One TMDL for Zinc in Oyster Tissue in Nueces Bay

Faith Hambleton, Program Manager
Total Maximum Daily Load Program
Texas Commission on Environmental Quality

TMDL Components

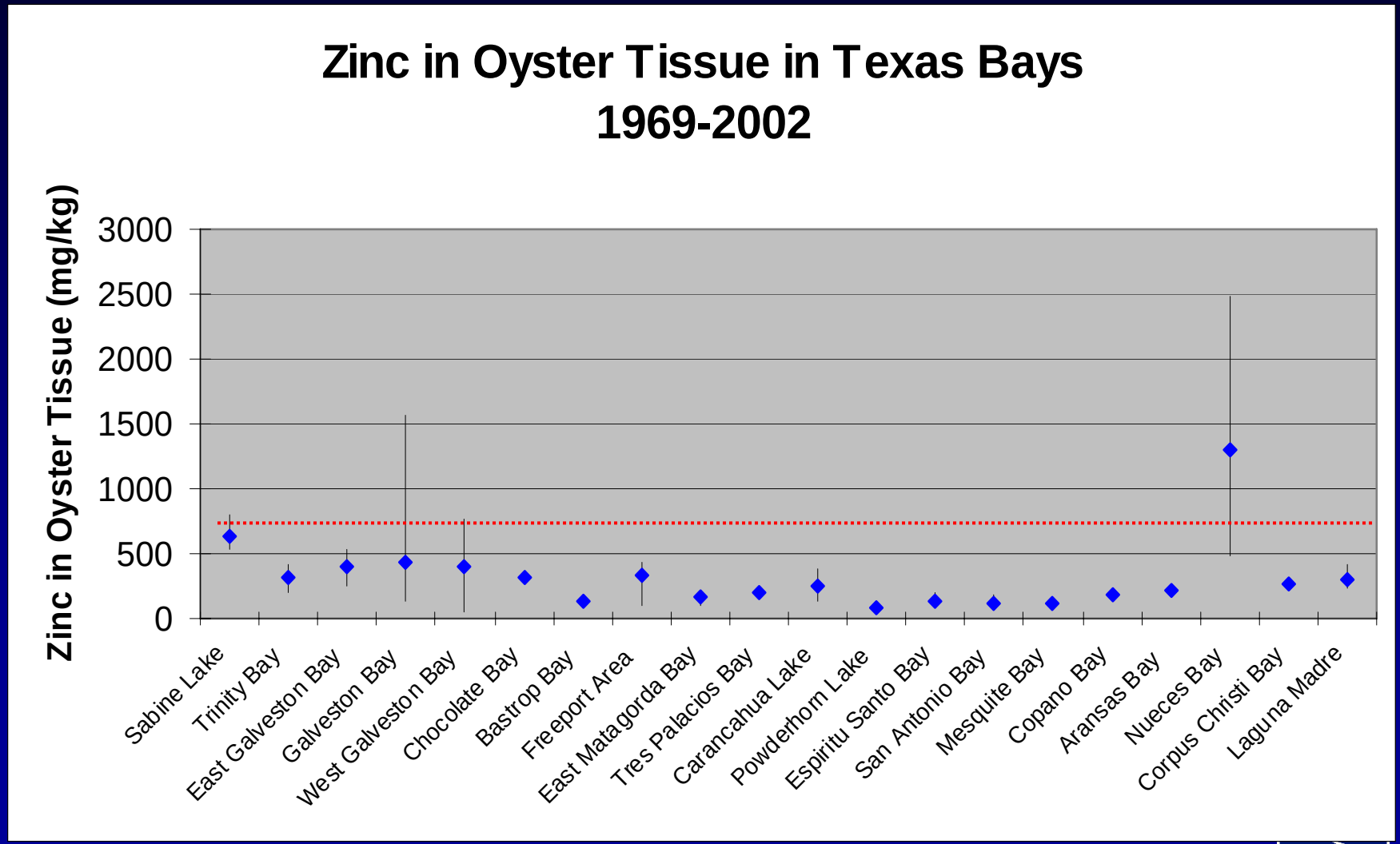
- Background Project Information
- Problem Definition
- Endpoint Identification
- Source Analysis
- Link Between Sources and Receiving Water
- Pollutant Load Allocation
- Reasonable Assurance of Implementation
- Public Participation

Watershed Area

Goals and Authority

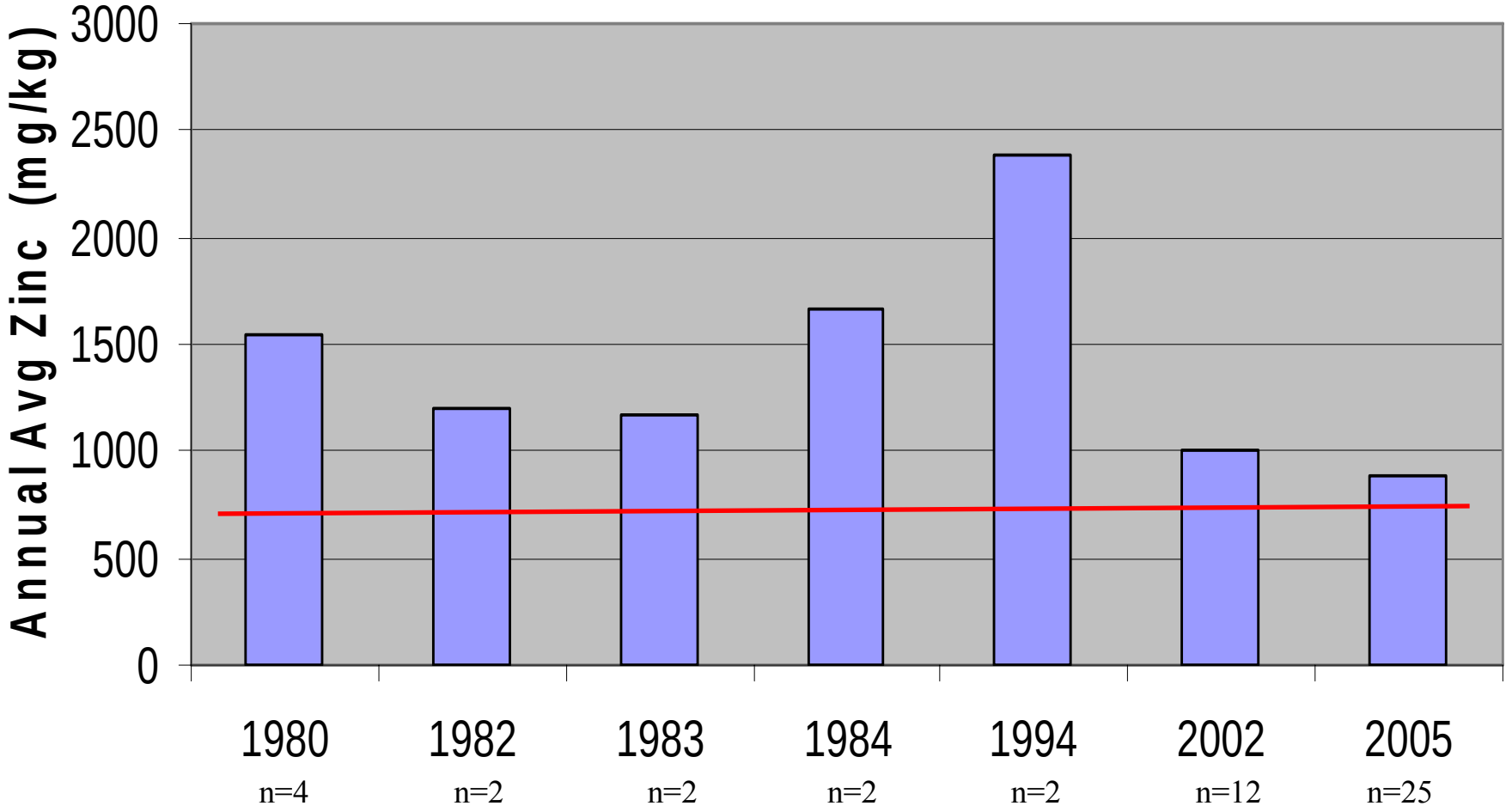
- Clean Water Act requires states to:
  - establish water quality standards (WQS)
  - identify waters not meeting WQS (303d List)
  - develop TMDLs
- Coastal Bend Bays & Estuaries Program
  - WSQ-1 Implement plans to improve water and sediment quality in identified segments.
  - Bays Plan- identified community concerns

Problem Definition



Zinc in Nueces Bay Oyster Tissue

(1980-2005)



Endpoint Identification

- TSHS's health assessment comparison value: 700 mg zinc/kg oyster tissue

- HAC value assumes:
  - Body weight = 70 kg (154 lbs)
  - Consumption rate = 30 g/day (or 8 oz/wk)
  - 30-year exposure rate

