Using a Metals Translator for Establishing NPDES Limits: A Case Study

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Hopkins Generating Station

Tallahassee, Florida

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Problems

- Copper in the 2-MGD discharge exceeded the standard
- The 50-µg/L mixing allowance was revoked
- The NPDES renewal would include the lower limit

Solutions

- Close the facility
- Dilute the discharge
- Reduce the cooling tower cycles
- Build a treatment facility
- Complete a copper translator study

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What is a metal translator?

- Original toxicity testing based on dissolved metals
- Standards based on total fraction
- Translator is the ratio of dissolved to total
- Process allows consideration for the ratio
- FDEP Guidance Document, December 2001

GUIDANCE FOR ESTABLISHING A METALS TRANSLATOR

Florida Department of Environmental Protection
Revision Date: December 17, 2001

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Preliminary Testing

- Determine dissolve fraction
- Determine edge of mixing zone
- Evaluate the translator

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Preliminary Testing Results

Parameters	Equipment Blank		Plant Effluent (D-001)		Downstream (D1)		Downstream (D2)	
	TestAmerica	Anatek	TestAmerica	Anatek	TestAmerica	Anatek	TestAmerica	Anatek
December 26, 2008								
Dissolved fraction (%)				23.2		6.3		46.1
January 18, 2009								
Dissolved fraction (%)				19.8		13.8		43.2

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Plan of Study

- Parameters
  - Total and dissolved copper
  - Hardness
  - Total suspended solids
  - pH
  - Organic carbon
- Quality assurance
- Number of sampling events
- Worst-case operating conditions
- Sampling locations

Worst-Case Conditions

- Receiving water considerations
  - Critical flow
  - Total suspended solids
  - Hardness
  - pH
  - Organic carbon
  - Seasonal variations
- Plant operating conditions
  - Operating at full load
  - Cooling tower cycles
  - Units in operation
  - Chemical additives

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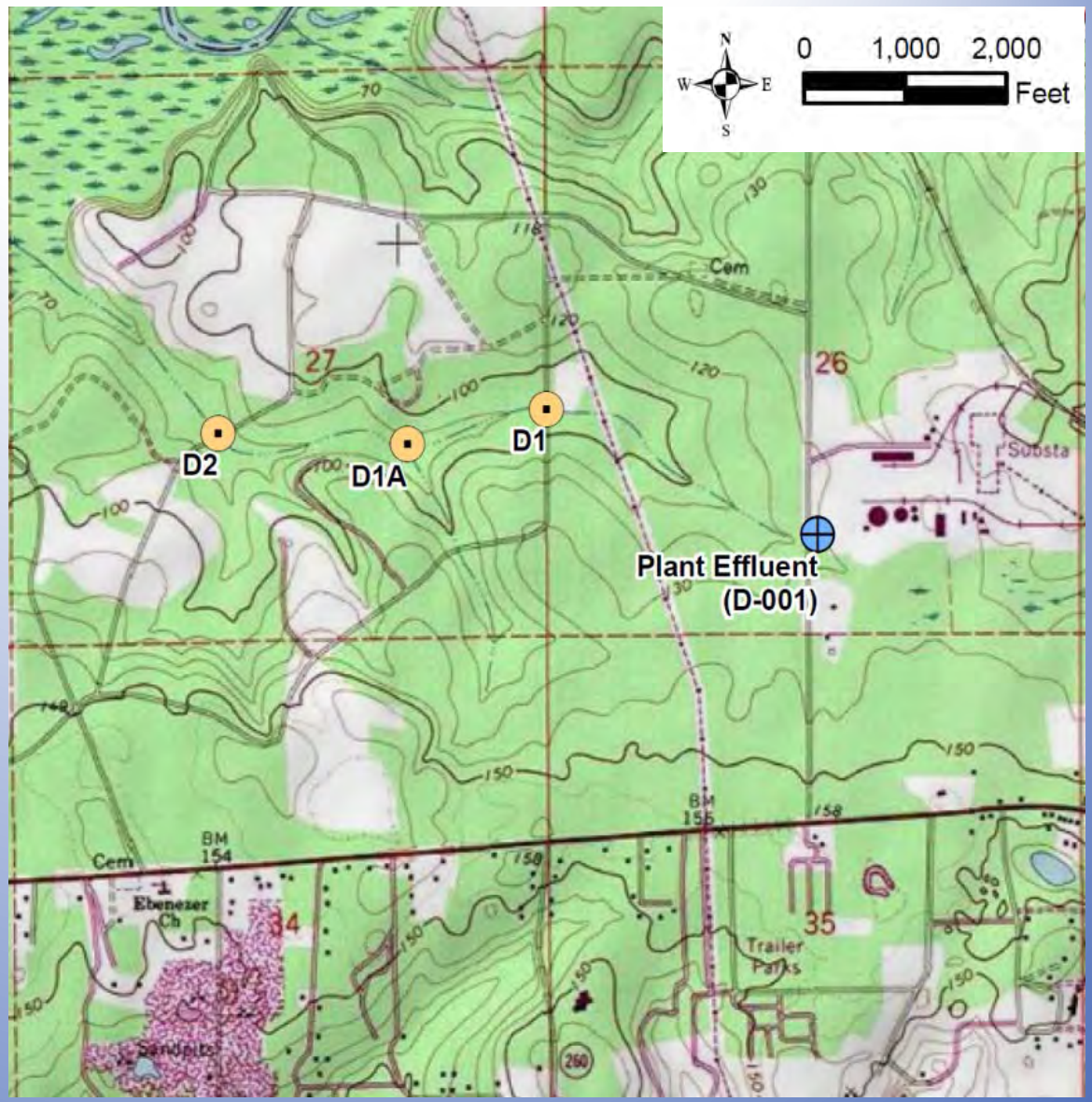
Sampling Locations



