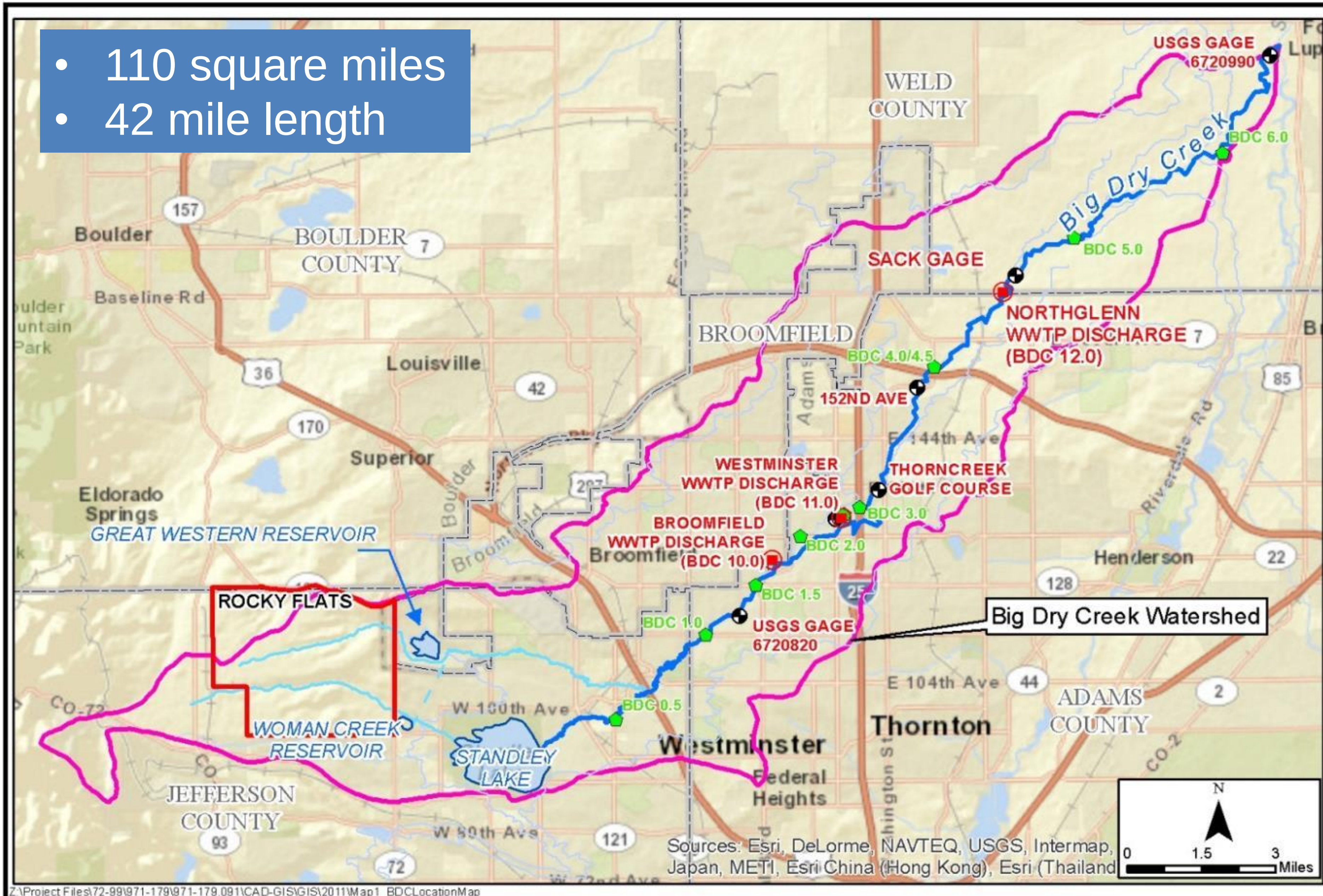
What's New with Your Neighbor?