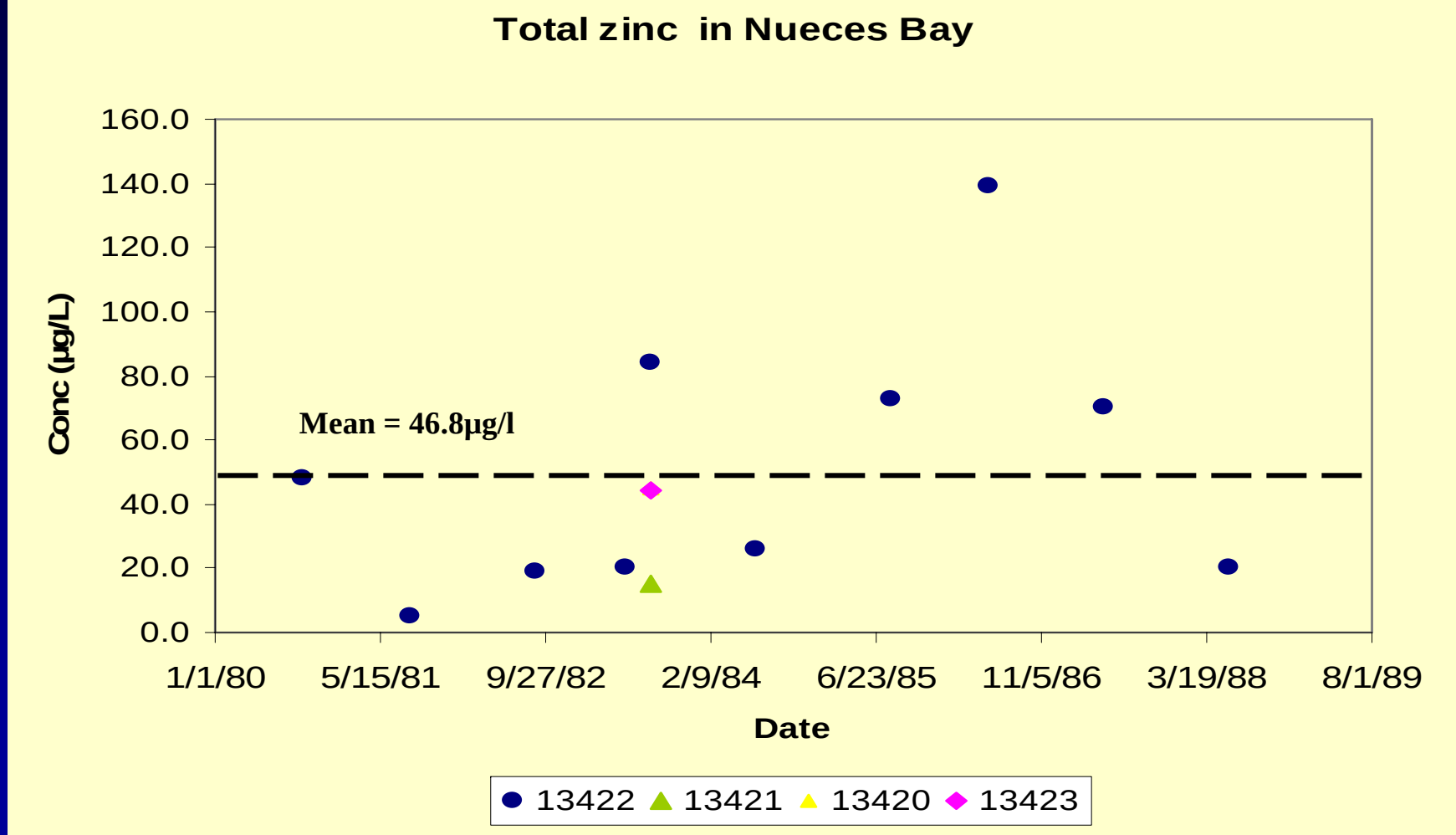
Water QualityTarget

- Bioconcentration factor (BCF) = tissue:water
- Zinc BCF = 23,820 L/kg (USEPA, 1987)
- 23,820 L/kg = 700 mg/kg/ [Zn water]

  target zinc concentration in **Water = 29 ug/L**

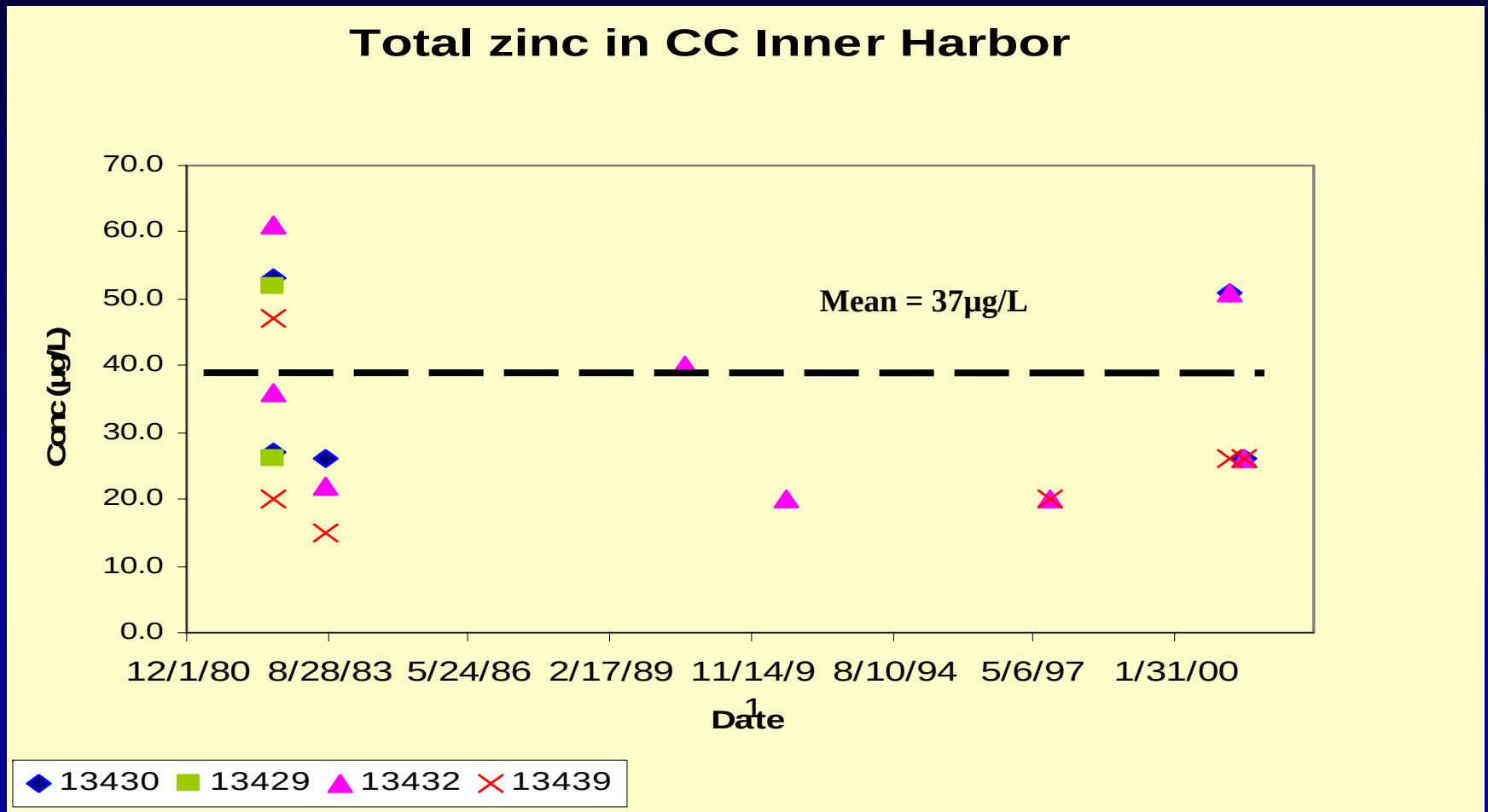
Historical Water Data

(from Mrini, et al., 2003)