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Point of Discharge (POD)

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D1 — Looking Upstream

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D2 — Looking Downstream

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D1A — Looking Downstream

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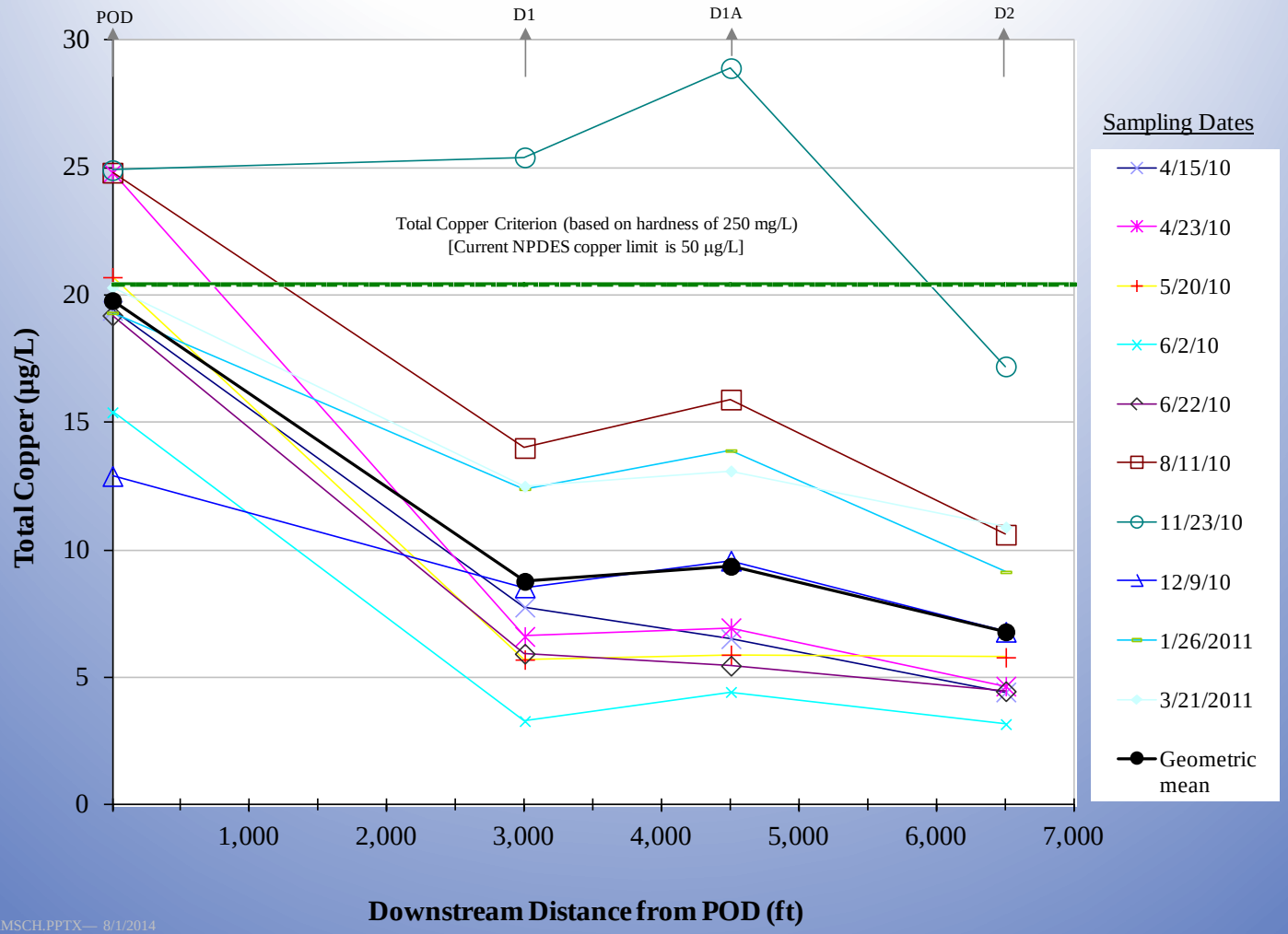
Total Copper Downstream from Point of Discharge



