# Water-Quality and Streamflow Time Trends, Upper Clear Creek Watershed (Colorado) – Systematic Long-Term Monitoring Fulfills a Range of Information Needs


*Presented by*

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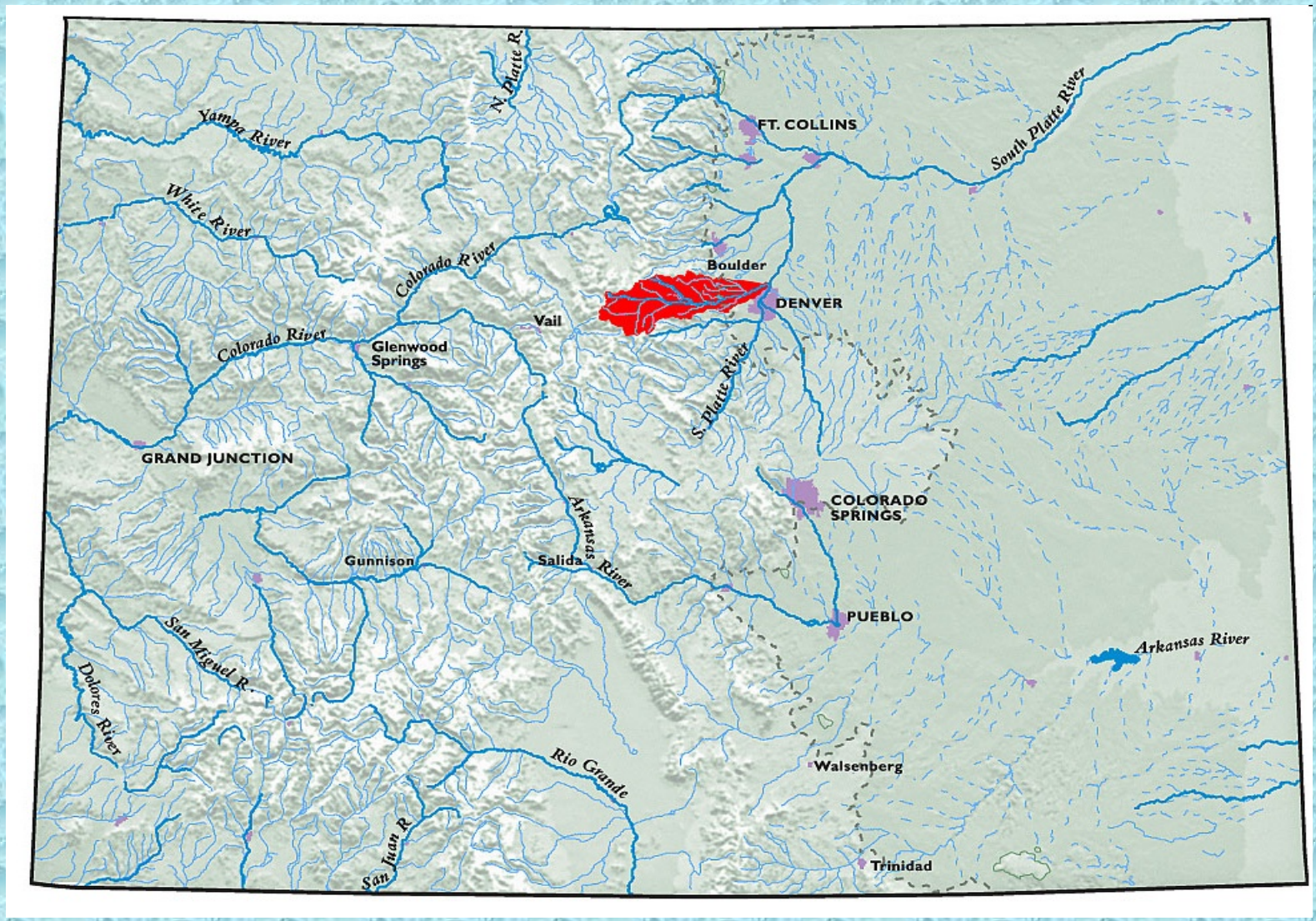
***USEPA Hardrock Mining Conference 2012, Session 6, April 4, 2012***

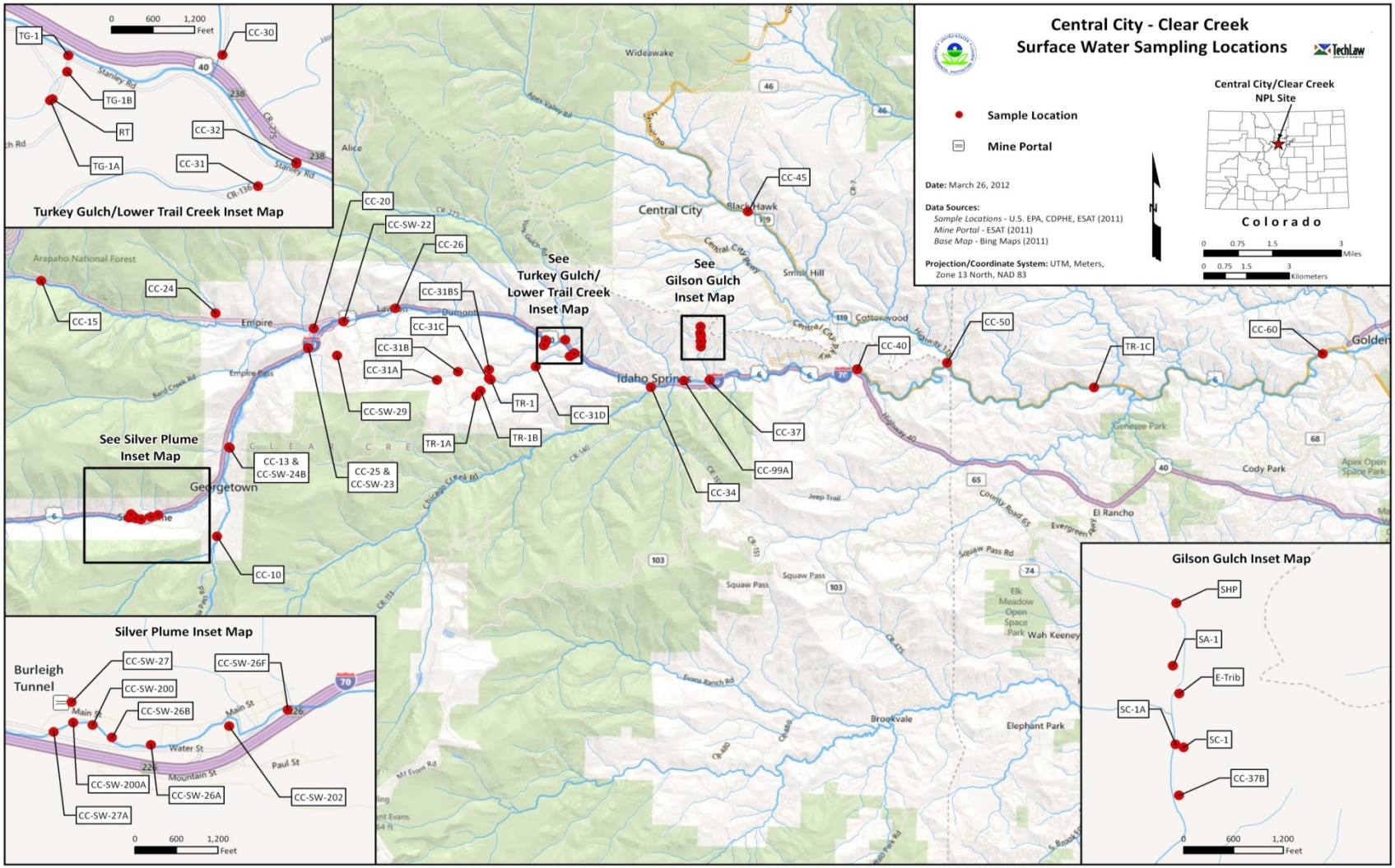
# *Overview of This Oral Presentation*

- Network-Design Concepts
- The Upper Clear Creek Watershed
  - Historical institutional & monitoring perspectives
  - Monitoring strategies and range of data sources
- Examples – Long-Term Time Trends
  - Systematic, dynamic monitoring
  - Recent addition of automatic-sampler instrumentation
  - Information types and assessment products (examples)
- Discussion and Questions
- Follow-Up: Poster Session II -- Tonight