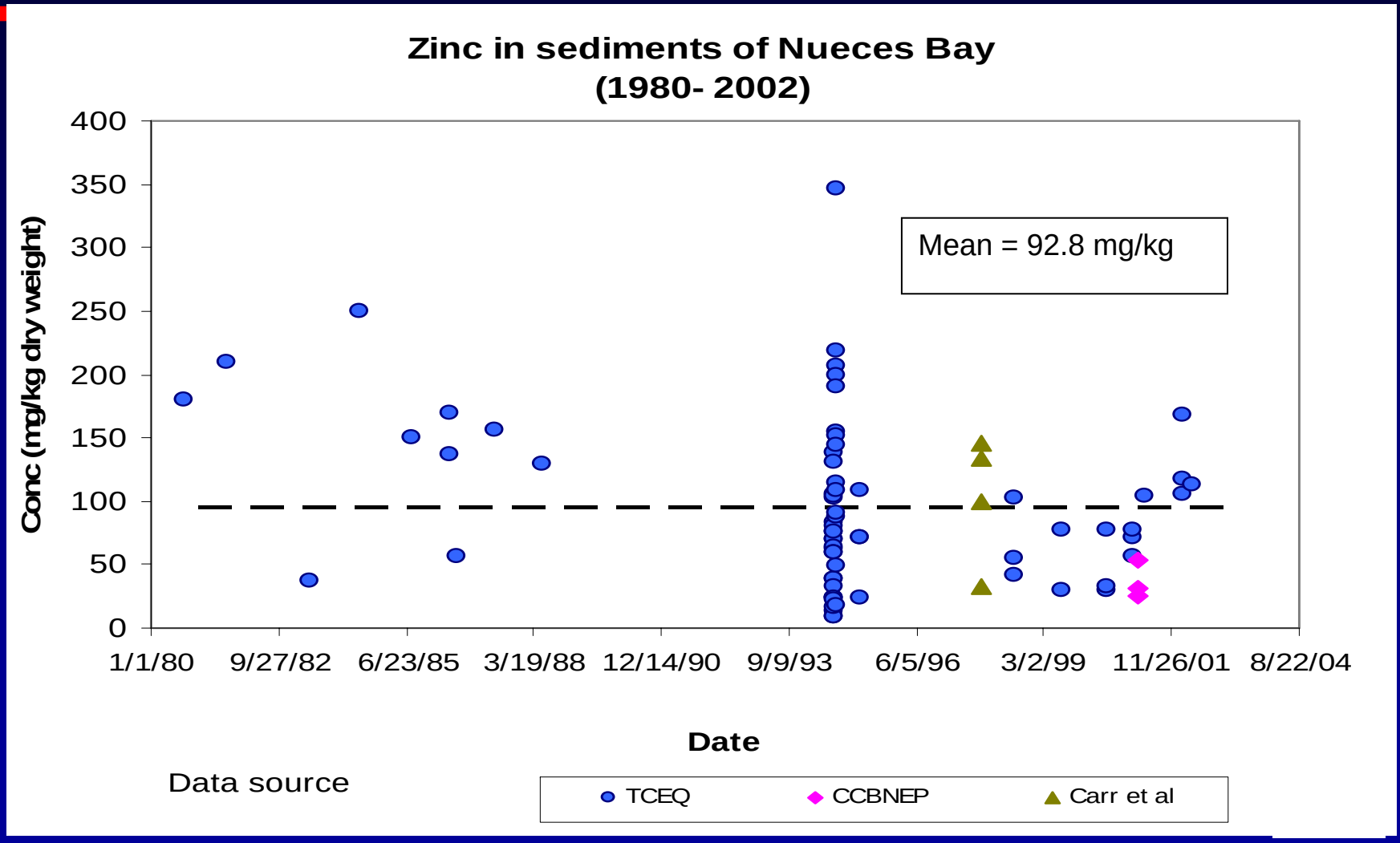
Historical Water Data

(from Mrini, et al., 2003)



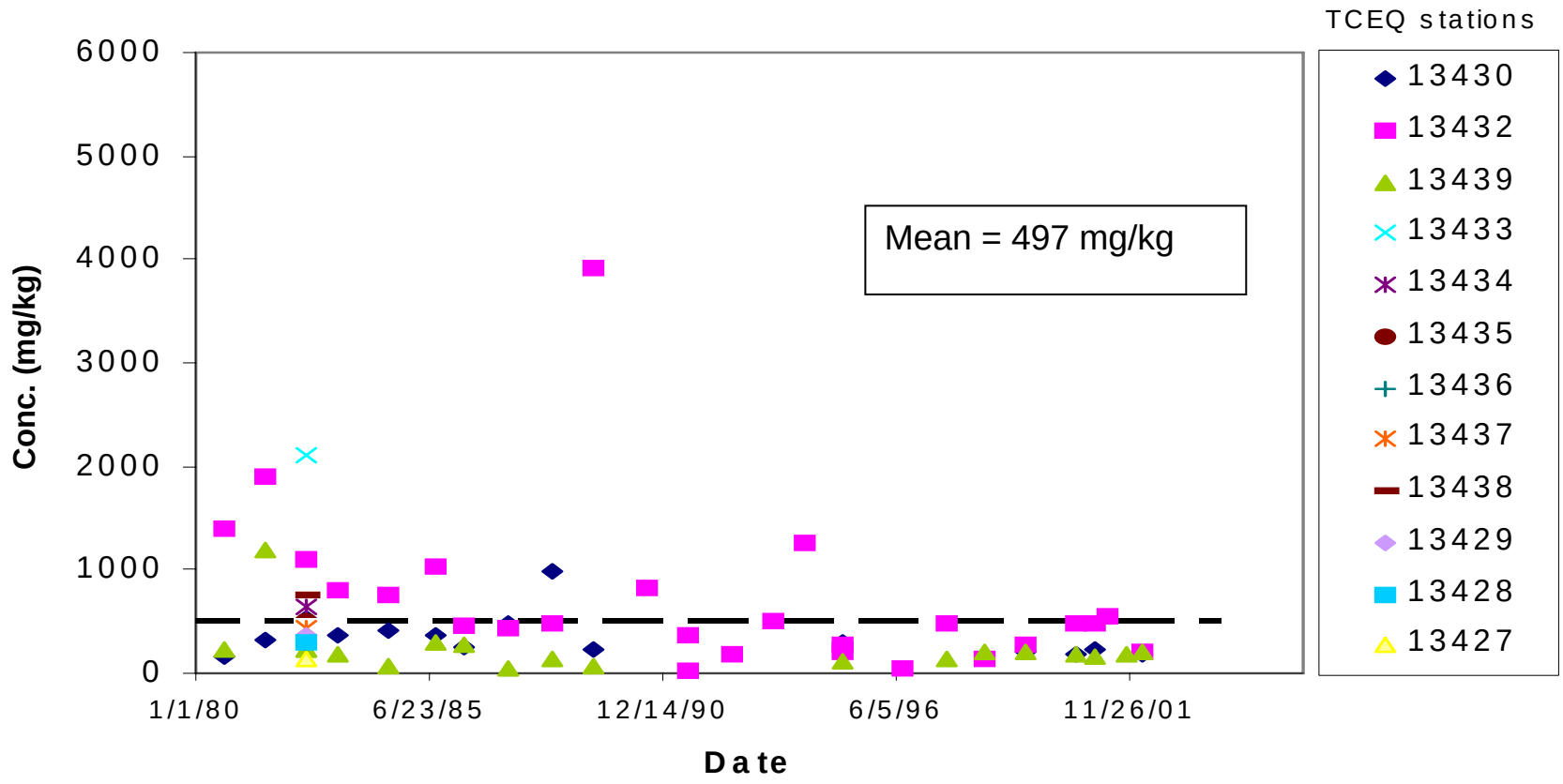
Historical Sediment Data

(from Mrini, et al., 2003)



Historical Sediment Data

(from Mrini, et al., 2003)



Source Analysis

- Total zinc loadings Model (Mrini, et al., 2003)
- CSTR model
  - Nonpoint sources (GIS-based watershed model)
    - Upstream watershed
    - Adjacent watershed
  - Atmospheric deposition (dry)
  - Point sources
    - Municipal
    - Industrial

Non-point Sources into Nueces Bay (frm Upstream Watershed)

Background zinc concentration for freshwater.

Flow from USGS gauge on Nueces River

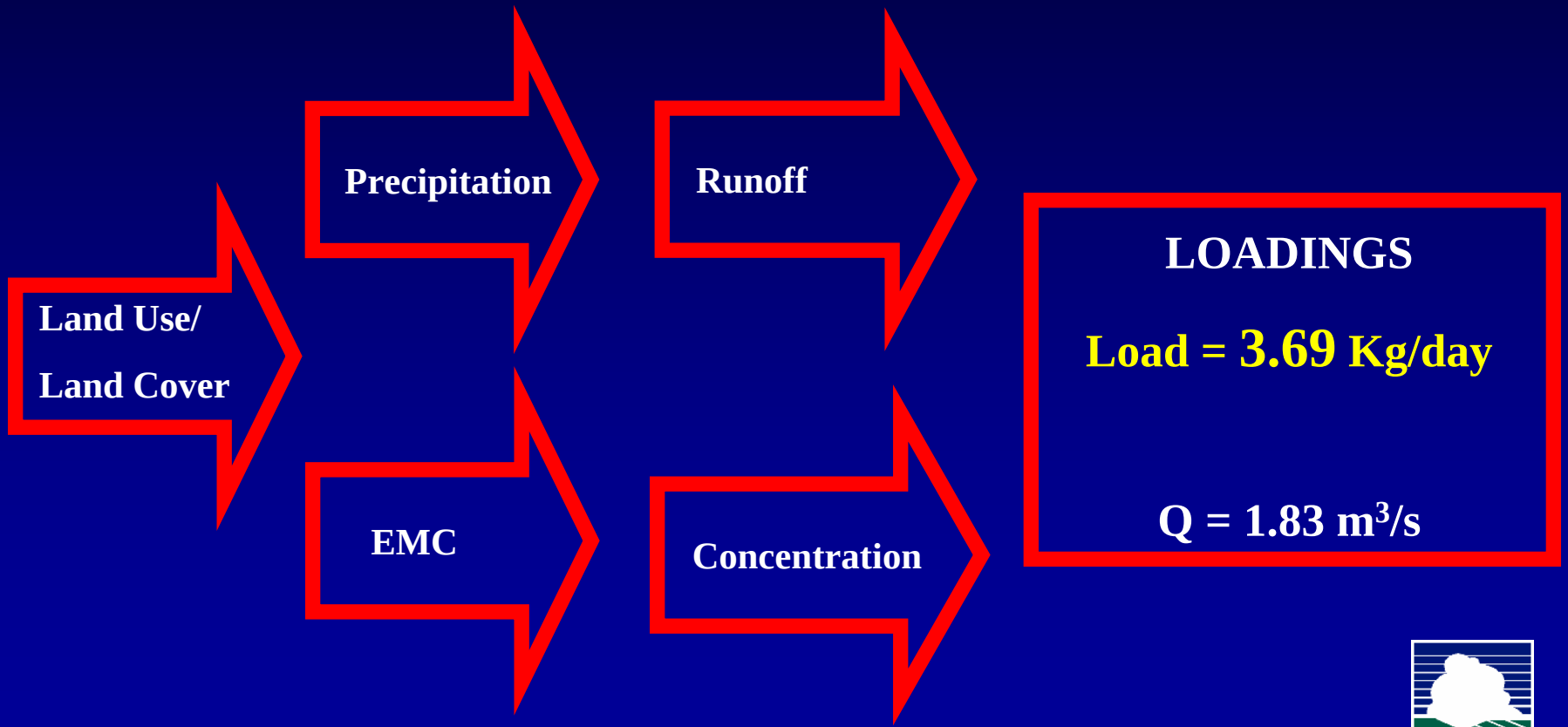
LOADINGS

Load = 4.27 Kg/day

Q = 2.47 m^3/s

Non-point Sources

(frm NB Adjacent Watershed)