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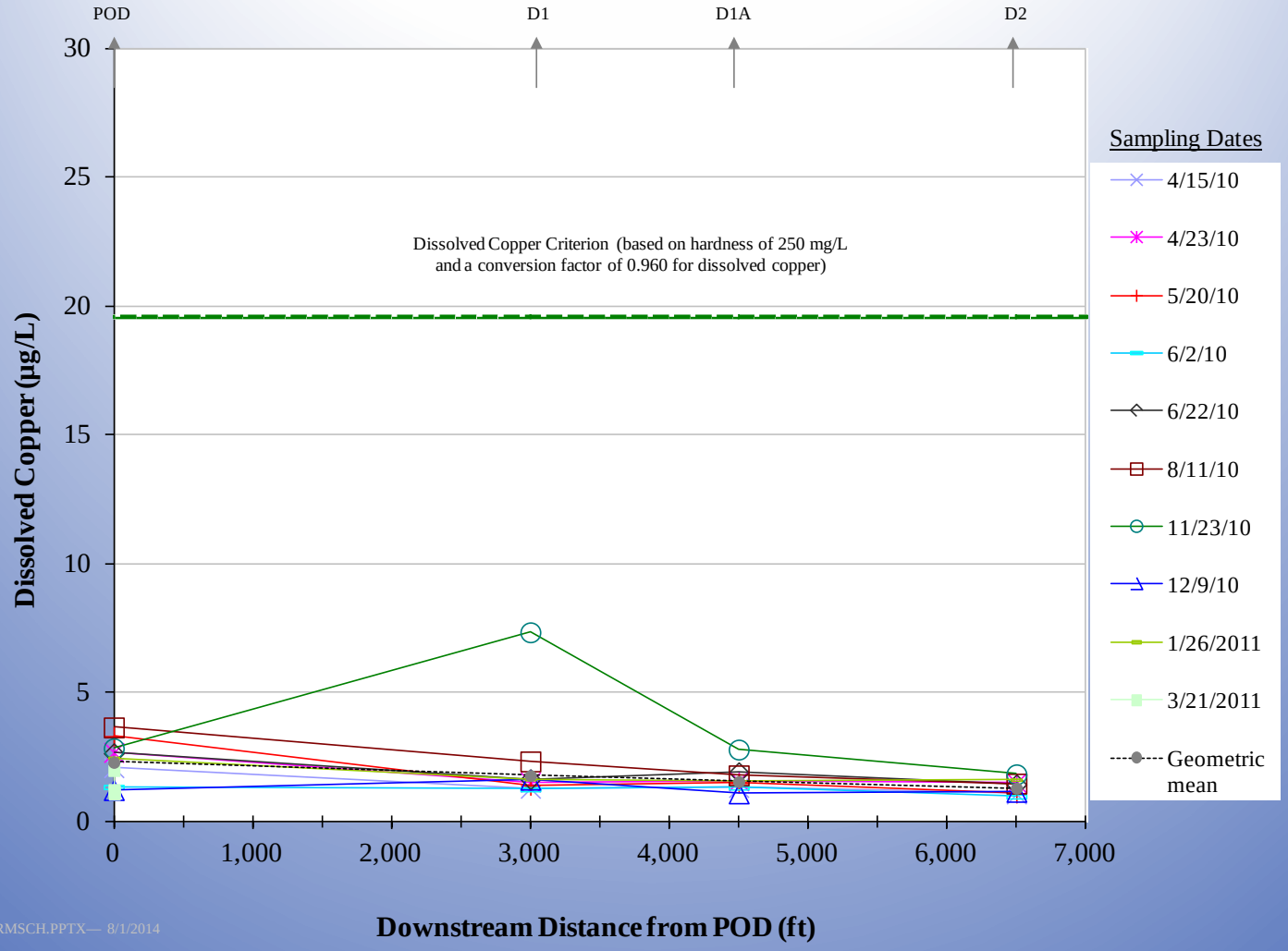
Dissolved Copper Downstream from Point of Discharge