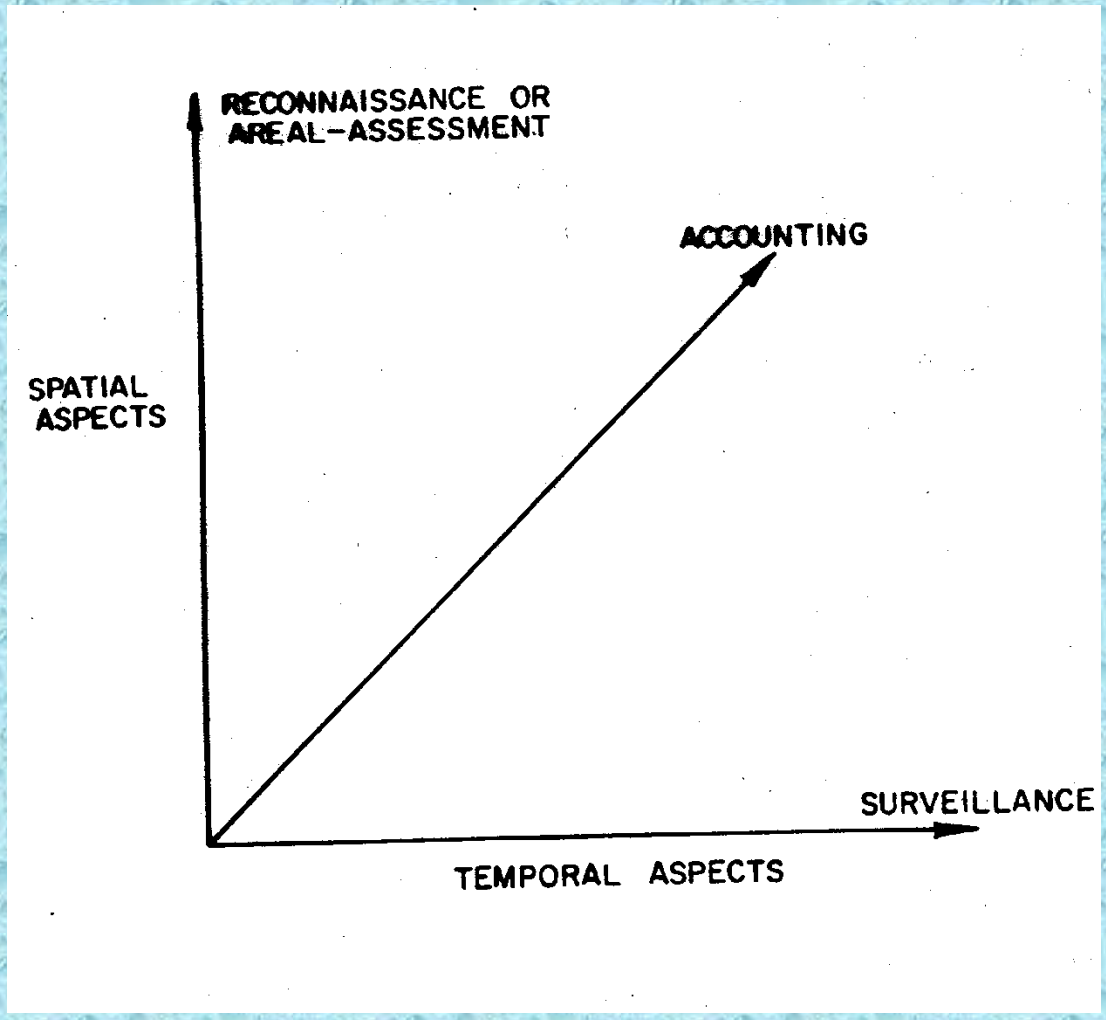
# Clear Creek Watershed - Colorado

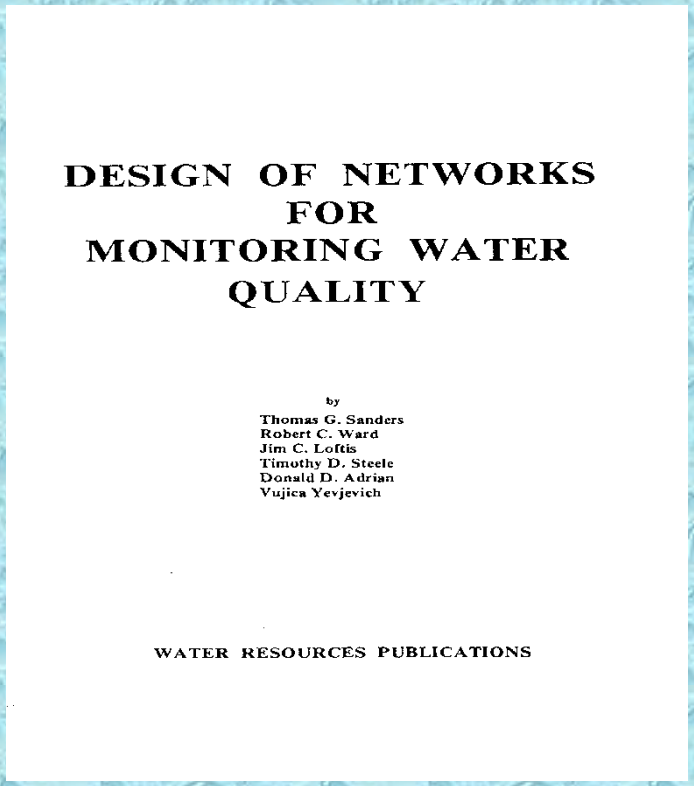


# *Upper Clear Creek Watershed – Monitoring Sites*



# *Monitoring-Program Functions – How Networks Tend to "Mature" over Time:*



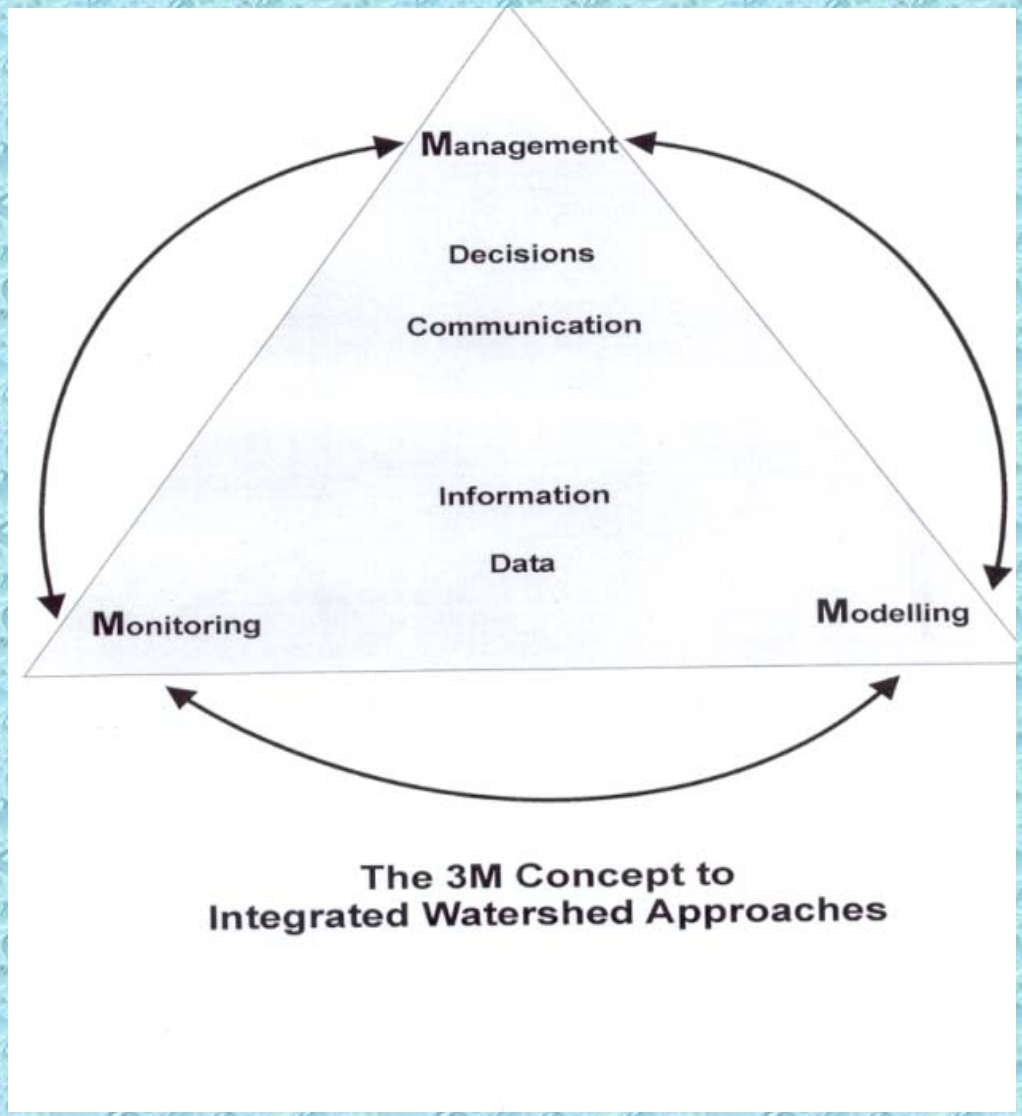
DESIGN OF NETWORKS FOR MONITORING WATER QUALITY

by

Thomas G. Sanders
Robert C. Ward
Jim C. Loftis
Timothy D. Steele
Donald D. Adrian
Vujica Yevjevich

WATER RESOURCES PUBLICATIONS

# Data Transformation →→→→ Information




The 3M Concept to
Integrated Watershed Approaches

*Integrated Watershed Management*

*Principles and Practice*

Isobel W. Heathcote
School of Engineering
University of Guelph

**SURFACE WATER-QUALITY MODELING**

Steven C. Chapra
*University of Colorado at Boulder*

*Wiley & Sons, Inc.*
Singapore / Toronto

THE McGRAW-HILL COMPANIES, INC.
New York St. Louis San Francisco Auckland Bogotá Caracas
Lisbon London Madrid Mexico Milan Montreal New Delhi
San Juan Singapore Sydney Tokyo Toronto

