

Collection and Analysis of Surface-Water Samples For Determination of Low-Level Mercury Concentrations in New Jersey

Christopher J. Kunz

New Jersey Department of Environmental Protection,
Water Monitoring and Standards, Bureau of Freshwater
and Biological Monitoring

And

Heather A. Heckathorn

United States Geological Survey
New Jersey Water Science Center



Overview

- Background
 - New Jersey Surface-Water Quality Criteria
 - Impetus For Study
- Sample Collection and Analysis
 - Analytical Method and Capabilities
 - Sample Collection Procedures
- 2005 Dissolved Mercury Study
- 2007 Total and Total Methyl Mercury Study
- Next Steps



Background

- Prior to 2005, ambient surface-water mercury concentrations were , for the most part, not quantifiable.
- Most mercury data was flagged as either non-detect or below reporting limits.
- Most mercury data could not be assessed, in terms of water quality criteria.



New Jersey Surface-Water Quality Criteria

- Acute Aquatic Life Criterion (Dissolved)
1.4 ug/L (1400 ng/L or ppt)
- Chronic Aquatic Life Criterion (Dissolved)
0.77 ug/L (770 ng/L or ppt)
- Human Health Criterion (Total Recoverable)
0.05 ug/L (50 ng/L or ppt)
- Proposed Wildlife Criterion (Total Recoverable)
0.00053 ug/L (0.53 ng/L or ppt)



Impetus For Study

- In 2005, the Bureau of Freshwater and Biological Monitoring was tasked with developing a monitoring strategy to investigate mercury levels in the State.
- USGS Wisconsin Mercury Laboratory (WIML) developed an analytical method capable of quantifying mercury concentrations at very low levels.



Sample Collection and Analysis



Analytical Method and Capabilities

- USGS WIML employs EPA Method 1631e Measurement of Mercury in Water
 - Method used to determine low-level mercury in filtered and unfiltered water.
 - Oxidation, purge and trap, and use of Cold Vapor Atomic Fluorescence Spectrometer (CVAFS).
- Method 1630 used for methyl mercury.



Analytical Method and Capabilities

- Improved accuracy and precision at low levels.
- USGS WIML Minimum Reporting Limit of 0.04 ng/L for mercury and methyl mercury (ppt).
- USGS WIML capable of analyzing for total mercury and methyl mercury in unfiltered and filtered water samples and in particulate samples.

Sampling Procedures

- Samples were collected and processed using Parts-Per-Billion Protocol (USGS Clean-Hands/Dirty Hands Techniques).
- Pre-cleaned supplies were provided by USGS WIML:
 - Teflon sample bottles/containers
 - Meissner capsule filters
 - Blank water
 - Preservative: Ultra-pure 6N HCl
- Disposable Tyvek suits were worn by field staff.



Sampling Procedures

- Samples were collected at stream centroid of flow.



Sampling Procedures (continued)

- Filtration was conducted in a sample-processing chamber.



Sampling Procedures (continued)

- All sample preservation was done at end of sampling day in controlled environment.
- Aqueous samples were transported and stored in a dark, cool environment until sample shipment.



2005 Dissolved Mercury Study

- NJDEP and USGS developed a limited synoptic study of some of the surface waters in the State.
- Sample a wide variety of stations across the state.
- Include reference stations, mixed land-use watersheds, urban watersheds and Pinelands watersheds.