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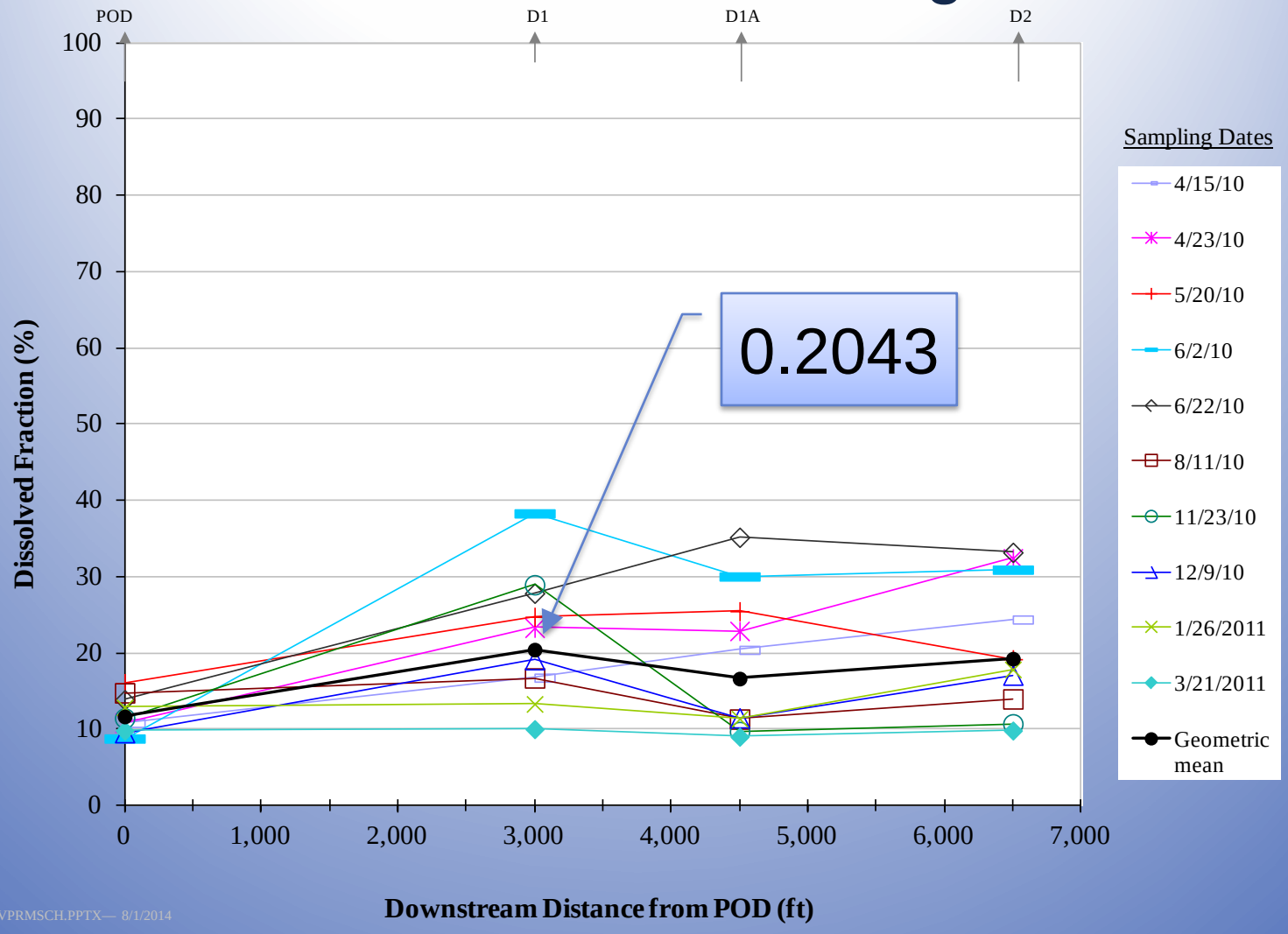
Dissolved Fraction of Copper Downstream from Point of Discharge



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Criteria Conversion Factors for Dissolved Metals

Metal	Freshwater Conversion Factors	Saltwater Conversion Factors
Cadmium*	0.909	0.994
Chromium (III)	0.860	—
Chromium (VI)	0.962	0.993
Copper	0.960	0.830
Lead*	0.791	0.951
Nickel	0.997	0.990
Silver	0.850	0.850
Zinc	0.986	0.946

*Conversion factors for cadmium and lead are hardness-dependent.

Translator-Based Criteria Equation

$$\textit{Translator-based criterion} =$$

$$\frac{\textit{dissolved copper criterion}}{\textit{translator}} =$$

$$0.96 \;\; 0.8545 \langle \ln H \rangle - 1.702\}$$

$$0.2043$$

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Total and Dissolved Copper Criteria and Translator-Based Criteria for a Range of Hardness Values

Hardness (mg/L as $CaCO_3$)	Florida Class III Water Quality Standard Criteria (µg/L)		Translator-Based Total Copper Criteria (µg/L)
	Total Copper	Dissolved Copper	
150	13.19	12.66	61.99
200	16.87	16.19	79.26
250	20.41	19.59	95.91
300	23.85	22.90	112.08
350	27.21	26.12	127.86
400	30.50	29.28	143.32

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Conclusions

- Preliminary evaluation is critical
- Dissolved fraction must be low
- Focused plan of study is key
- It works!!

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