## *Institutions and Politics -- Highlights*

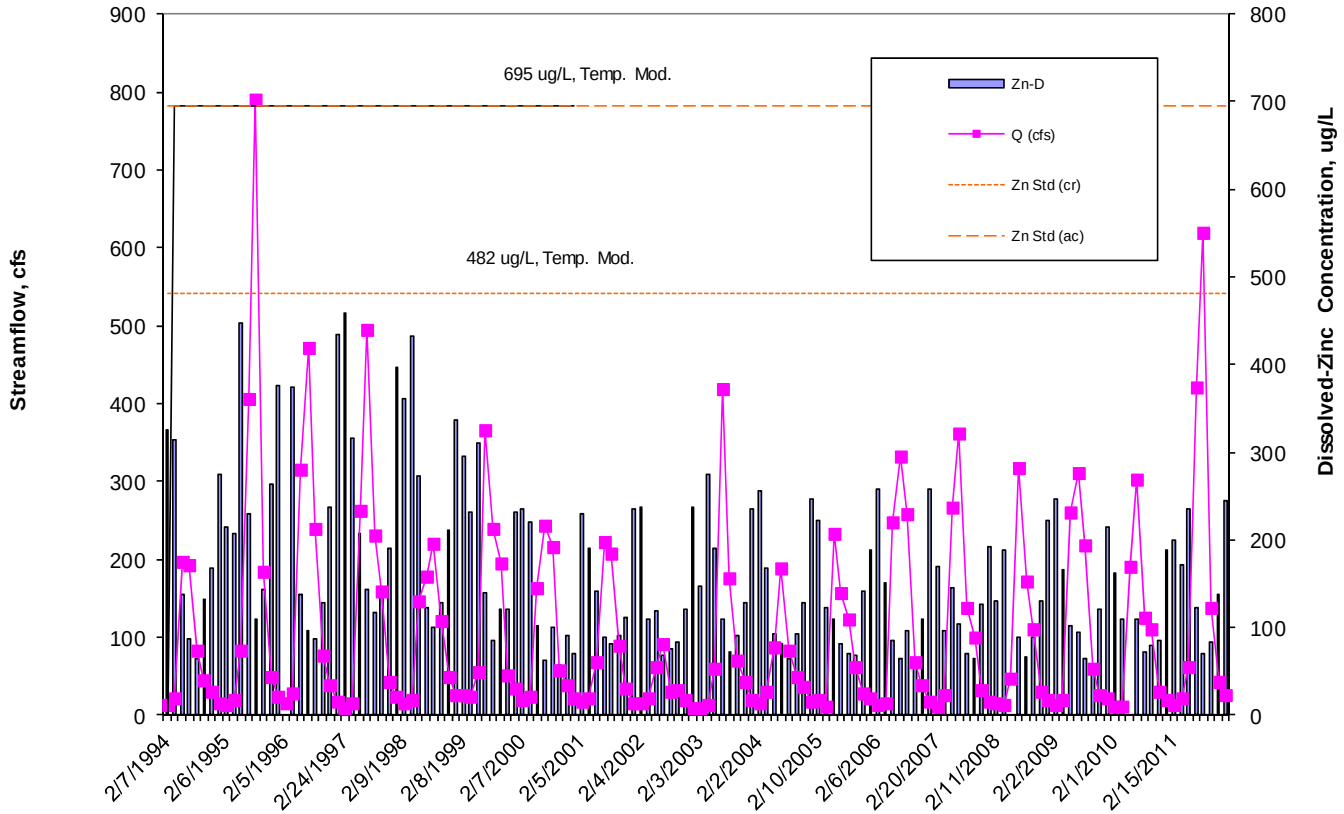
- Clear Creek/Central City Superfund Investigative Area
- Clear Creek Watershed Management Agreement
  - Adopted 1993; 23 entities (27stakeholders in 2010)
- Upper Clear Creek Watershed (Basin) Association
  - 208 WQ planning/management entity; public meetings
  - Affiliates: CDOT, Molson-Coors, Climax Molybdenum, and
- Clear Creek Watershed Association (CCWF)
  - 501(c)(3) grants' administration; project implementation
- Standley Lake Cities (SLCs) – Westminster, Northglenn, Thornton (and Arvada)
- State and Federal agencies: CDPHE, CDOW, USFS, etc.

# *Water-Quality/Hydrologic Data Sources in the Upper Clear Creek Watershed*

- Streamflows, USGS-WRD, five active gages (+ three)
- Water-quality: nutrients, sediment-related, field
  - UCCWA-SLCs → originally 18 stream sites, now 4 key + 9 hi/low
  - "Secondary" sources: BHCCSD & CDPHE-WQCD
  - Includes monitoring of wastewater treatment plants
  - Added automatic-samplers, four "key" monitoring sites
- Trace metals (total/dissolved), HRD, field variables
  - USEPA (analyses since 1994); SLCs (sampling, 1994-2004)
  - Other sources: CDOW, RiverWatch, BBCCSD, CDPHE (Argo)
- TOCs (recent SLCs); some major ions: Mg, Ca, Cl, Alk, $SO_4$
- Possible needs: suspended sediment, PCPs, radionuclides

# 18 Years – Systematic TMs Monitoring Data

**Figure 1 -- Clear Creek above West Fork Clear Creek (Site CC-25 D-Zn Concentrations, 1994-2011), Stream Segment 2a**



# Hardness Concentrations – Seasonal Pattern

*(Underlying Basis for Seasonal HRD-Based TMs Stream Standards)*

**Figure 2 -- Clear Creek below Idaho Springs at Kermitts (Site CC-40) Hardness Concentrations, 1994-2011, Stream Segment 11**