Atmospheric Source

(Atmospheric deposition[1]) (bay area)

LOADINGS

Load = 18.67 Kg/day

[1]Wade, et al., 2000

Permitted Point Sources

Name	Permit No.	Permit type	Max permitted flow (MGD)
Nueces Bay Power Station	WQ0001244-000	Industrial	500
City of Portland	WQ0010478-001	Municipal	2.5
Sublight Enterprises Inc.	WQ0011096-001	Municipal	0.009
City of Odem (pending)	WQ0010297-002	Municipal	<1

Point Sources

(Municipal)

(Typical Pollutant Concentration[1]
0.165 mg/l) (Permitted Flow)

LOADINGS

Load = 1.57 Kg/day

[1]Armstrong and Ward, 1998

Point Sources

(Industrial)

(Avg. zinc concentration in CCIH 37ug/l)

(Permitted Flow from Nueces Bay Power Station 500 MGD)

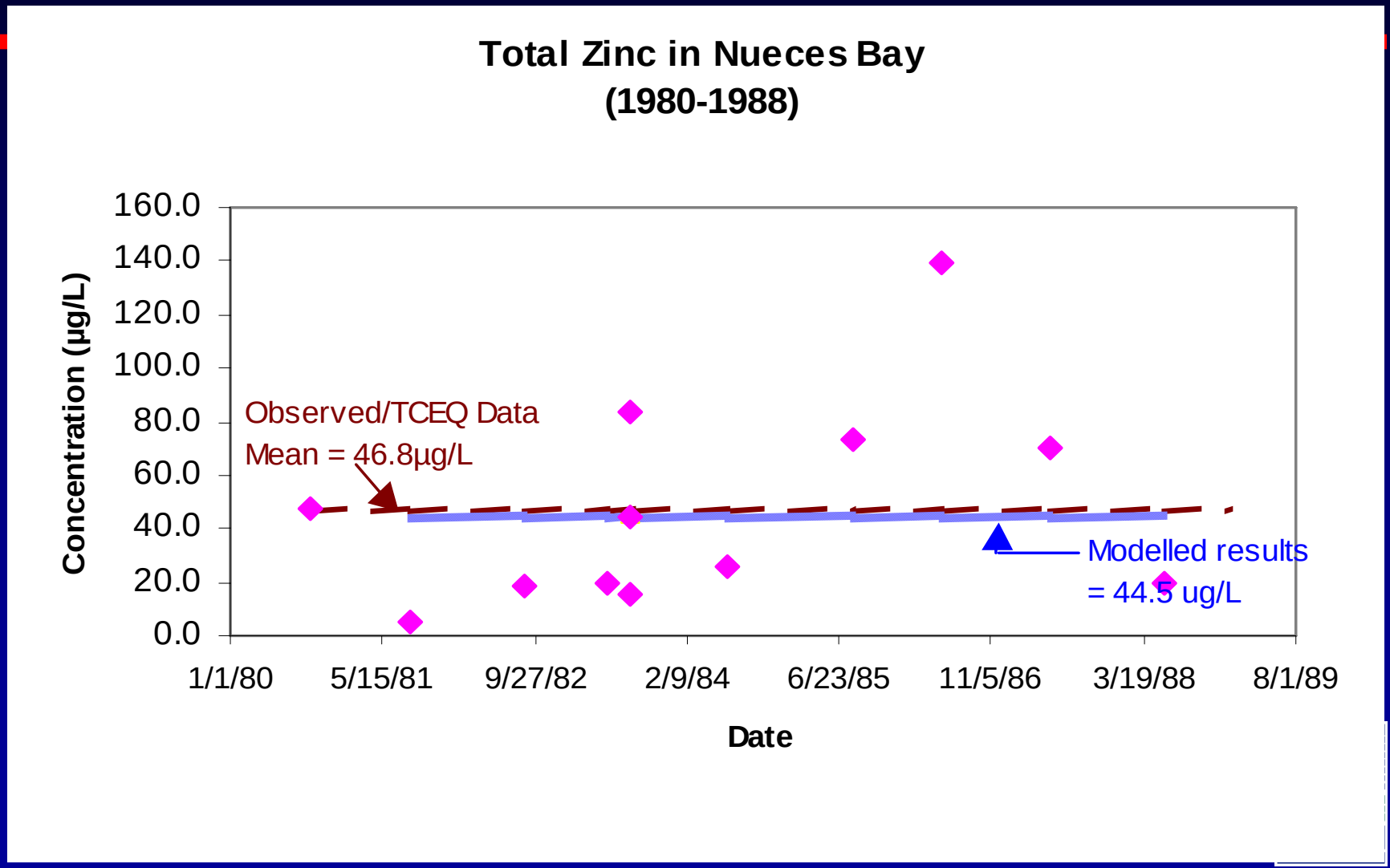
LOADINGS

Load = 70.01 Kg/day

Total Zinc Loads

Source	Load (kg/d)	%
NPS		
Upstream	4.27	4.35
Adjacent	3.69	3.76
Atm. Dep.	18.67	19.01
Subtotal	26.63	27.1
PS		
Municipal	1.57	1.6
Industrial	70.01	71.3
Subtotal	71.58	72.9
Total	98.2	100

Modeled vs. Observed



Pollutant Load Allocation

Scenario	Load (kg/d)	Conc. (ug/l)	Flow (m^3/s)
Current	98.2	61.4	26.31
Target	65.9	29	26.31
Load Reduction needed	32.3	----	----

Pollutant Load Allocation

$$TMDL = \sum LA + \sum WLA + AFG$$

TMDL = 26.6 kg/d + 32.6 kg/d + 6.7 kg/d

TMDL = 65.9 kg/d

Where

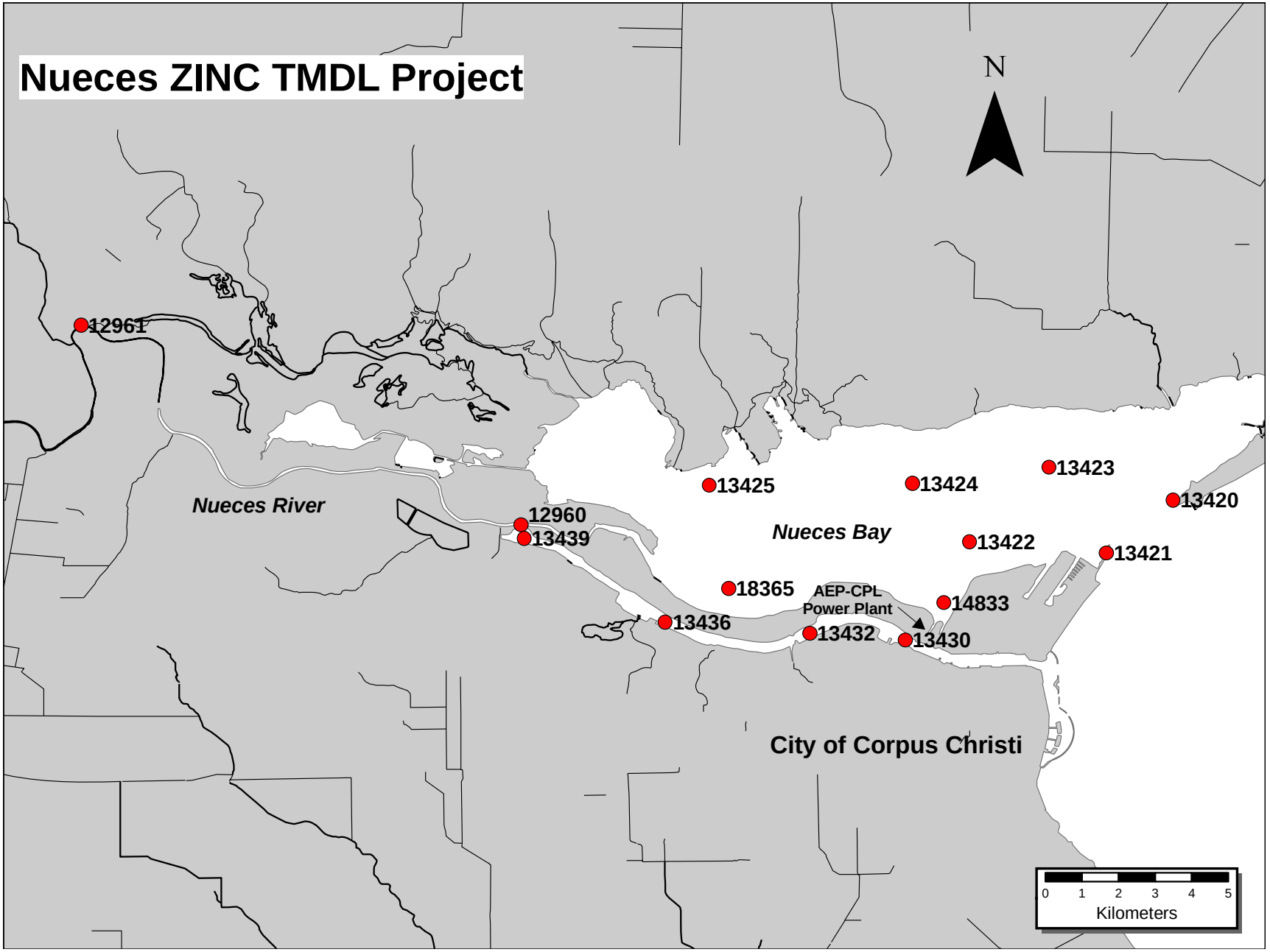
∑LA = subtotal for NPS (26.6 kg/d),

∑WLA = subtotal for PS (71.58 kg/d) – load reduction (32.3 kg/d), and

AFG = 10% of TMDL (65.9 kg/d)