2016 Big Dry Creek Watershed Update

Jane Clary,
Wright Water Engineers
October 25, 2016

- 110 square miles
- 42 mile length



Big Dry Creek Watershed Association

- Formed 501(c)(3) in 2004; active since 1997
- Financially Contributing Members
  - Board of Directors
    - City and County of Broomfield
    - City of Westminster
    - City of Northglenn
    - Adams County (no WWTP)
    - Weld County (no WWTP)
  - Woman Creek Reservoir Authority
- In-kind Support--City of Thornton

Major Activities During 2015-2016

- Collaborative instream monitoring program
- Support of Westminster USGS gage
- Database management
- Annual water quality analysis
- Biological Monitoring
  - October 2014 fish & bugs analysis/report
  - October 2016 sampling
- Annual newsletter
- BDCWA meetings
- Co-sponsoring CLEAN Center research project focused on stream erosion
- Participating in CLEAN Center as an overall case study
- Participated in Regulation 38 Hearing and 2016 303(d) List Hearing
- Participated in E. coli TMDL process with CDPHE/EPA
- Regional involvement: Barr-Milton/Nutrient Symposium

Monitoring and Analysis: Making Sure We Have Scientifically Defensible Information

- Monitoring plan on website: www.bigdrycreek.org
- 8 locations monitored monthly for water quality and/or flow
- Nutrients, metals, *E. coli*, other
- Macroinvertebrate, fish and habitat assessment—now biennially at 6 sites
- USGS Gage at Westminster (funding)
- Database/data sharing—supports regulatory processes such as Regulation 38, 303(d) List, discharge permit process, etc.

Highlights of Annual Water Quality Analysis (for 2015 data)

- Constituents of interest
  - *E. coli*
  - Selenium
  - Iron
  - Nutrients
  - Biological/ aquatic life