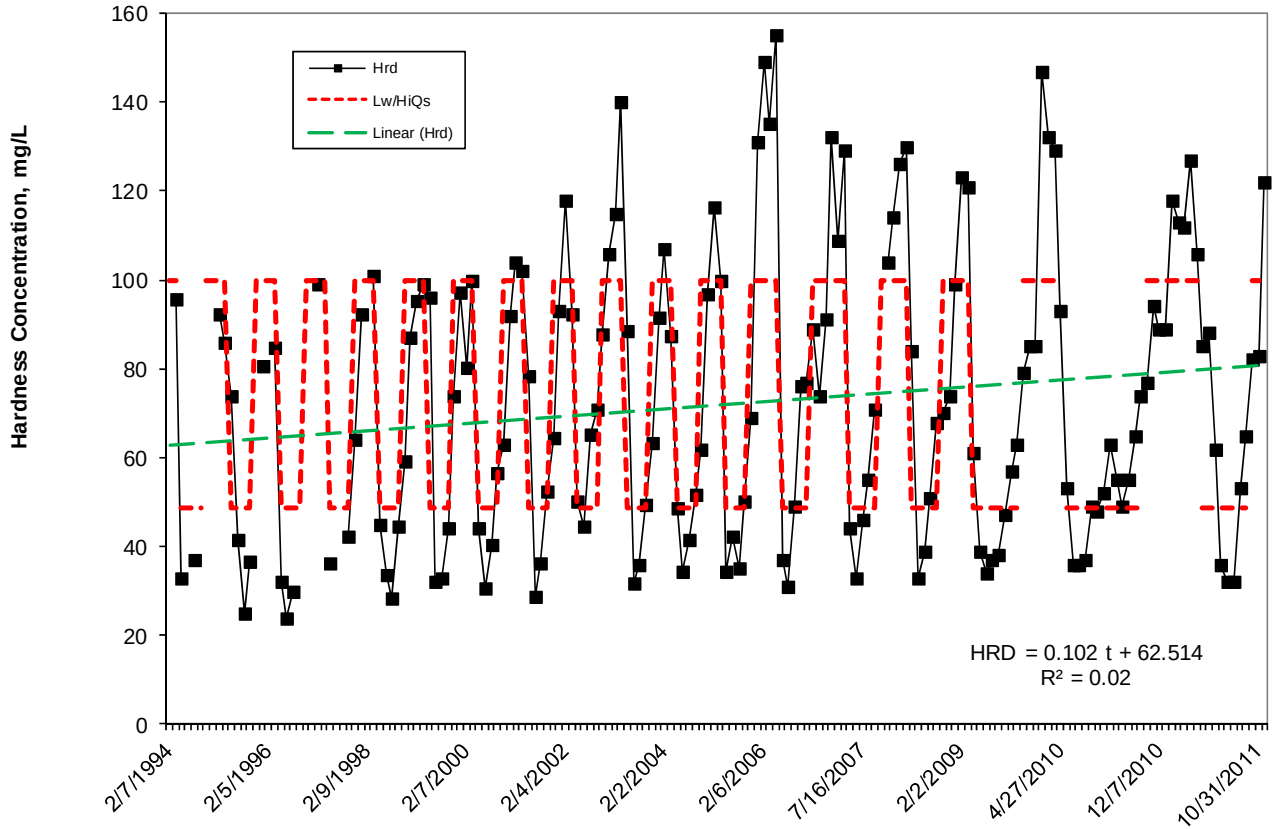
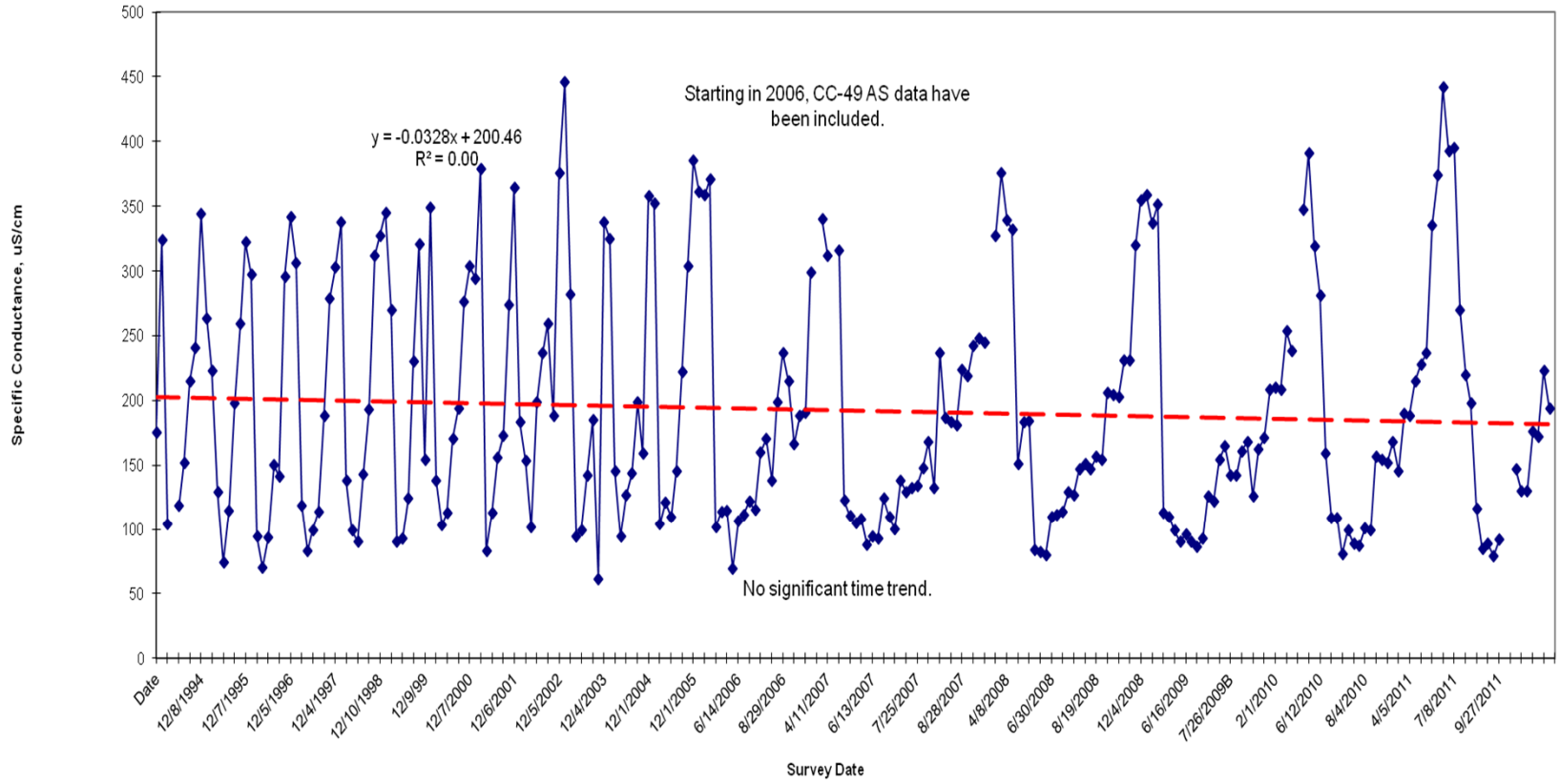
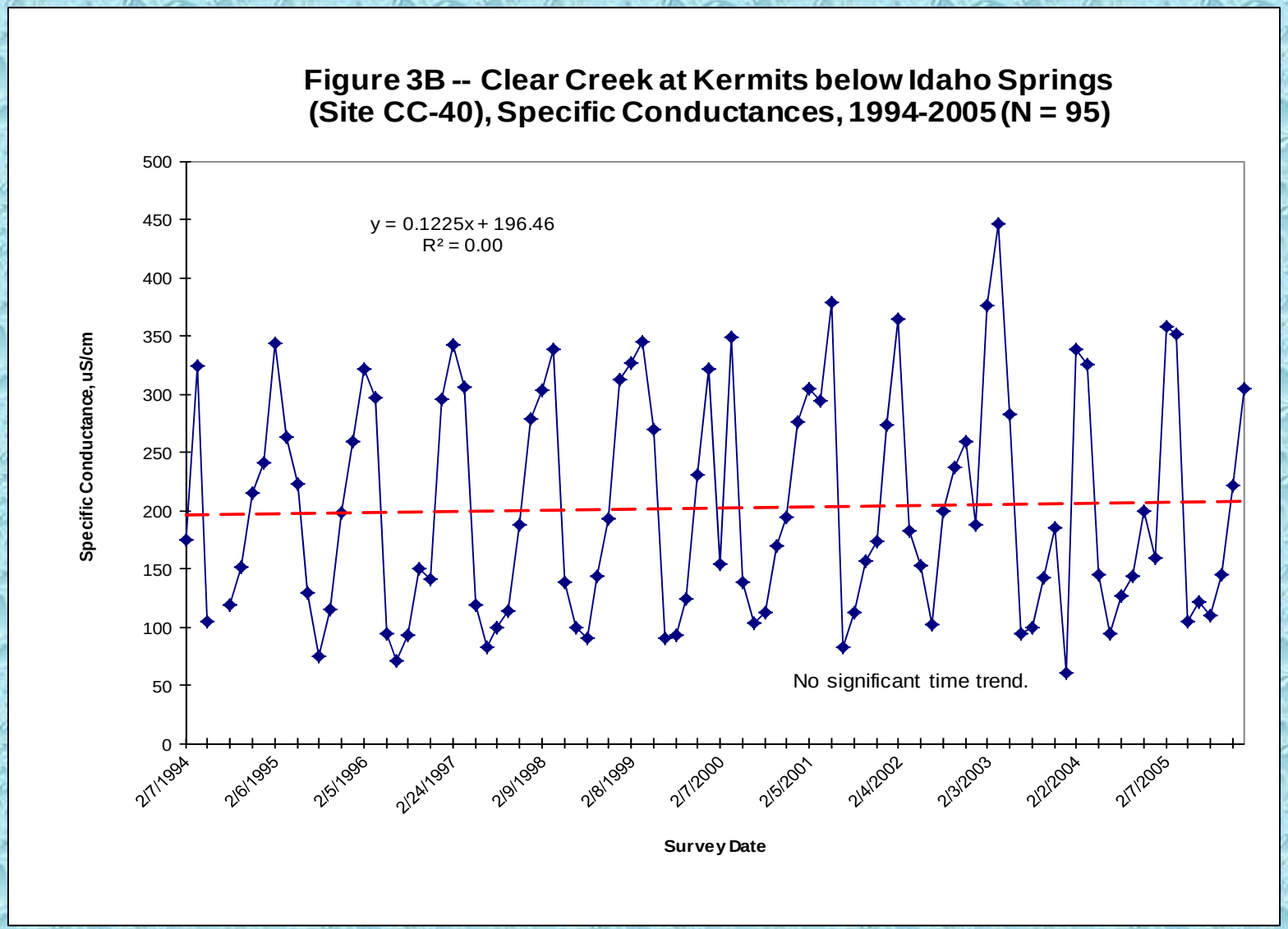


**Figure 3A -- Clear Creek at Kermits below Idaho Springs (Site CC-40), Specific Conductances, 1994-2011 (N = 179)**



# Specific Conductance – Expanded Scale (1994-2005)



# Argo Tunnel Adit – A Primary Mining-Related Point Source in the Upper Clear Creek Watershed

**Figure 4 -- Argo Tunnel, Pre-Treatment D-TMs Concentrations**
***(1973-1997) Sources: USGS (Wentz/Moran), CSM (Wildeman/Cain), other***

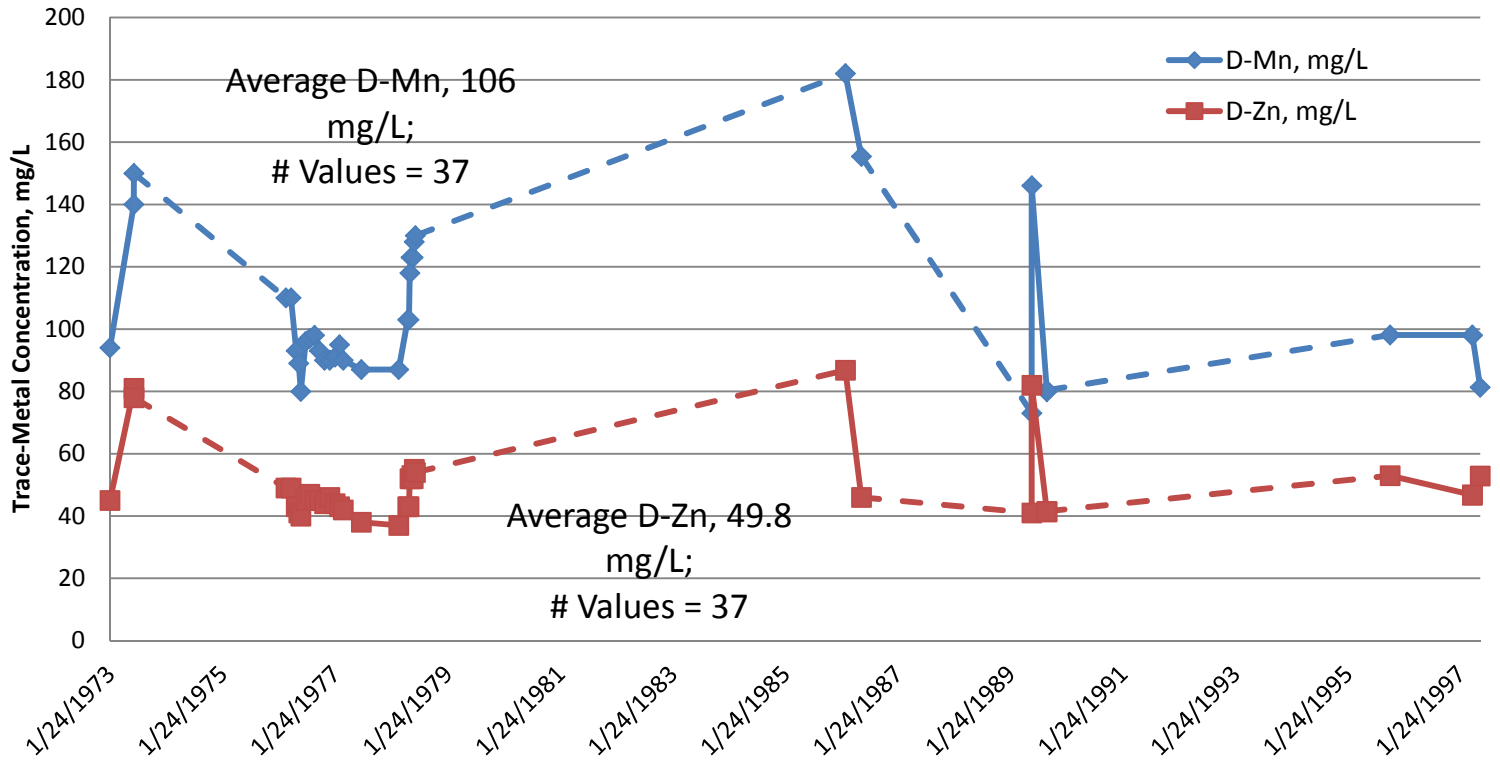


**Figure 5A -- Argo Tunnel Treatment-Facility Discharge, Total (Recoverable) Manganese Concentrations, mg/L (April 1998 - December 2011)**