New Data
(June 2004 to May 2005)

- Parameters:
  - Zinc in water and sediment
  - Field (temp., DO, salinity, pH, cond., etc.)
  - Other (TOC, total solids, TSS, sediment grain size)
- Frequency:
  - Quarterly for water
  - Biannually for sediment
- Stations:
  - 8 in Nueces Bay, 2 in Nueces River
  - 4 in Corpus Christi Inner Harbor


Nueces ZINC TMDL Project
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Nueces River
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Nueces Bay
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18365
AEP-CPL
Power Plant
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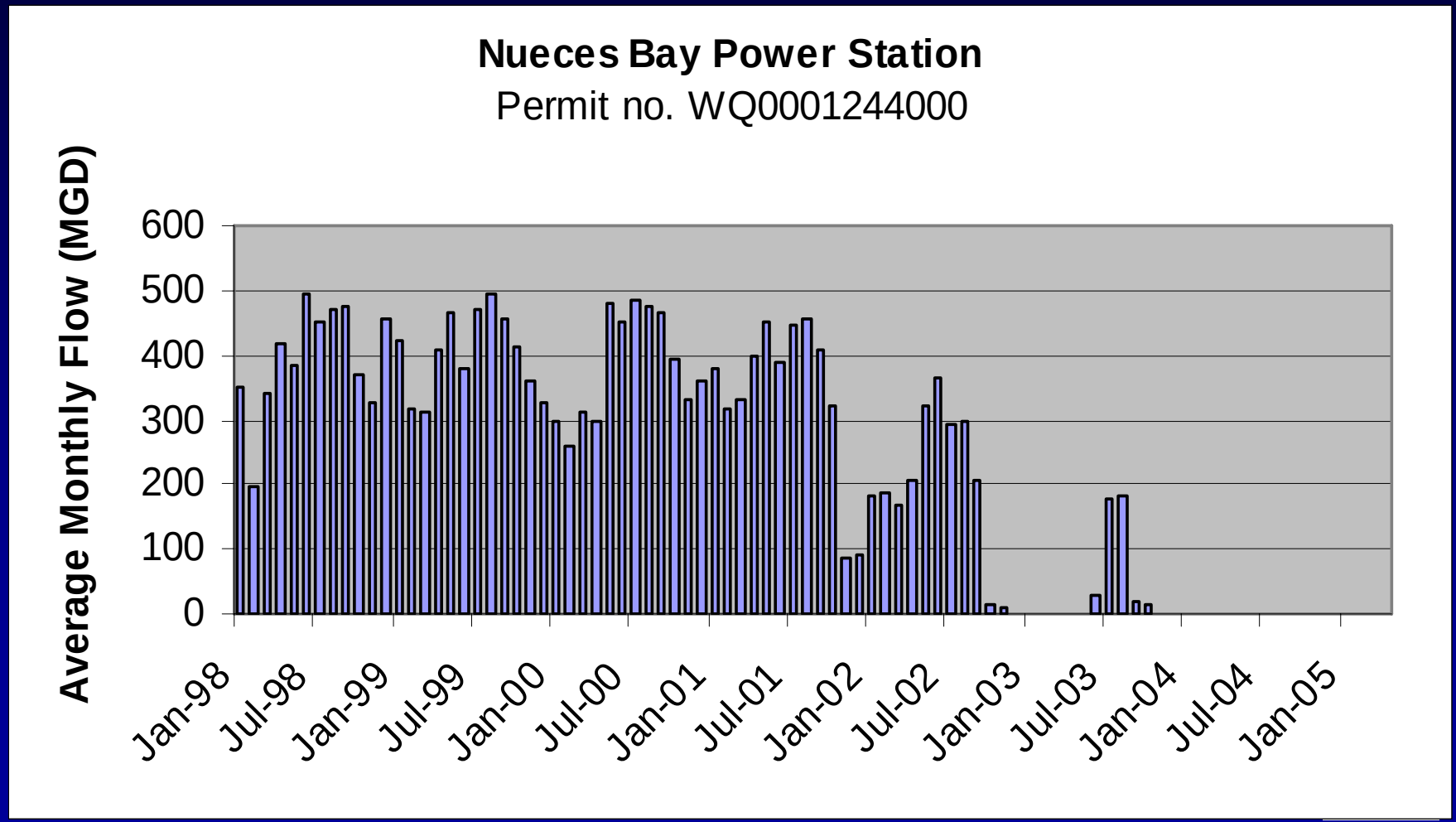
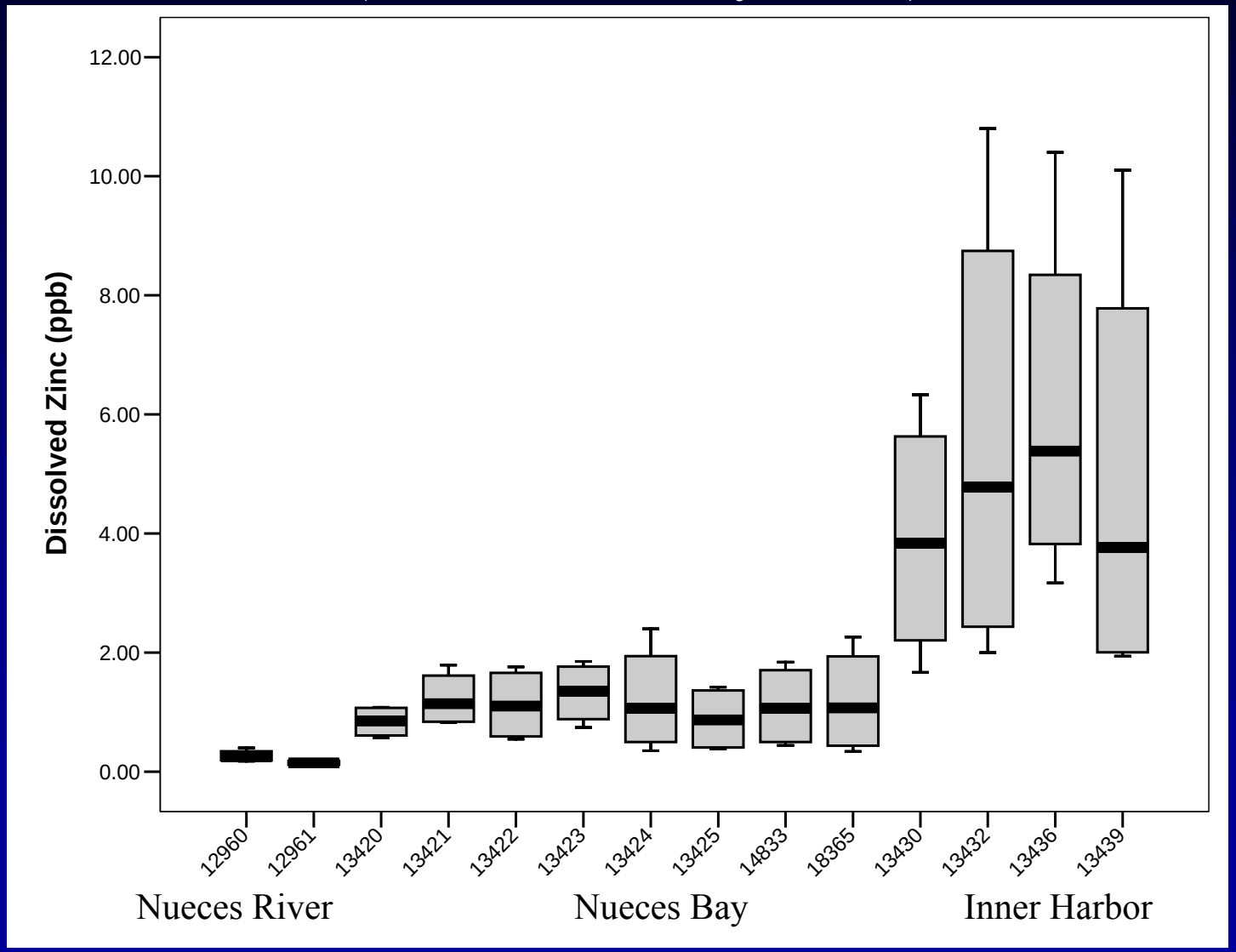
13432
13430
City of Corpus Christi
0 1 2 3 4 5
Kilometers