Overall Comparison to Designated Uses and Standards

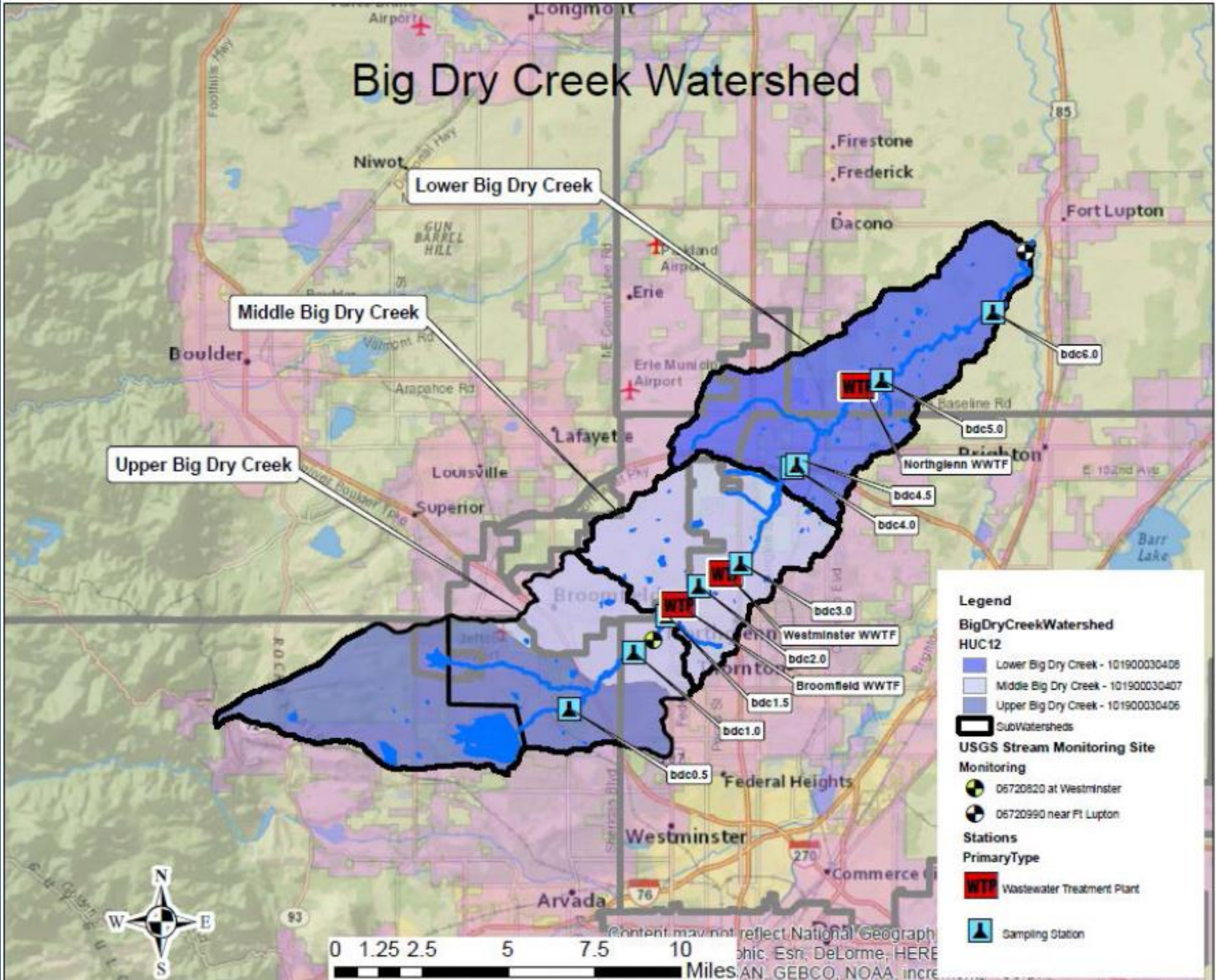
Designated Uses	Use Attained?
Aquatic Life Life Warm 2	Partial*
Recreation P (Potential Primary Contact)	no
Agriculture	yes
Parameter Groups	**Standards Attained?**
Physical (e.g., DO, pH)	yes
Biological (E. coli)	no
Inorganics (e.g., CN, NH3)	yes
Metals (e.g., Cu, Cd, Zn, Se)	Partial (Fe below WCR 8)
Other	**Comments**
Interim Nutrient Values (e.g., TP, TN)	Future Issue
Aquatic Life Policy 10-1 (e.g., MMI)	Attains