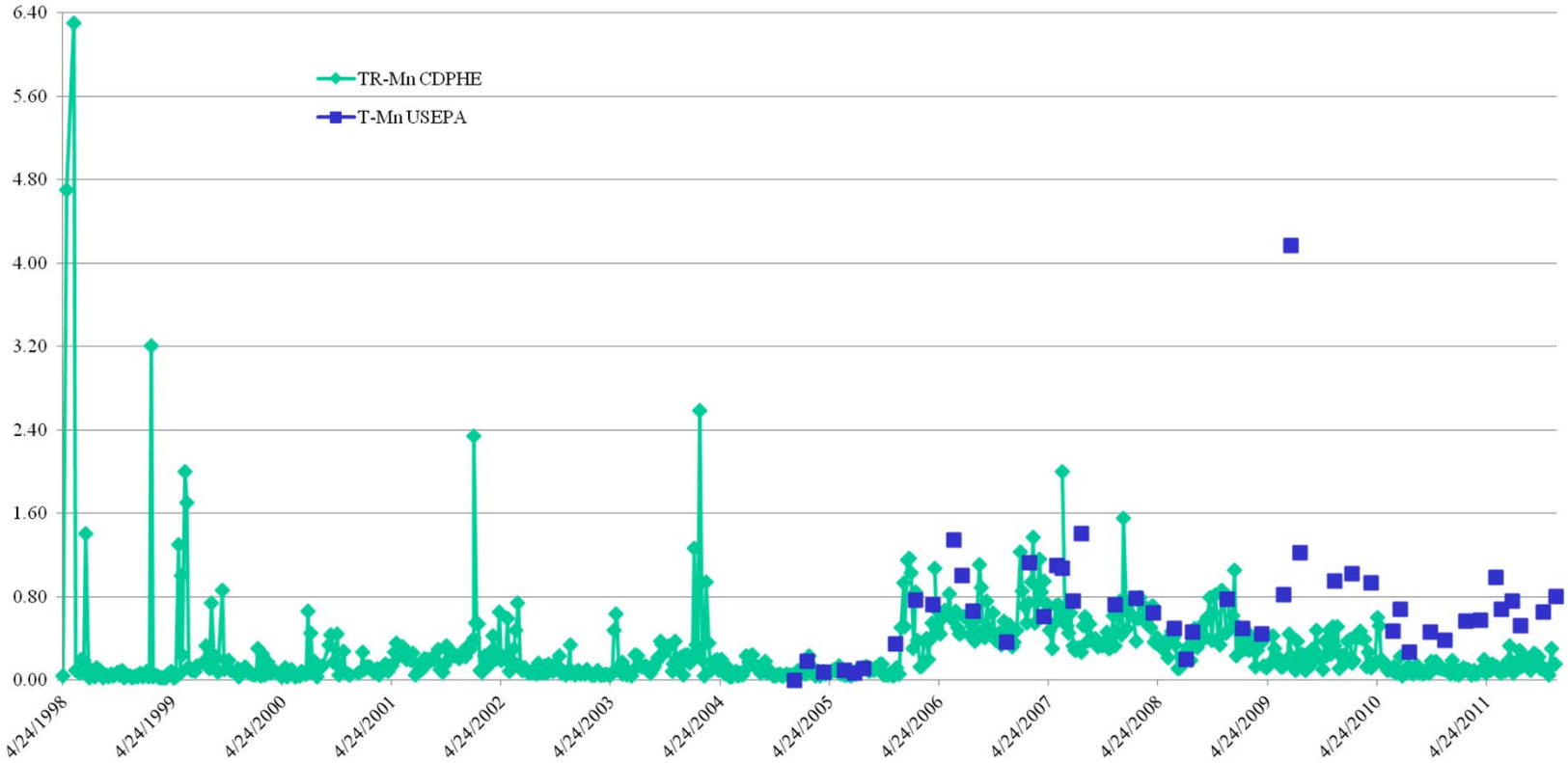
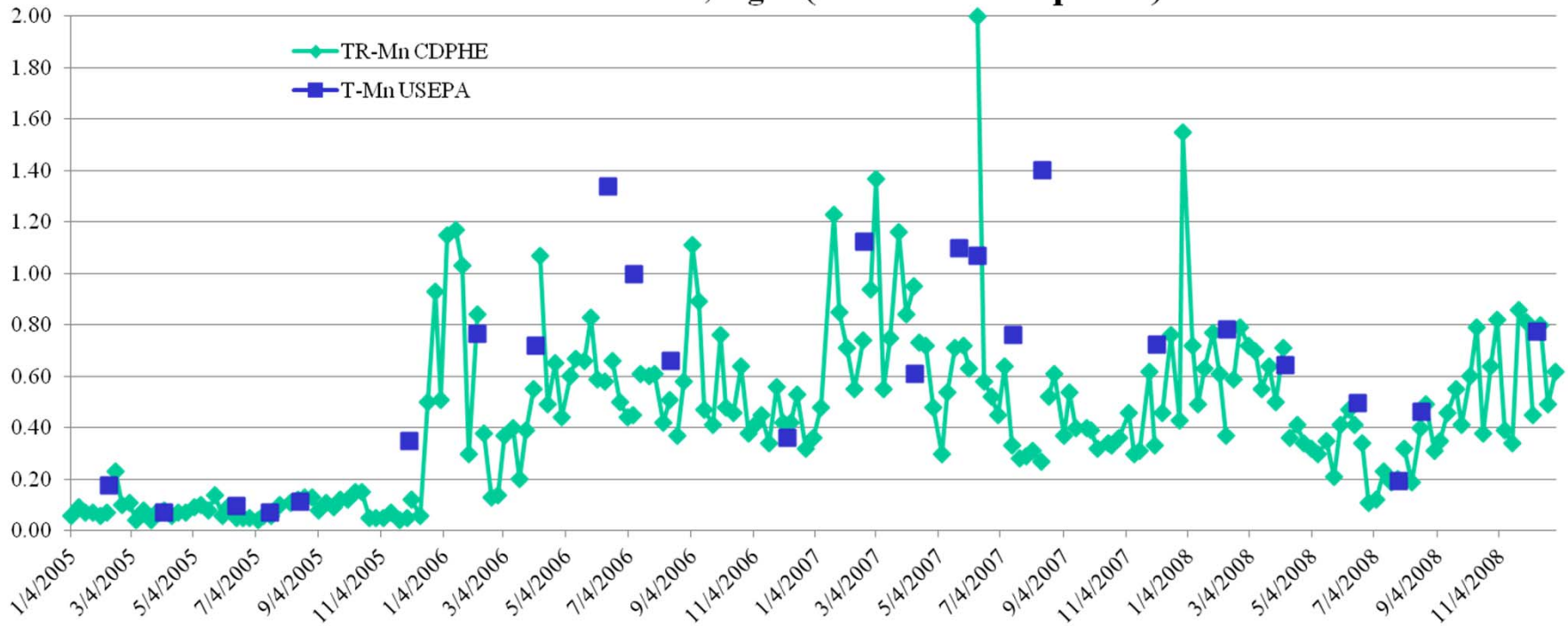
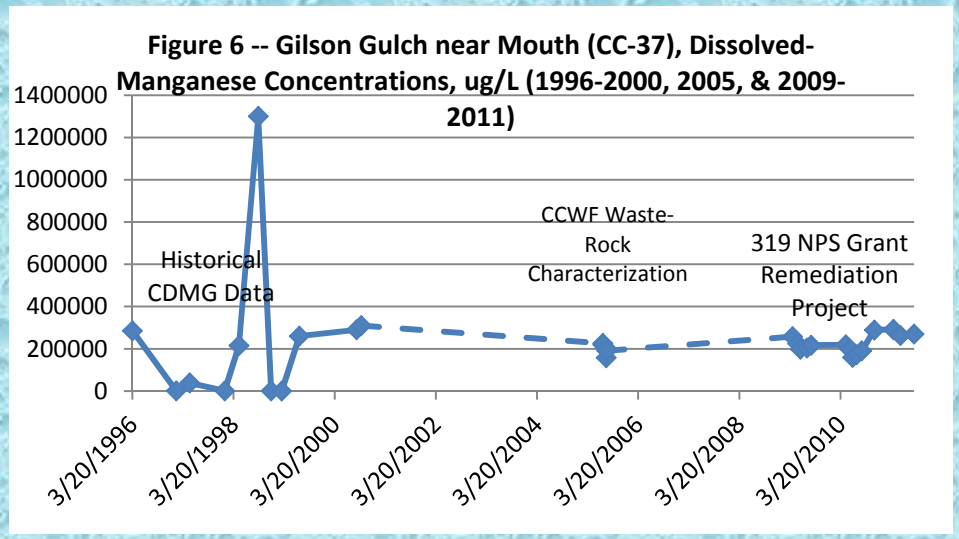
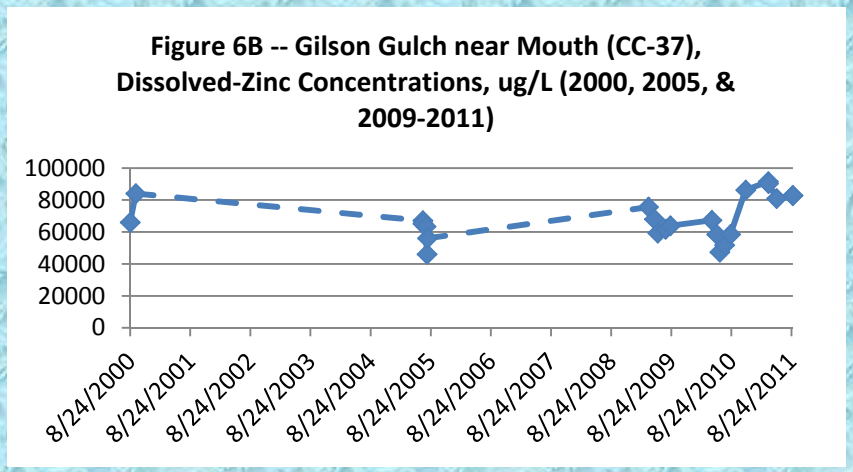