Power Stn Flows



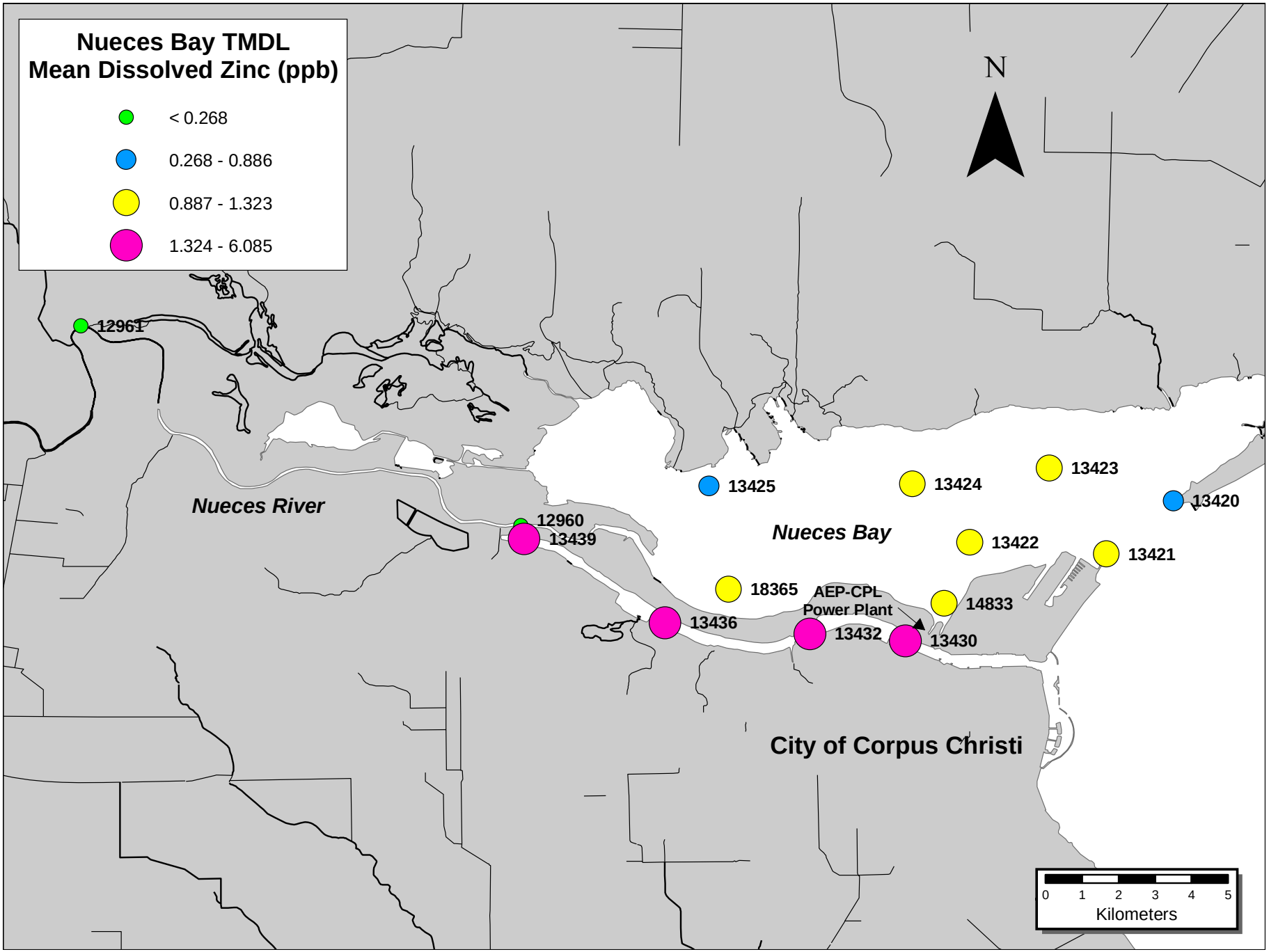
Dissolved Zinc in Water

(June 2004-May 2005)



Average Dissolved Zinc (2004-05)

Waterbody	**Avg. Diss. Zinc (ug/l)**
Nueces River tidal	0.21
Nueces Bay	1.11
Corpus Christi Inner Harbor	5.12


Nueces Bay TMDL
Mean Dissolved Zinc (ppb)
< 0.268
0.268 - 0.886
0.887 - 1.323
1.324 - 6.085
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Nueces River
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0 1 2 3 4 5
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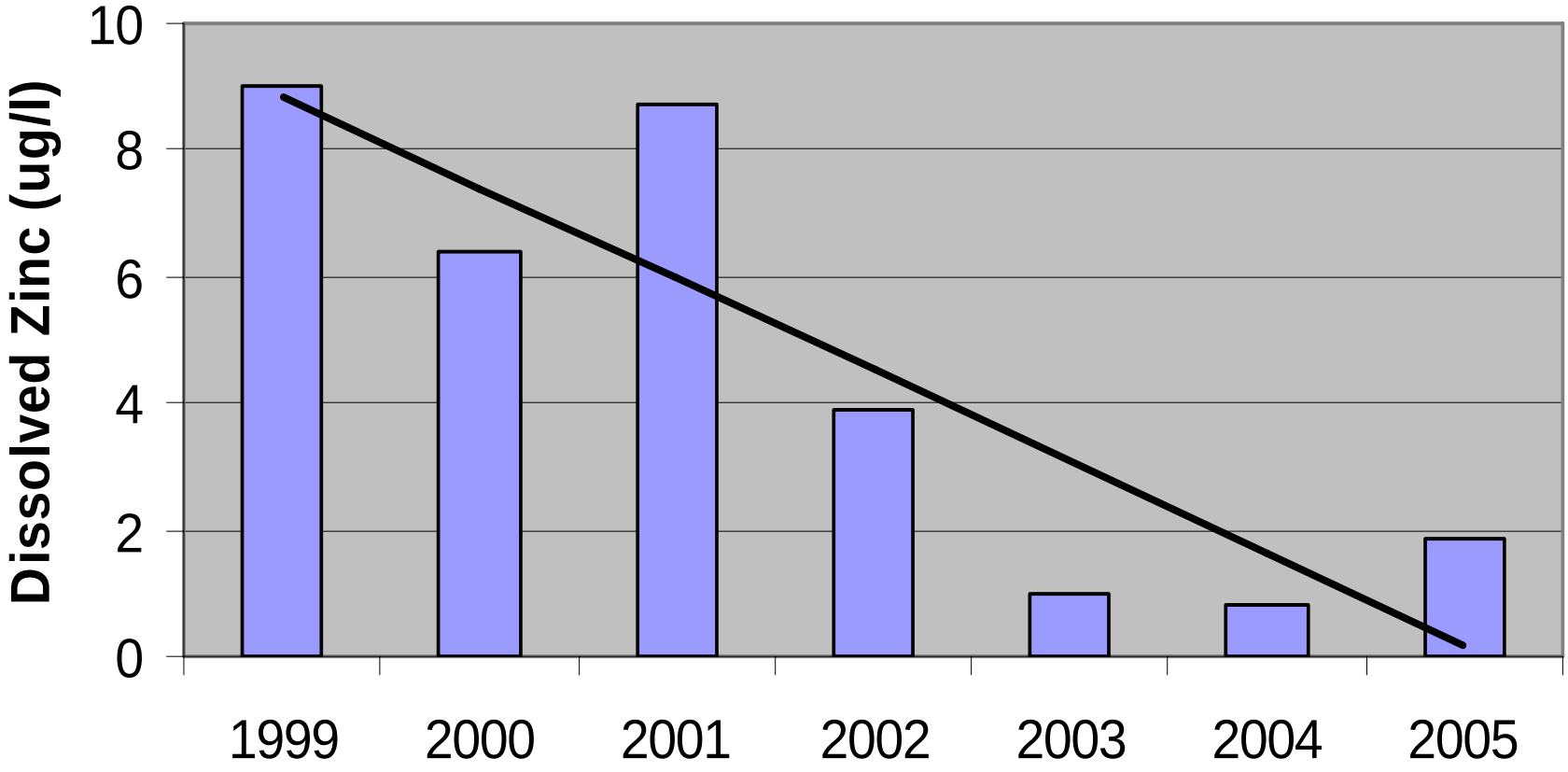
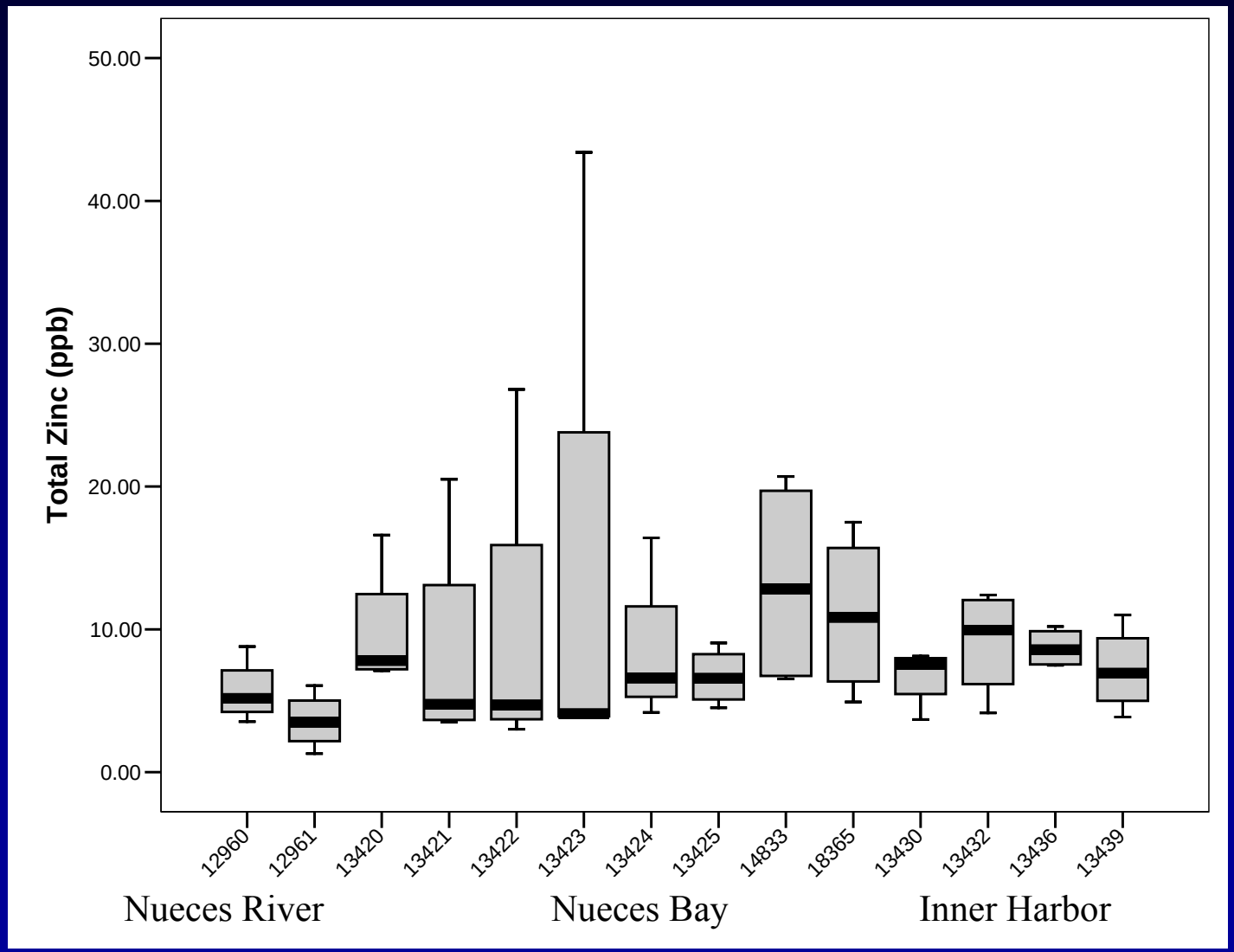
Nueces Bay Average Dissolved Zinc
1999-2004

