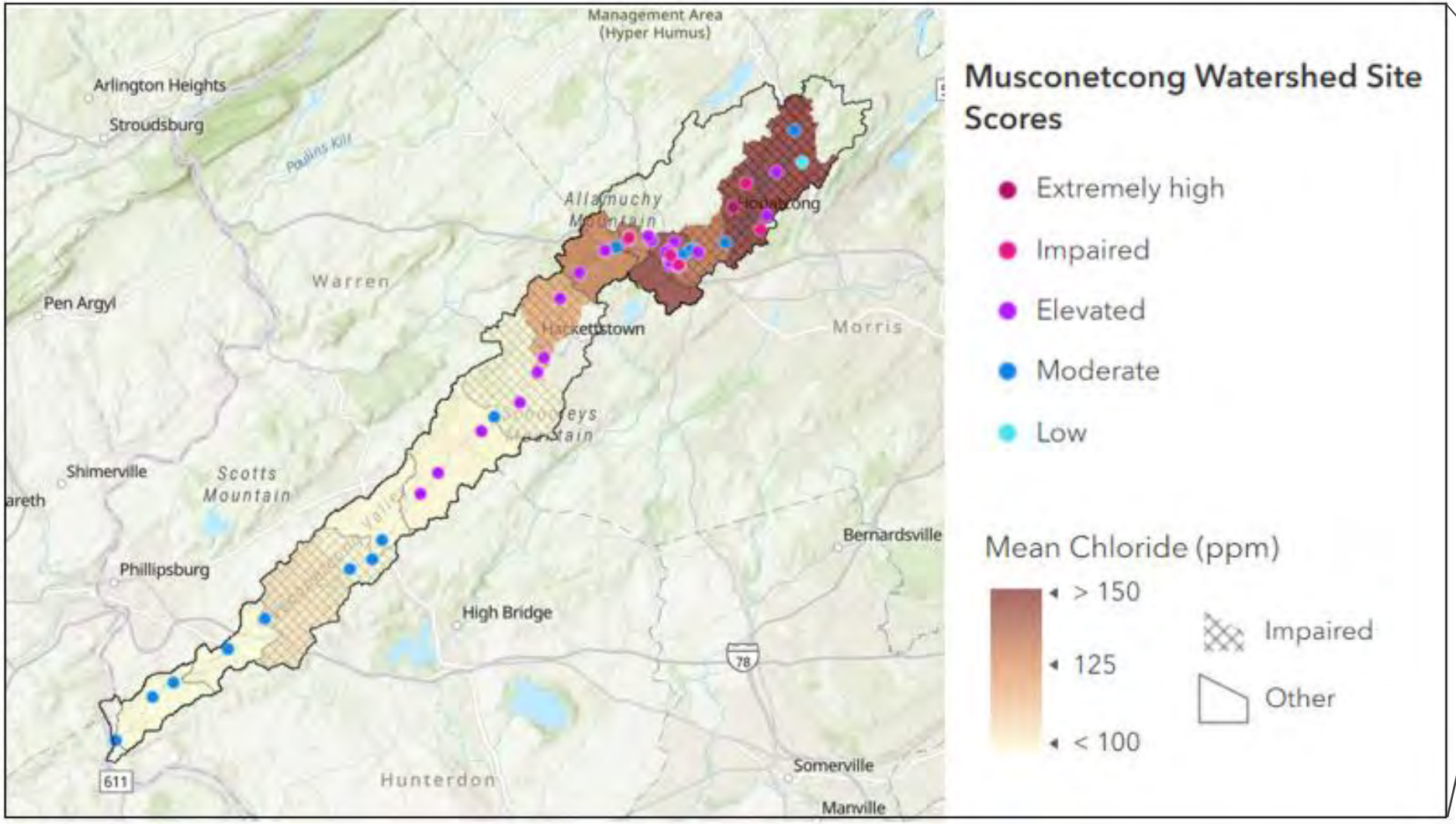
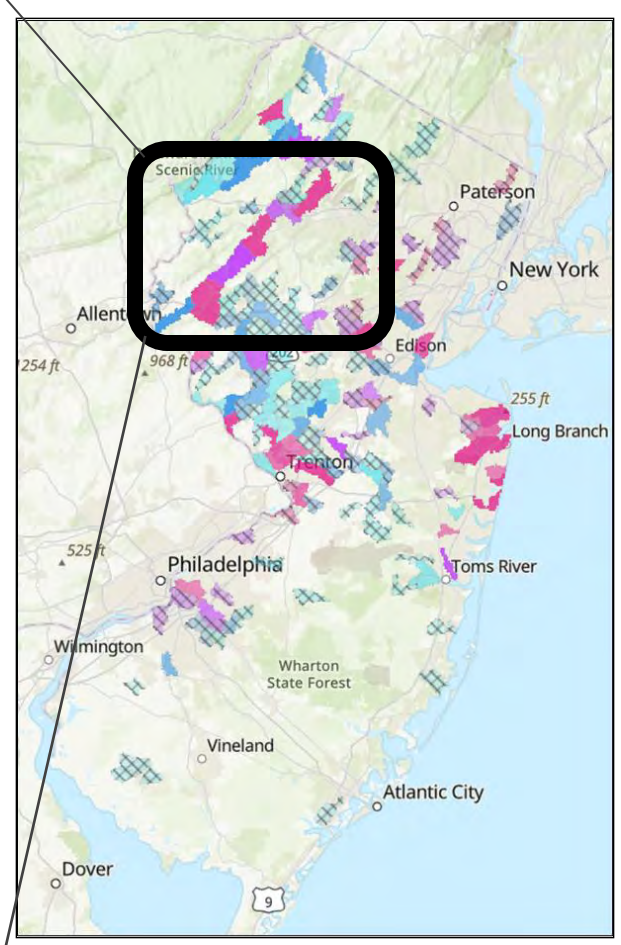
NJ Salt Watch Chloride Trends in Musconetcong River