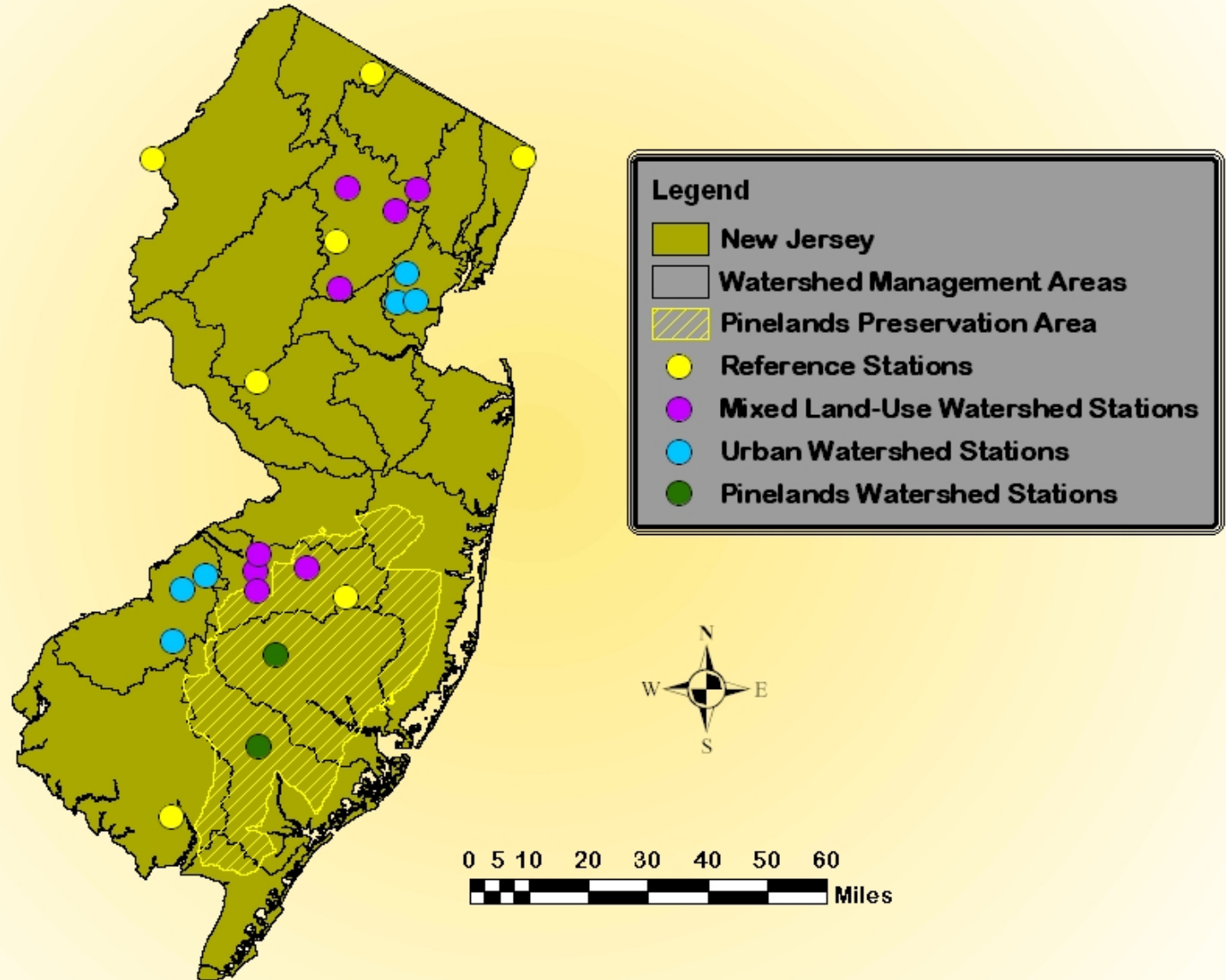


2005 Mercury Study Objectives (continued)

- Sample subset of reference stations twice.
- Sample subset of urban watershed stations twice; once during base-flow conditions and once during elevated flow conditions.