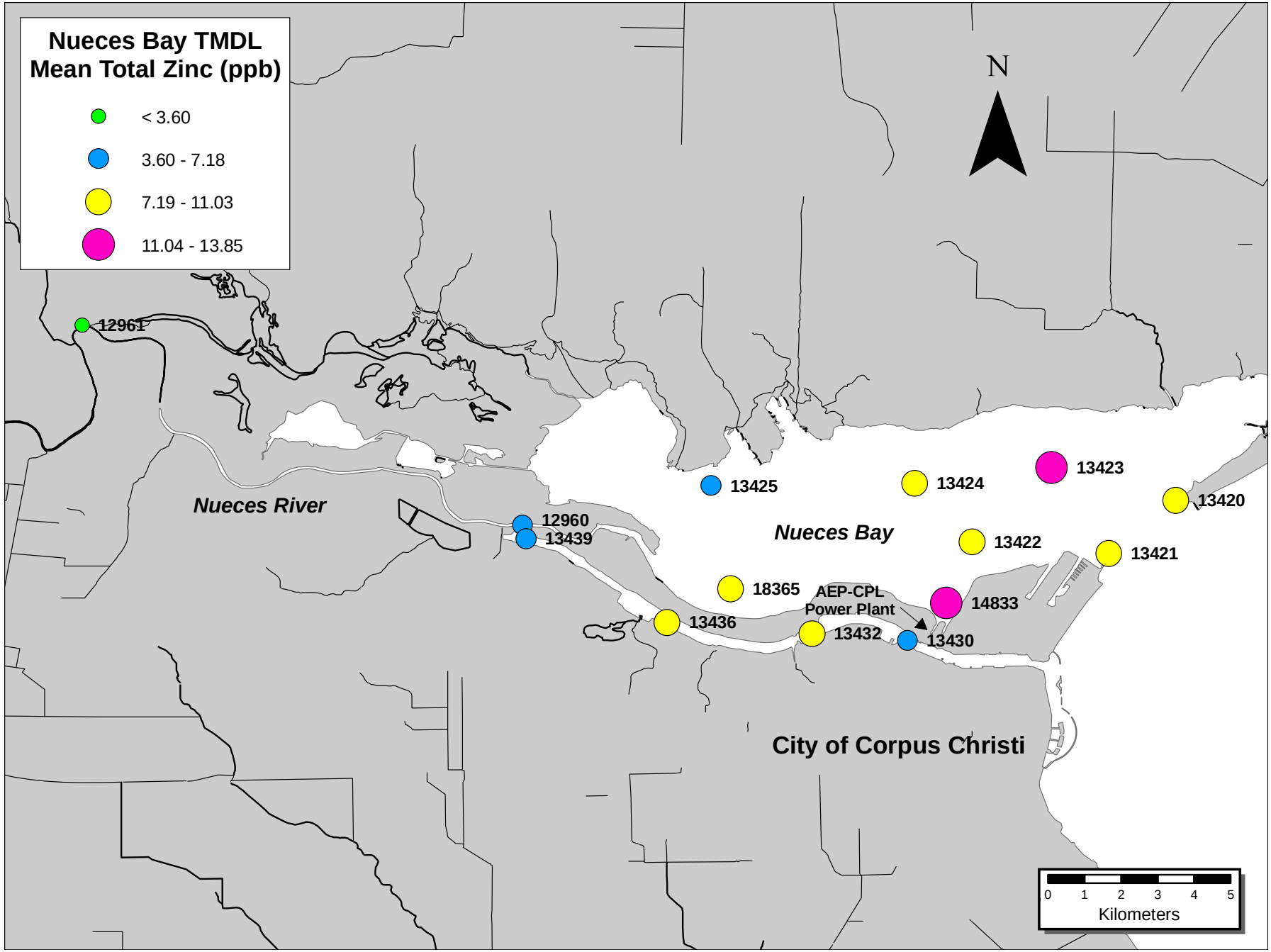


Total Zinc in Water



Average Total Zinc

Segment	Avg. Tot. Zn (ug/l)
Nueces River tidal	4.63
Nueces Bay	10.15
Corpus Christi Inner Harbor	7.93