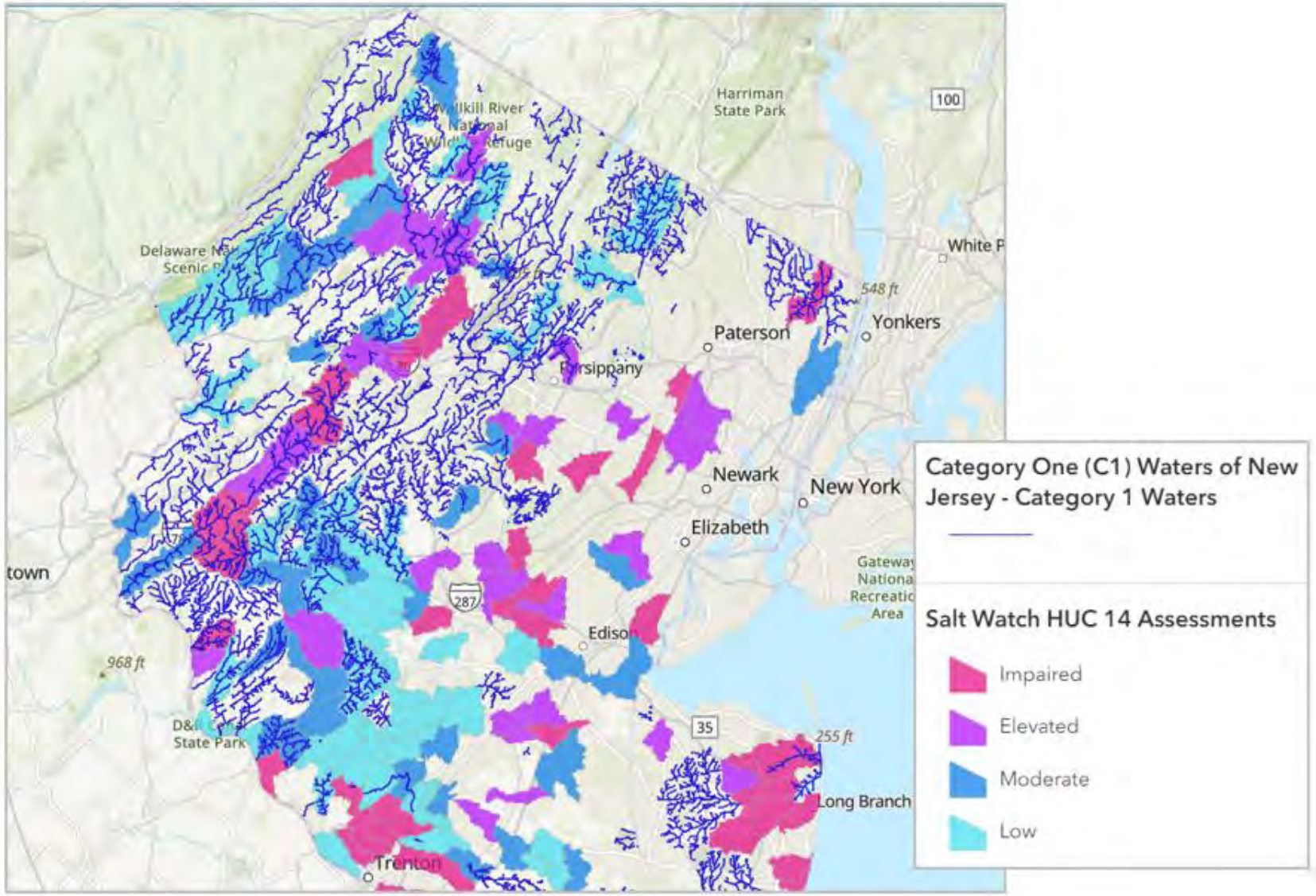




NJ Salt Watch

Category 1 Antidegradation Policy

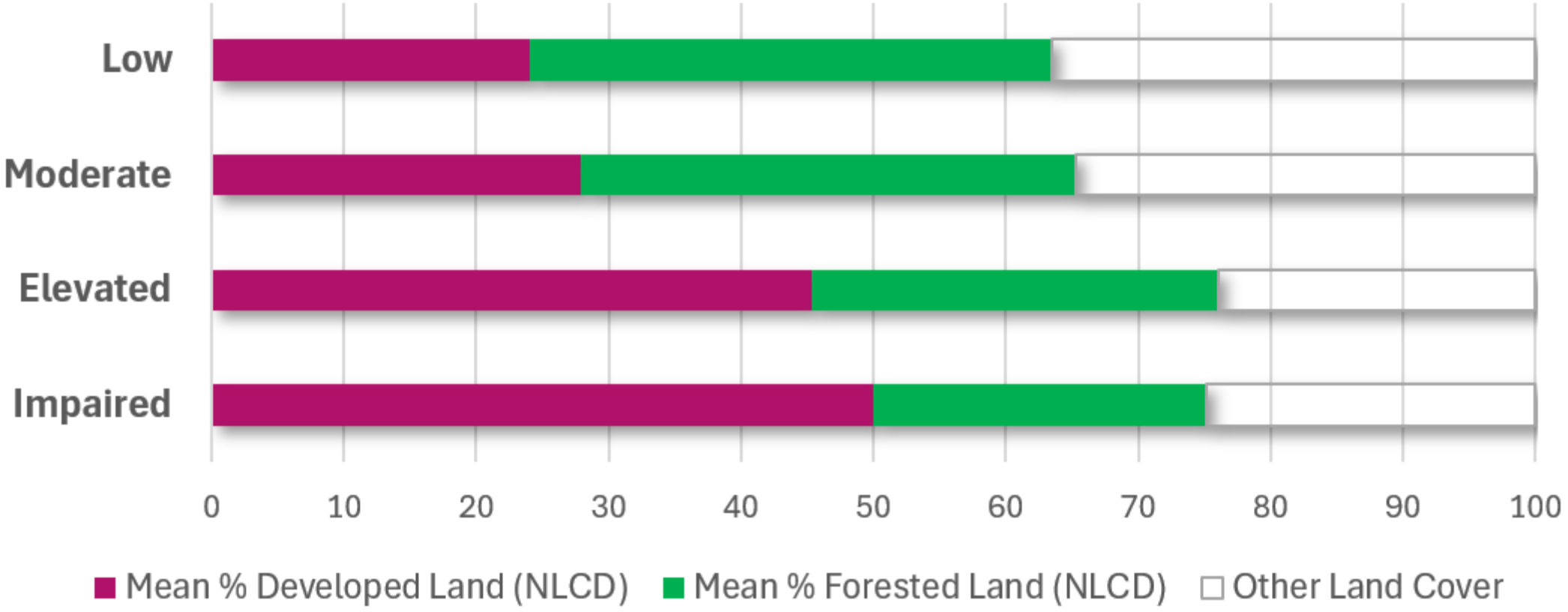
Pristine and exceptional waters receive **"...protection from measurable changes in water quality..."**



Impaired chloride conditions found by NJ Salt Watchers in 193 stream miles in 10 HUC-14s