SAMPLING STATIONS FOR 2005 LOW-LEVEL MERCURY STUDY

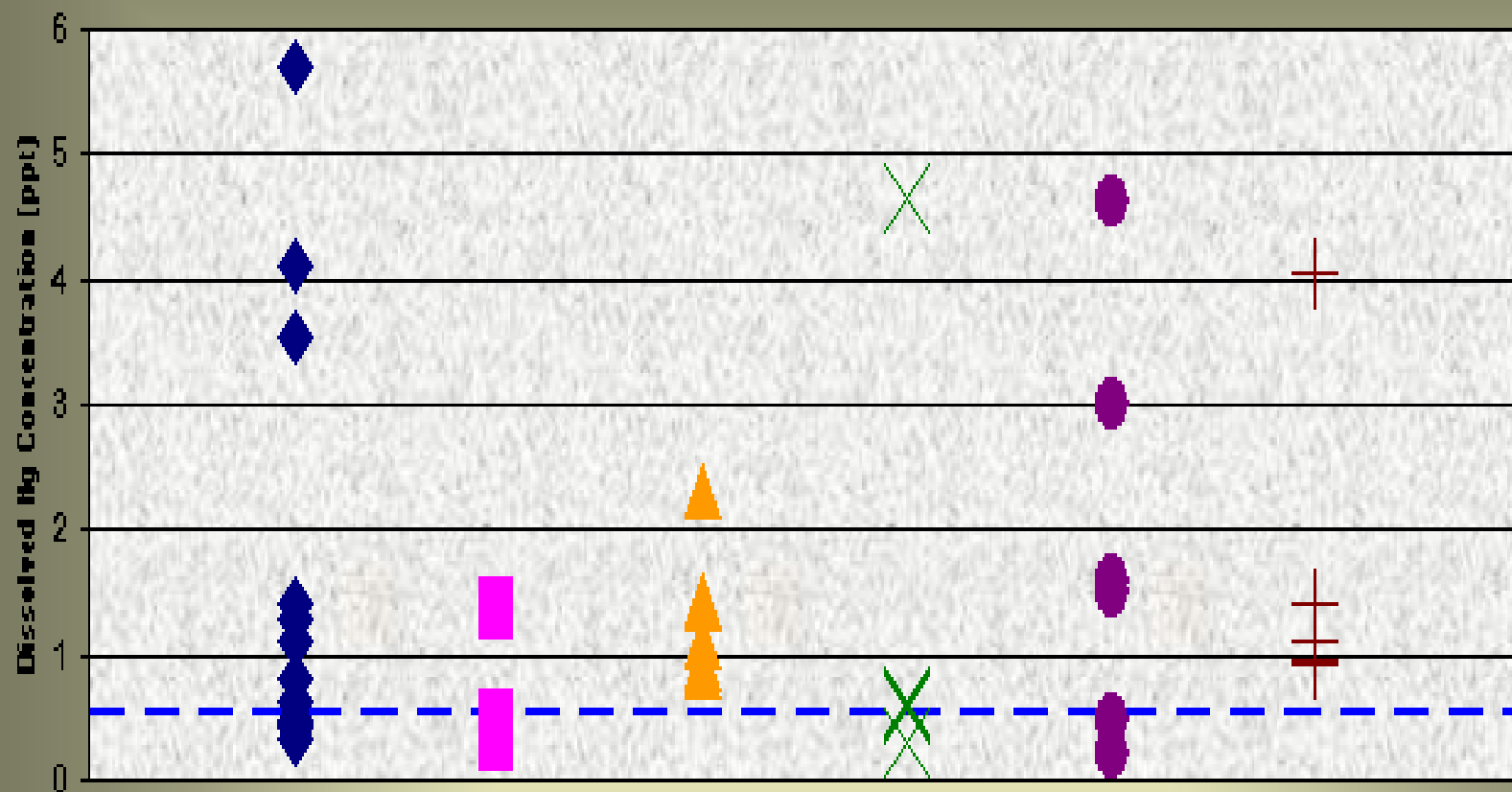


2005 Mercury Study Results

- All dissolved mercury concentrations were well below existing water quality criteria (Range = 0.21 - 5.71 ppt, median = 1.04 ppt).
- Station type (land-use) was not a good predictor of mercury concentrations.
- Dissolved mercury Concentrations appeared to increase with flow.