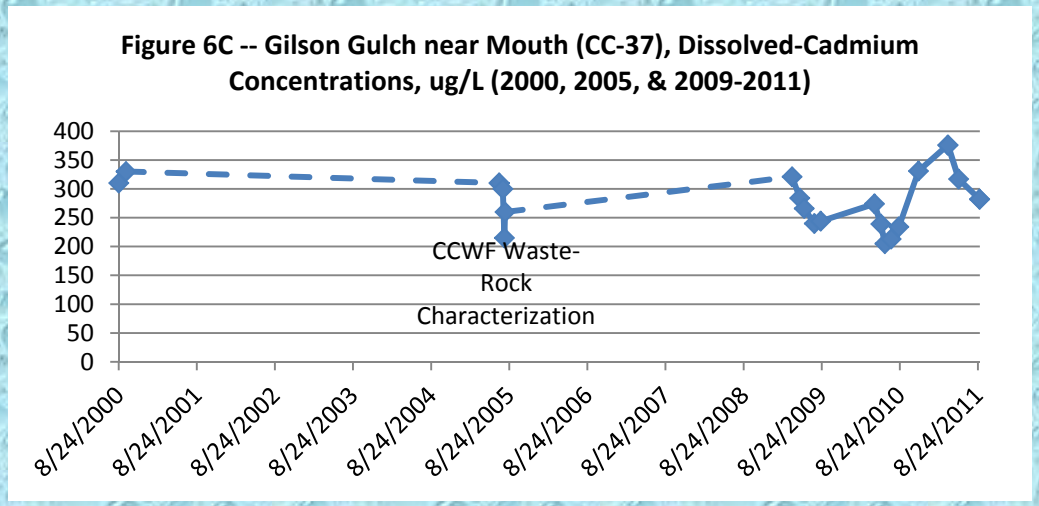
**Figure 5B -- Argo Tunnel Treatment-Facility Discharge, Total (Recoverable) Manganese Concentrations, mg/L (2005 - 2008 Subperiod)**

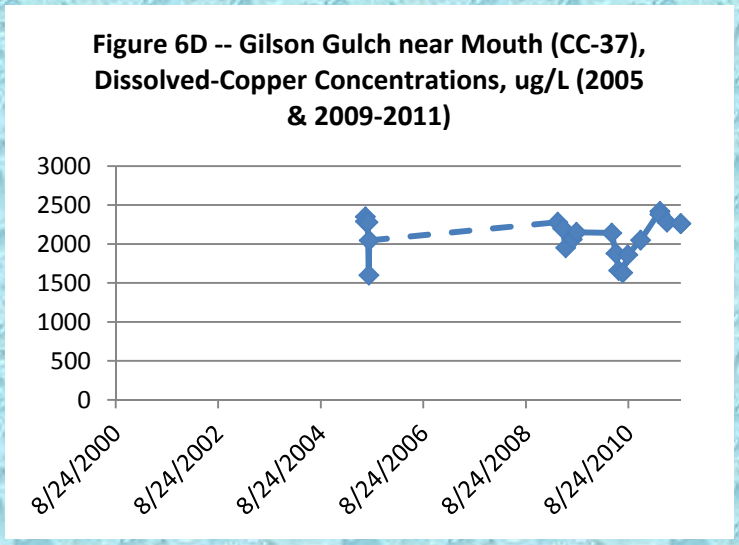


# 319 NPS Grant – Gilson Gulch Remediation Project – Pre-/During-Project TMs Characterization



# Trail Creek – Pre-/During-Project TMs Characterization over a Longer Period of Time (5 & 2 years, respectively)

**Figure 7 -- Trail Creek near Mouth (CC-31), Dissolved-Zinc Concentrations, ug/L (2005-2011, # Samples = 83)**

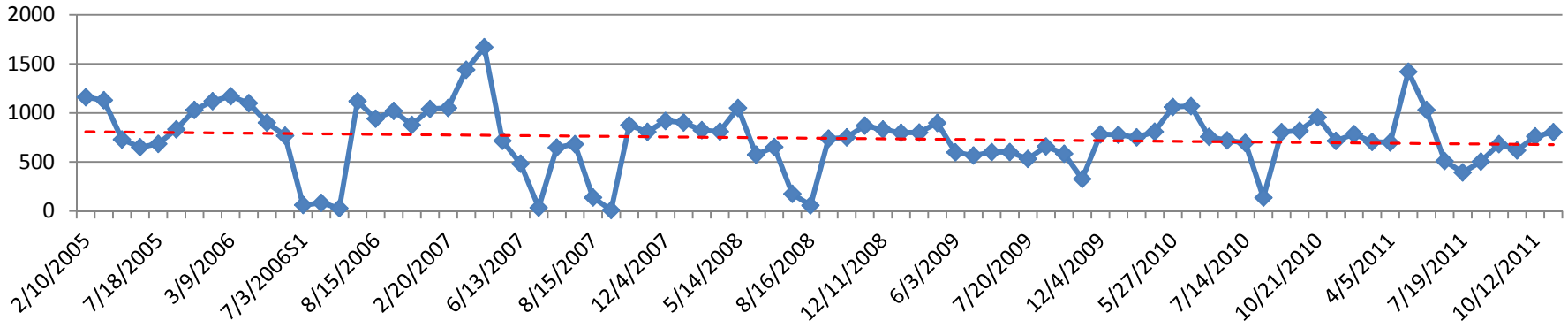
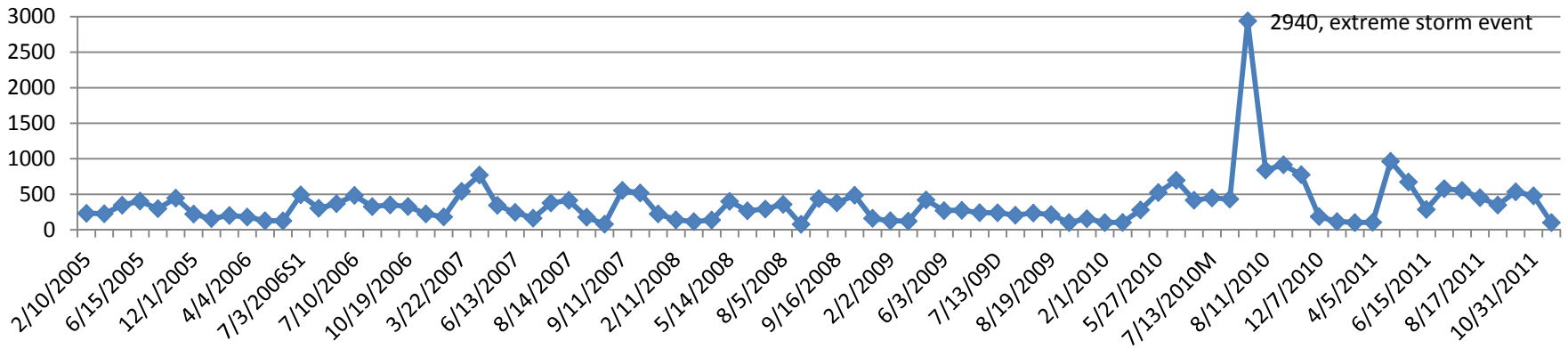
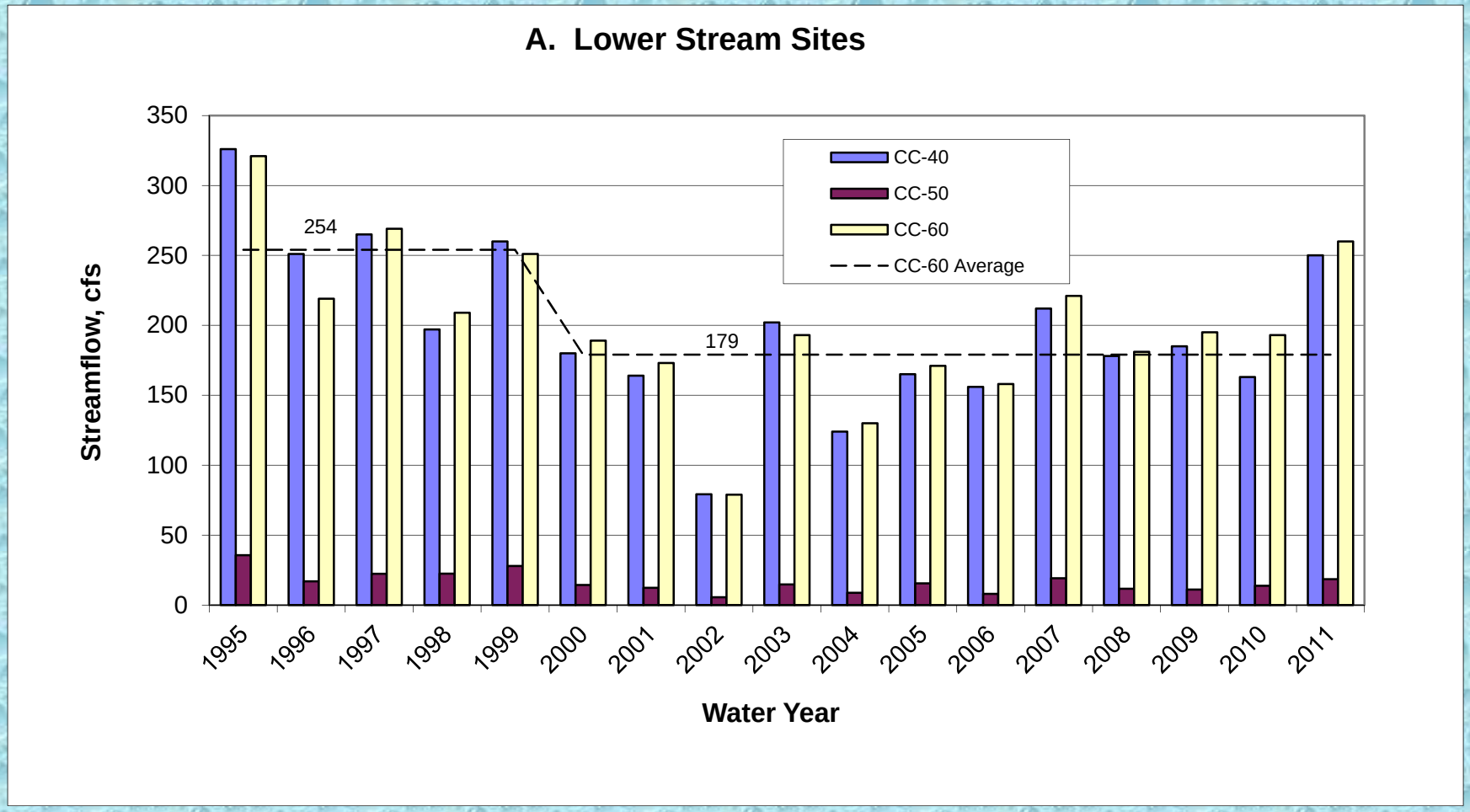