The Watershed Institute

NJ Salt Watch
Developed or Forested Land Cover Proportions in "Average" HUC-14 Subwatersheds of each Chloride Condition Category



Solutions

A. Regulatory Actions for Reducing Road Salt Impacts

1. Stormwater Management Rules (N.J.A.C. 7:8)

- Permanent structure for storage of deicers
- Pollution prevention/good housekeeping at maintenance yards
- Salt equipment must be dry cleaned (shoveling, sweeping) prior to washing
- Street sweeping
- Remove piles of excess salt
- Private Salt Storage Ordinance
- Containment of any brines
- Annual employee training & reporting on activities listed above

Spilled salt piles like this need to be swept up within 72 hours for reuse or proper disposal.

Tier A municipalities must adopt an ordinance managing private salt storage piles like this.

2. NJDEP Snow Removal and Disposal Policy

- No dumping snow in waterbodies
- Manage snow melt discharge

B.1. Voluntary Actions for Reducing Road Salt Impacts

Best Management Practices for Winter Maintenance Professionals

Examples:

1. **Materials, Sustainability, and the Environment**
   - Use deicing material at the effective temperature range for that material; Avoid using abrasives (sand) except in ice storms
2. **Weather and Information**
   - Use real-time, local weather forecast
   - Use pavement temperature sensors
   - Keep track of materials used, safety, customer satisfaction
3. **Equipment**
   - Obtain automated spreader controls
   - GPS for route & application tracking to improve performance
   - Obtain brine mixing, storage and application equipment
4. **Operations and Tactics**
   - Calibration, anti-icing with brine, slow trucks speed when applying salt
5. **Strategies, Public Relations, and Training**
   - Snow decision plan, workforce development, public outreach, adequate funding

File:Nevada Department of Transportation (NDOT) Road Weather Information System (RWIS) at Lamoille Summit on Nevada State Route 227 (Lamoille Highway) number 1.JPG

B.2. Voluntary Actions for Reducing Road Salt Impacts

Identify and Communicate Success Stories

Deicing Best Practices lead to Cost Savings of 30 to 50% or more.
Example: Calibration of salt spreaders

- **The city of Cudahy, WI**
- **BRAND NEW truck was set to dispense 200 lb/lane mile of salt**
- **Was dispensing 907 lb/lane mile (on left)**
- **After calibration, 205 lb/lane mile (on right)**

A 77% savings!

More info at Salt Wise:
https://www.wisaltwise.com/

Photo source:

Tim Birkel
Engineering Supervisor, City of Cudahy
414.769.2272 | cudahy-wi.gov | birkelt@cudahy-wi.gov
414.405.5538 | 5050 S Lake Dr, Cudahy, WI 53110

B.3. Voluntary Actions for Reducing Road Salt Impacts

Education and Outreach for Everyone

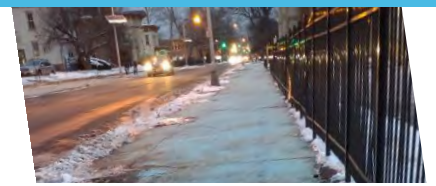
- More salt is not better
- Understand negative impacts of salt use
  - Example: Participate in NJ Salt Watch
- Manage expectations/level of service
- Change behavior

12 ounce Cups Not Buckets!

Image: Microsoft 365

Image: Wi Salt Wise

After shoveling, scatter salt leaving space between grains: a 12 oz cup full of salt is enough to treat a 20-foot driveway or 10 sidewalk squares.