Nueces Bay TMDL
Mean Total Zinc (ppb)
< 3.60
3.60 - 7.18
7.19 - 11.03
11.04 - 13.85
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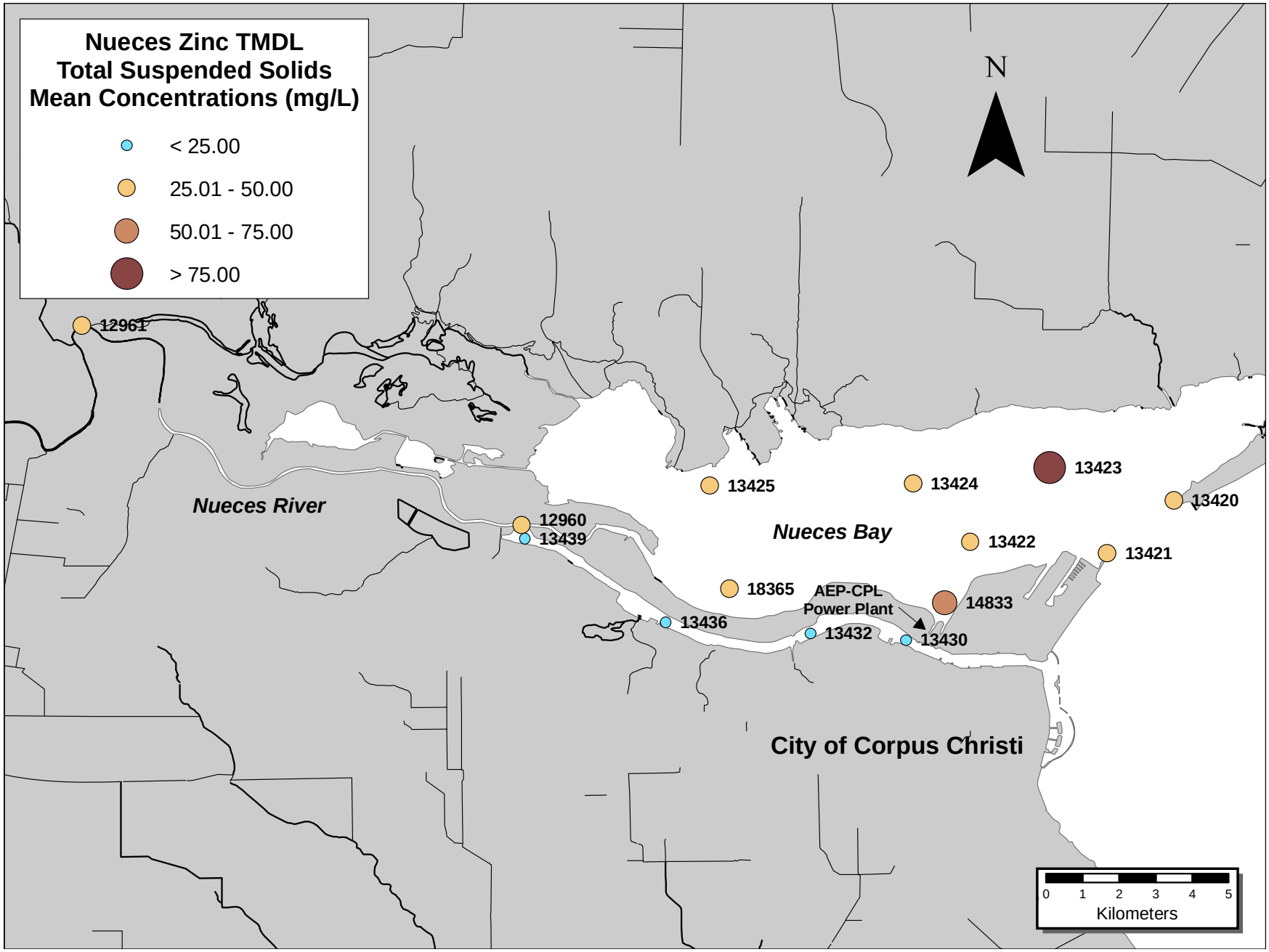
Nueces Zinc TMDL
Total Suspended Solids
Mean Concentrations (mg/L)
< 25.00
25.01 - 50.00
50.01 - 75.00
> 75.00
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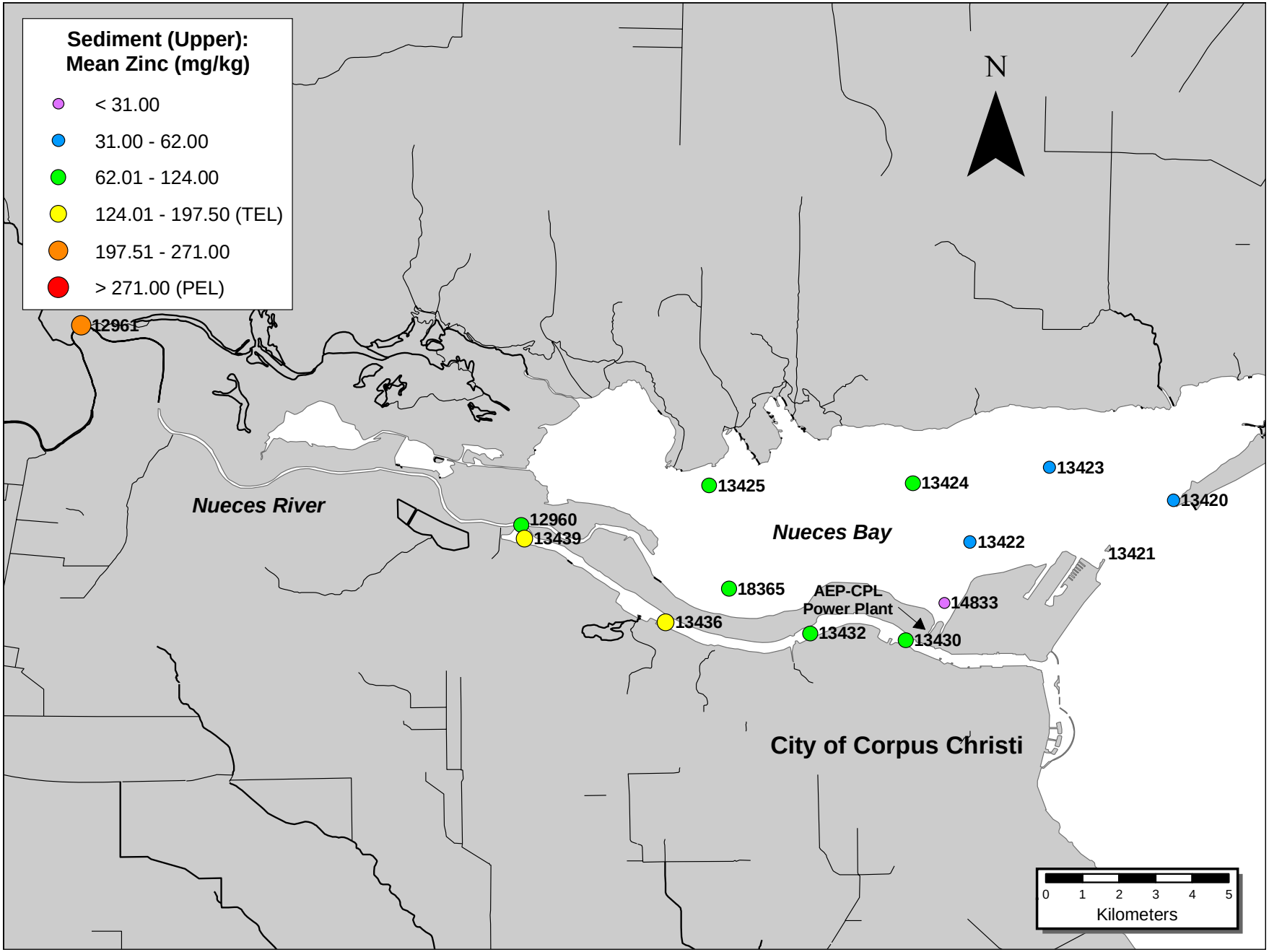
Sediment (Upper):
Mean Zinc (mg/kg)
< 31.00
31.00 - 62.00
62.01 - 124.00
124.01 - 197.50 (TEL)
197.51 - 271.00
> 271.00 (PEL)
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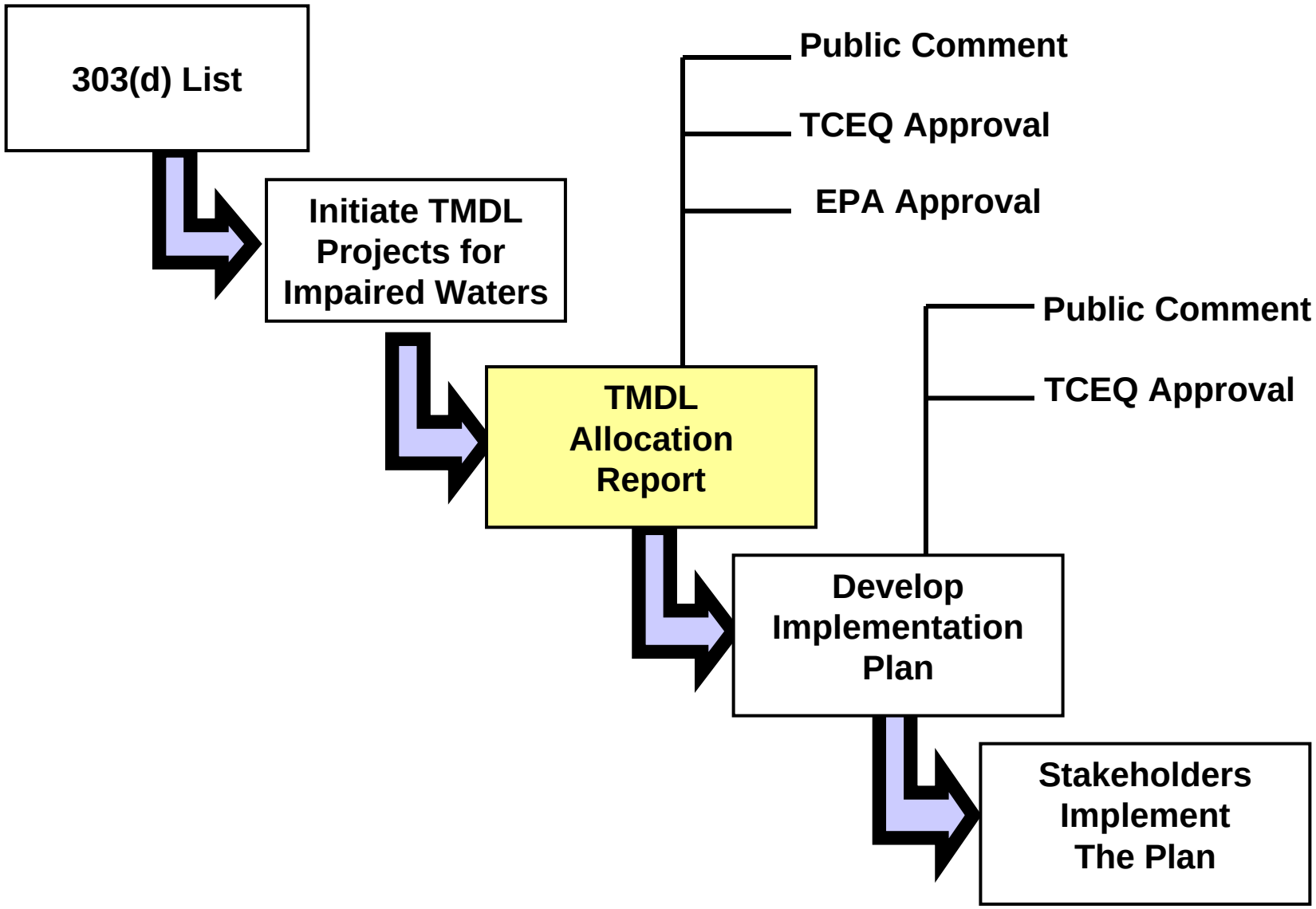
303(d) List
Initiate TMDL Projects for Impaired Waters
TMDL Allocation Report
Public Comment
TCEQ Approval
EPA Approval
Develop Implementation Plan
Public Comment
TCEQ Approval
Stakeholders Implement The Plan

Implementation Plan Strategy

- Phased Implementation:
  - I. Reduce NBPS zinc load
  - II. Investigate source of atmospheric deposition
  - III. CCIH dredging options
- Continue monitoring water, sediment and tissue
- Evaluate progress toward achieving TMDL on a continuing basis
- Hold regular stakeholder meetings

Load Reduction Scenarios

L = Q * C , where L = load (kd/d),
Q = flow (m^3/s), and C = concentration (ug/l) then:

% flow reduction	Reduced flow (m^3/s) Q	Avg. Total zinc in CCIH C	Zinc load from CPL (kg/d) L	Load reduction (kg/d)
100	0	37	0	70.01
90	2.19	37	7.0	63.01
80	4.38	37	14.0	56.01
70	6.57	37	21.0	49.01
60	8.76	37	28.0	42.01
50	10.95	37	35.0	35.01
40	13.14	37	42.0	28.01
30	15.3	37	48.91	21.10
20	17.5	37	55.94	14.07
10	19.7	37	62.98	7.03

www.tnrcc.state.tx.us/water/quality/tmdl/

Faith Hambleton, Program Manager
fhamblet@tceq.state.tx.us

Sandra Alvarado, Project Manager
salvarad@tceq.state.tx.us
512/239-6643