**Figure 7B-1 -- Trail Creek near Mouth (CC-31), Dissolved-Manganese Concentrations, ug/L (2005-2011, # Samples = 83)**

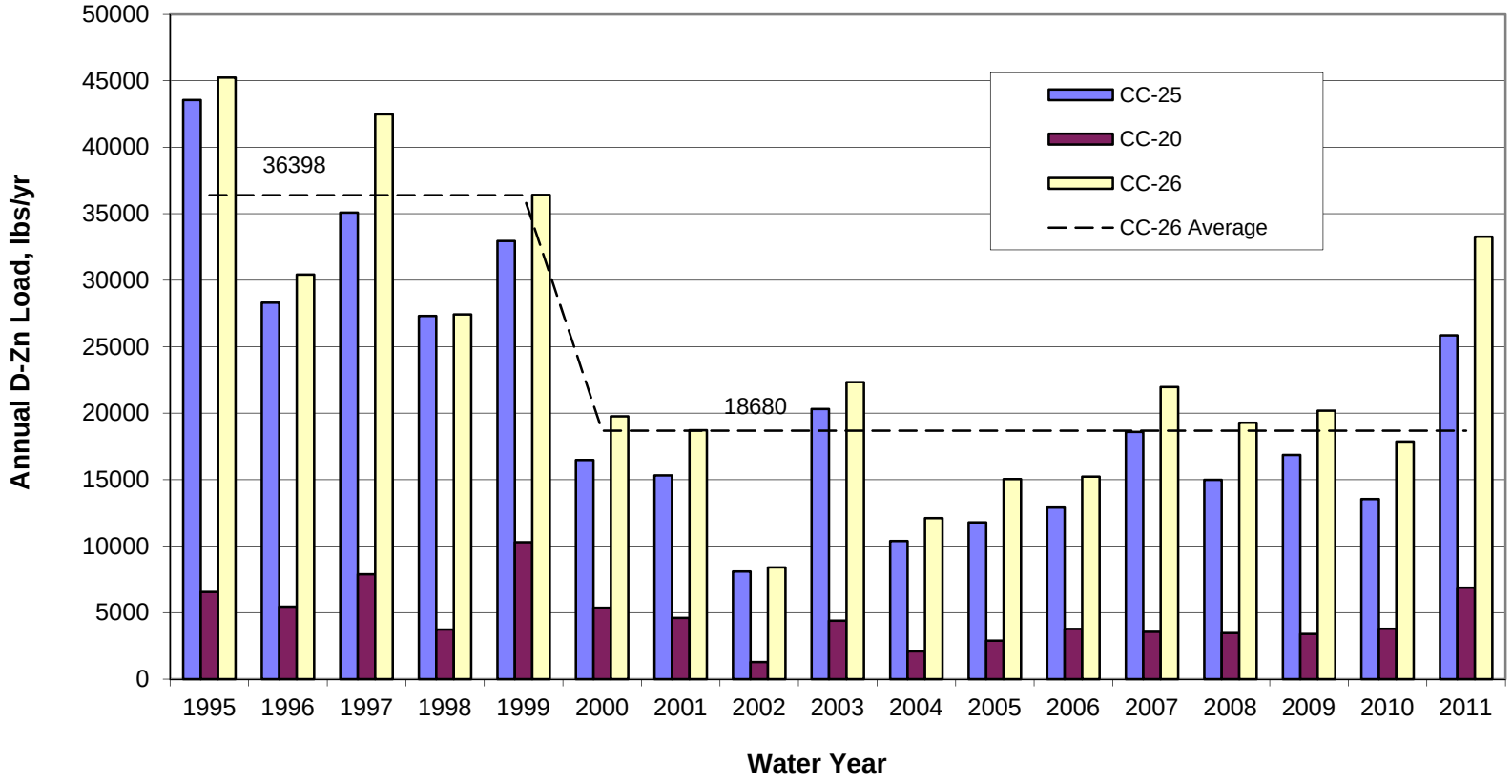


# Upper Clear Creek Watershed – Annual Streamflows (1995-2011 Water Years)

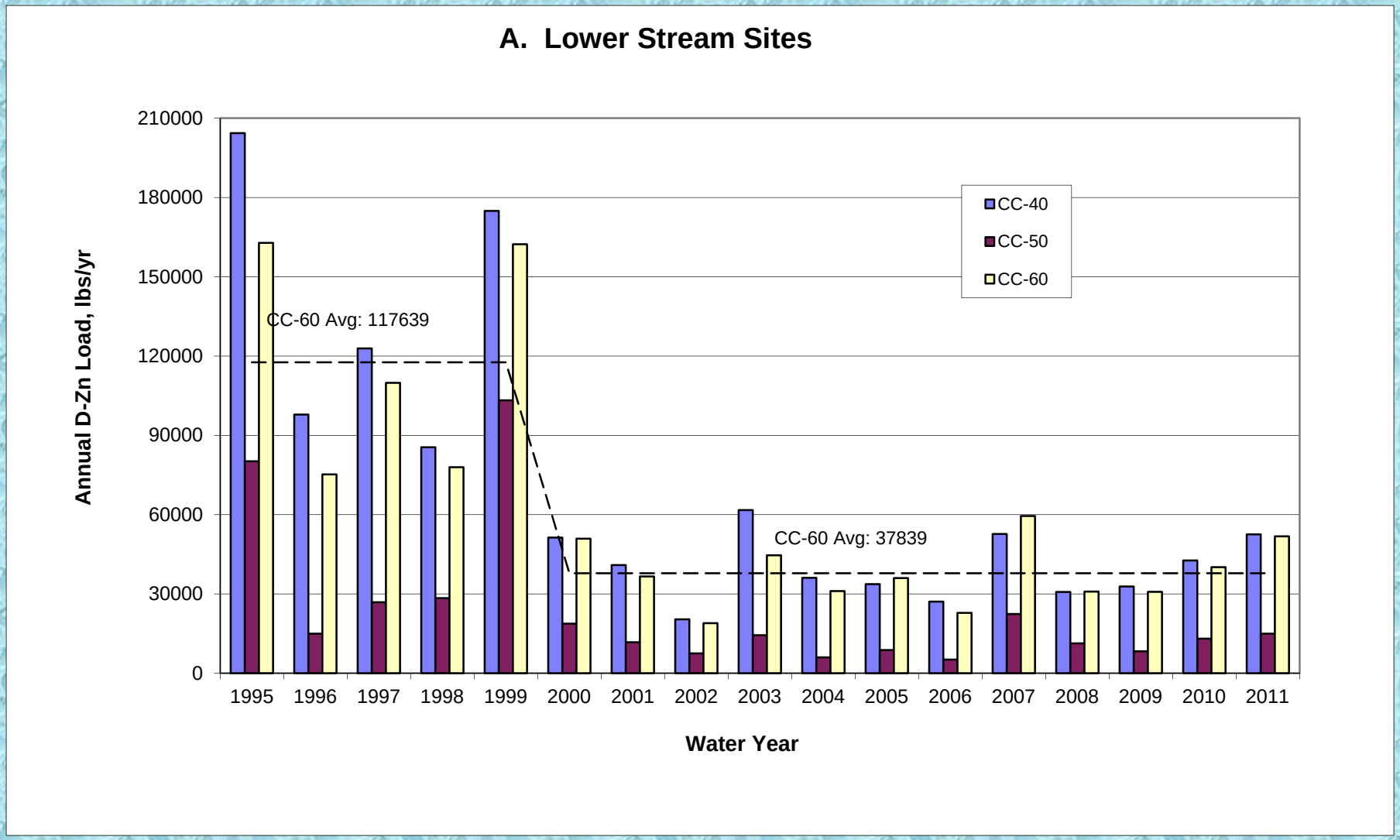


# Annual D-Zinc Loads, Upper Clear Creek Watershed Upstream Monitoring Locations (1995-2011 Water Years)

**Figure 9 - Upper Stream Sites**



# Annual D-Zinc Loads, Upper Clear Creek Watershed Downstream Monitoring Locations *(1995-2011 Water Years)*



# UCC Watershed – An Example of WWTP Long-Term Total-Nitrogen Concentration Time Series

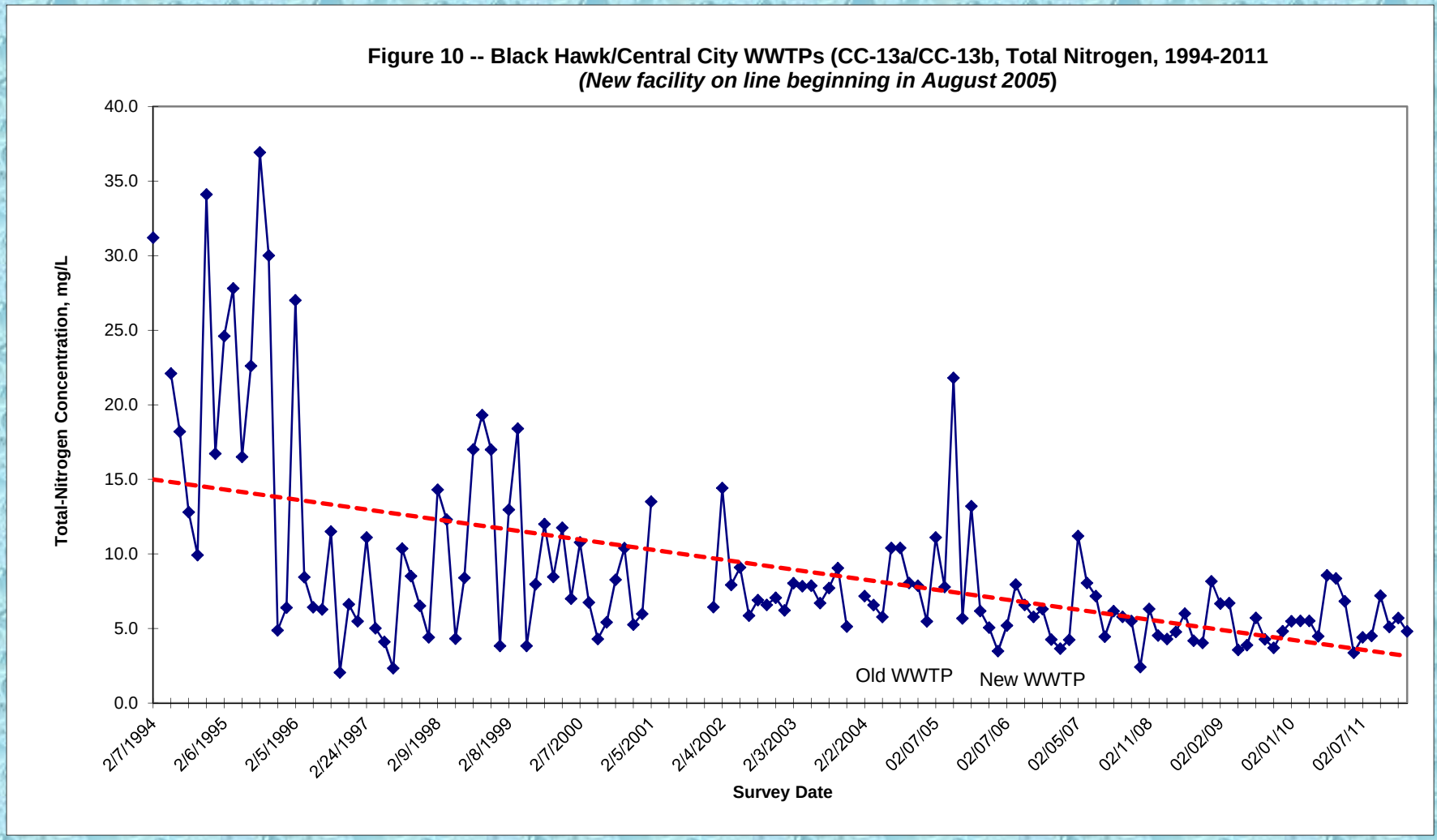
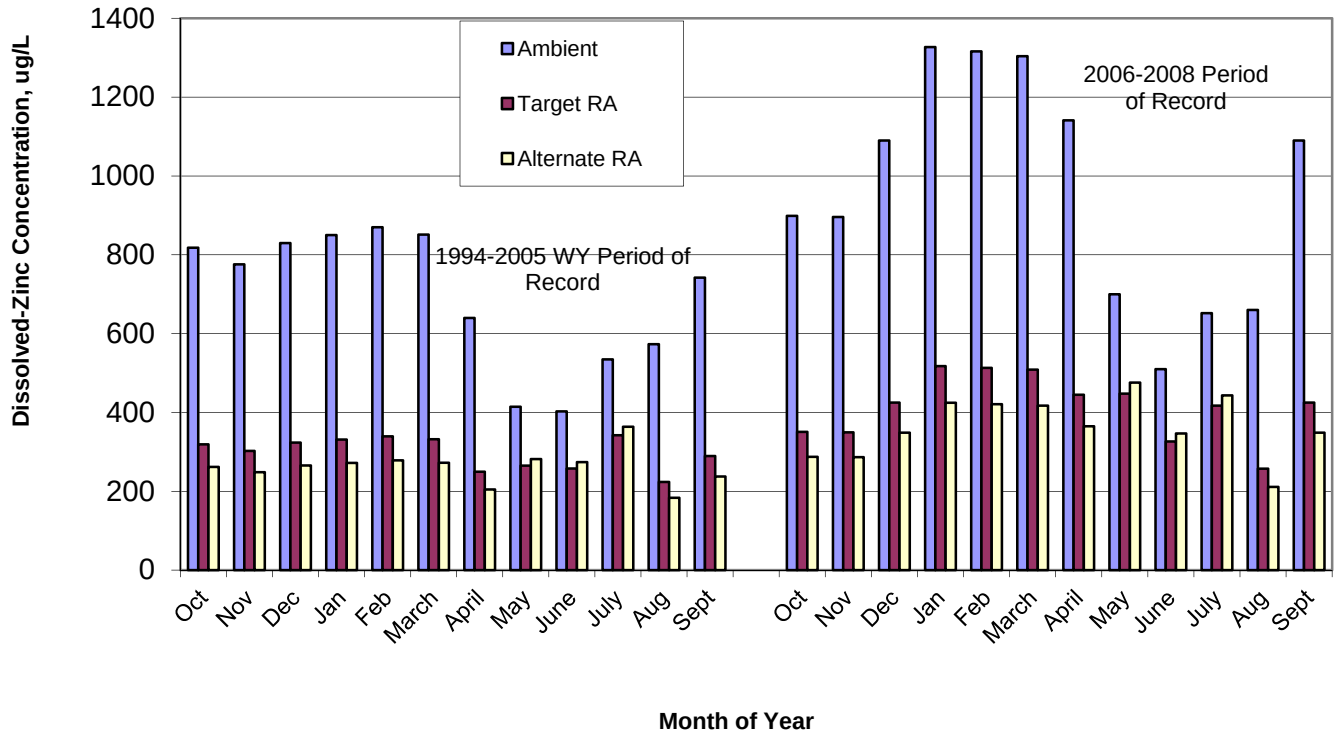


**Figure 90 -- D-Zinc Concentration Reductions, Remedial Actions, Snake River below Peru Creek (SW-050)**



# *Some Monitoring/Data Points to Ponder:*

- Systematic monitoring as several benefits
- Data end-user needs should be incorporated into any SAP
- Data adds "value" when transformed into information
- **Post-project remedial-action monitoring is critical**
- Basic questions:
  - How does a WQ monitoring network "mature"?
  - What constitutes a sufficient period of record?
  - What is the preferred scheduling/frequency in a year?
  - How can field data/analytical lab costs be controlled?
  - *How does one deal with varying minimum detection limits?*
- Promote monitoring-program collaboration/coordination (reduce/minimize overlap by myriad of data collectors)
- Database repository – file updates/maintenance/stability
  - Colorado's Data Sharing Network (DSN) is being encouraged for use