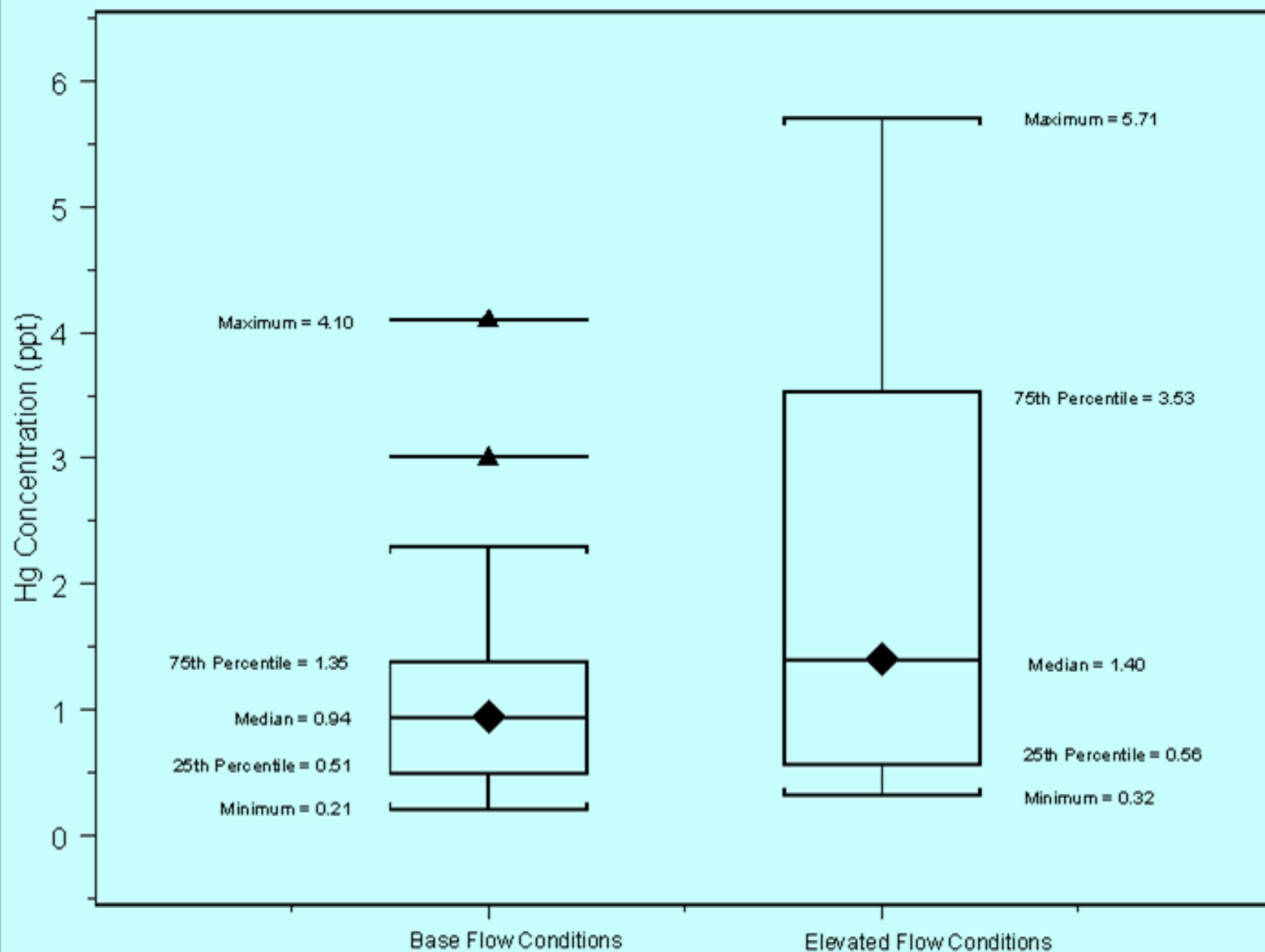
Dissolved Low-Level Hg Results by Station Type