Don't do this

Image: NJDEP

Do this →

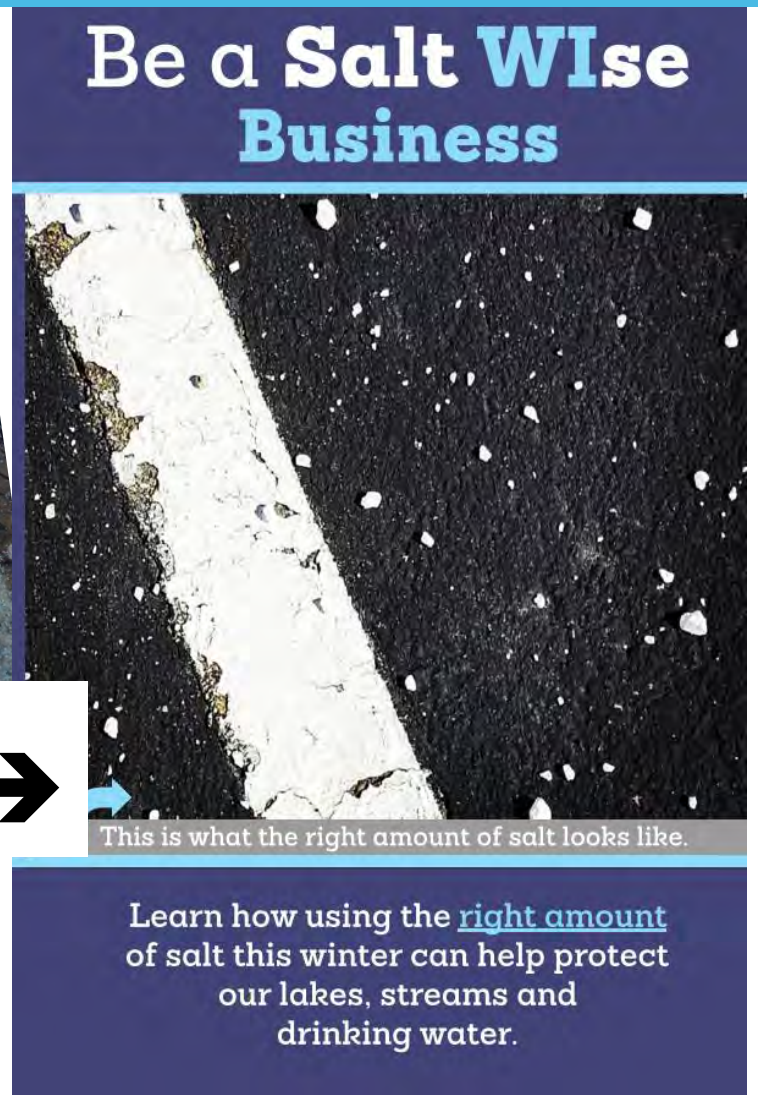


Image: https://www.wisaltwise.com/Partner-Resources

B.4. Voluntary Actions for Reducing Road Salt Impacts

Safe Winter Driving for Everyone

Image source: https://vtrans.vermont.gov/operations/winter

B.5. Voluntary Actions for Reducing Road Salt Impacts

Sustainable Jersey: Winter Best Practices to Reduce Road Salt Impacts

Activity	What to Do	Points
Participate in New Jersey Salt Watch Study	Monitor for one winter season. Present results and analysis on road salt reduction with community members. Refer to Resource 1 for background and education resources.	5
Workforce Training	Ensure municipal staff involved in road salt application receive best management practices training.	5
Create and submit road salt inventory	Monitor for one winter season. Present results and analysis on road salt reduction with community members	10
Implement a Winter Road Maintenance Best Management Practice (BMP)	Refer to Resource 2 for information about BMPs.	5
Maximum Awarded for this Action:		15

Webinar: https://www.sustainablejersey.com/resources/presentations/webinars/#c3607

Action: https://www.sustainablejersey.com/actions/#open/action/607

B.5. Voluntary Actions for Reducing Road Salt Impacts

Sustainable Jersey: *New Funding Cycle Coming!*

- $200,000 in grants are available to NJ municipalities participating in the Sustainable Jersey program.
- $2k, $10k, and $20k grants for sustainability projects and green team support

CYCLE SPONSOR	PROJECT TYPE	ELIGIBLE APPLICANTS	GRANT AMOUNTS	CYCLE LAUNCHED	FUNDING AVAILABLE
PSEG Foundation	General Sustainability	Munis	$2k, $10k & $20k	Mid-Nov	$200,000

Learn more and apply:

MUNICIPAL GRANTS

C. NJDEP Next Steps

- **2020 Restoration Grant awarded to Brick Twp Municipal Utilities Authority (BTMUA)**
  - Workshop (held 2023)
  - BMP report
  - BMP demonstration implementation

- **White paper** (background studies of TDS & Cl used to develop TMDL)

- **TMDL**
  - Propose in NJ Register
  - 30-day public comment period
  - Respond to comments
  - Adoption of the TMDL as an amendment to Water Quality Management Plans

- **Implementation**
- **Continue data collection and analysis**

Winter Salt Week

January 27-31, 2025

Daily Webinars at 1:30pm

- Wed, Jan 29: Hamilton Township DPW

NJ Salt Watch Statewide Snapshot

- Fri, Jan 31

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