# Acknowledgements


- Co-authors of Poster Paper *(same title; tonight)*
  - J. David Holm, CCWF consultant
  - Mary Boardman, CDPHE-HMWMD
  - **Mike Holmes, USEPA Region 8 (TMs "Champion")**
- Upper Clear Creek Watershed Association
- Clear Creek Watershed Foundation
- CDPHE-HMWMD's, USGS-WRD's (D.A. Wentz/R.E. Moran) & Tom Wildeman's (CSM) **Argo Data**
- Ron J. Abel, ex-CDPHE-HMWMD *(review comments)*

*Note: Opinions and statements expressed herein are the author's alone and don't reflect any policies & stances of any of these organizations.*

# *Thanks for your attention & interest – Questions? [or come by Poster #1, Session II]*

**UPPER CLEAR CREEK WATERSHED PLAN**

**319-Grant Report – Phase-I Work Tasks**

*CDPHE-WQCD Purchase Order #OE FAA WQC05000024*

***Prepared For:***

Upper Clear Creek Watershed Association
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Idaho Springs, CO 80452

***On Behalf of:***

Colorado Department of Public Health & Environment
Water Quality Control Division, and
U.S. Environmental Protection Agency

***Prepared by:***

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TDS Project Number 0405

September 27, 2005

**UPPER CLEAR CREEK WATERSHED TRACE-METALS DATA ASSESSMENT**

**Clear Creek/Central City Superfund Investigative Area**

*2011 Addendum*

***Prepared For:***

Clear Creek Watershed Foundation
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***On Behalf of:***

Clear Creek County, U.S. Forest Service, and
U.S. Environmental Protection Agency

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December 29, 2011