Station Type

- ◆ Reference
- ▲ Mixed Land-Use Watershed (Rancocas Ck)
- Urban Southern Watershed (Cooper River)
- Proposed Wildlife Criteria
- Mixed Land-Use Watershed (Passaic River)
- × Urban Northern Watershed (Rahway River)
- + Pinelands Watershed

DissolvedHg Concentrations (ppt) at Stream Flows Above and Below Long-term Daily Median Flow



Conclusions

- Land-use did not appear to influence dissolved Hg concentration.
- Air deposition is probably major factor influencing mercury concentrations in surface-waters in New Jersey.
- Surface-water mercury concentrations are influenced by stream flows.

Further Work

- In 2007, NJDEP and USGS again collaborated and began another limited study.
- This time total recoverable and total methyl mercury were parameters of concern.

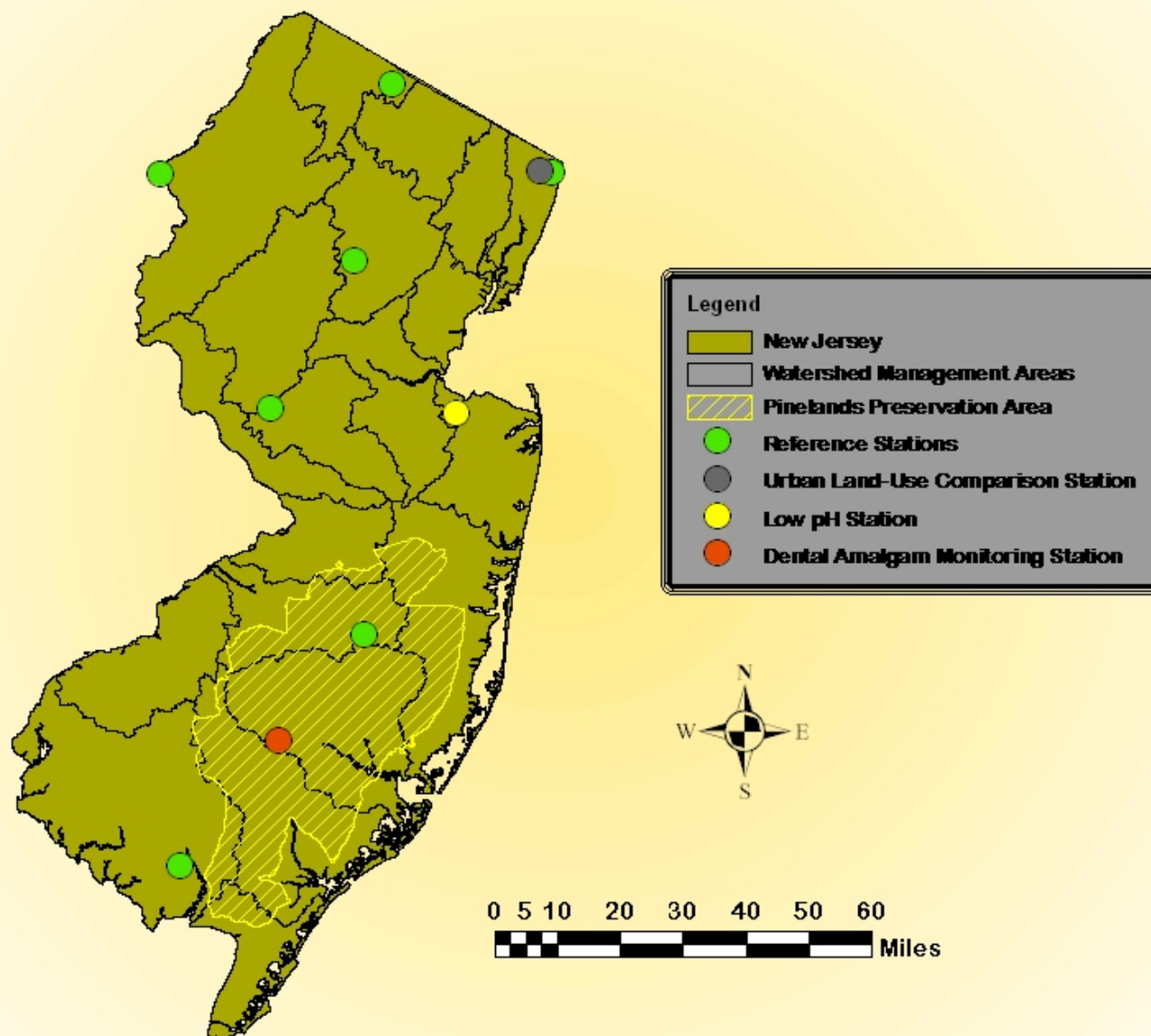


Objectives of 2007 Mercury Study

- Sample all 7 reference stations in the state quarterly, to investigate possible seasonality of mercury concentrations
- Conduct side-by-side comparisons of one-person and two-person sample collection methods.
- Sample one additional station quarterly to track changes due to new dental amalgam regulations.



SAMPLING STATIONS FOR 2007 LOW-LEVEL MERCURY STUDY



2007 Mercury Study Preliminary Results

- Data for 4th sample round still pending.
- Side-by-side comparisons show good agreement for total Hg (methyl Hg data incomplete).
- Too early to determine impacts of dental amalgam regulations.



One-Person vs. Two-Person Collection Methods (Total Hg)

Station	Name	Date	Two Person Method (ng/L)	One Person Method (ng/L)	% Difference
01442760	Dunnfield Creek	5/3/2007	0.49	0.52	6
01368820	Double Kill	5/3/2007	0.78	0.76	-3
01378780	Primrose Brook	5/2/2007	1.65	1.62	-2
01400860	Stony Brook trib.	5/7/2007	3.7	3.9	5
01466500	McDonalds Branch	5/3/2007	3.99	4.11	3
01411955	Gravelly Run	5/2/2007	1.81	1.79	-1
01409414	Hammonton Creek	5/2/2007	13.5	13.3	-1
01378387	Tenakill Brook	9/6/2007	0.91	0.84	-7
01378400	Dwars Kill	11/2/2007	1.03	1.04	1
01409414	Hammonton Creek	11/2/2007	20	19.4	-3
01466500	McDonalds Branch	11/2/2007	1.02	0.92	-9
01400860	Stony Brook trib.	11/2/2007	3.84	3.73	-3



Next Steps

- Evaluate remaining data for seasonality differences.
- Confirm applicability of one-person method with quality assurance officers in NJDEP and USGS.
- Select new stations to gather data in support of proposed wildlife criterion.



Summary

- Air deposition of mercury appears to be a significant source for mercury concentrations in surface-water in New Jersey.
- Sample collection and analysis can be reliably performed by well-trained, motivated staff.
- Low-Level mercury data collection, being very expensive, necessitates a measured pace.
- One-person sample collection method is promising.



Contact Information

- Christopher J. Kunz
New Jersey Department of Environmental Protection; Water
Monitoring and Standards; Bureau of Freshwater and Biological
Monitoring
P.O. Box 427
35 Arctic Parkway
Trenton, NJ 08625
(609) 292-0427
Fax: (609) 633-1095
Email: chris.kunz@dep.state.nj.us
- Heather A. Heckathorn
United States Geological Survey
New Jersey Water Science Center
810 Bear Tavern Road, Suite 206
West Trenton, NJ 08628
(609) 771-3983
Email: haheck@usgs.gov