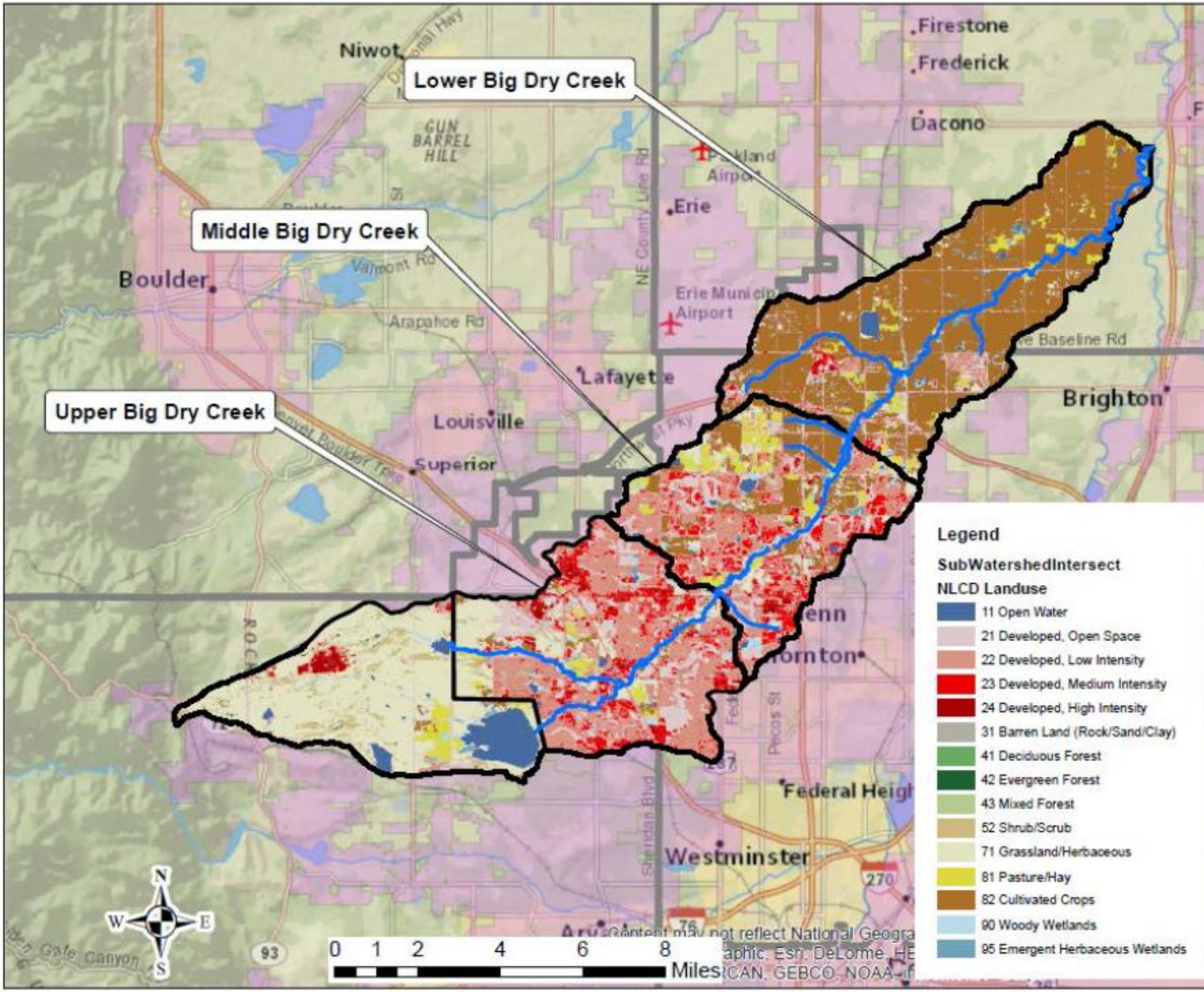
E. coli TMDL

- Load duration curve approach
- 10% MOS + Reserve Capacity
- Reductions not targeted to WWTPs
- Public notice and final notice completed summer 2016
- Prepared by Division with input from BDCWA
- Hydrology was a major complicating factor

COLORADO
Department of Public Health & Environment

Total Maximum Daily Load Assessment
Big Dry Creek – COSPBD01, Broomfield, Jefferson, Adams, and Weld Counties, Colorado


Big Dry Creek Watershed
Lower Big Dry Creek
Middle Big Dry Creek
Upper Big Dry Creek
Longmont
Niwot
Boulder
Lafayette
Louisville
Superior
Broomfield
Erie
Firestone
Frederick
Dacono
Fort Lupton
Brighton
Thornton
Federal Heights
Westminster
Arvada
Commerce City
Barr Lake
bdc6.0
bdc5.0
Northglenn WWTF
bdc4.5
bdc4.0
bdc3.0
Westminster WWTF
bdc2.0
Broomfield WWTF
bdc1.5
bdc1.0
bdc0.5
Legend
BigDryCreekWatershed
HUC12
Lower Big Dry Creek - 101900030408
Middle Big Dry Creek - 101900030407
Upper Big Dry Creek - 101900030406
SubWatersheds
USGS Stream Monitoring Site
Monitoring
06720820 at Westminster
06720990 near Ft Lupton
Stations
PrimaryType
WTP Wastewater Treatment Plant
Sampling Station
0 1.25 2.5 5 7.5 10
Miles
N
S
E
W


Lower Big Dry Creek
Middle Big Dry Creek
Upper Big Dry Creek
Firestone
Frederick
Dacono
Niwot
Erie
Boulder
Lafayette
Louisville
Superior
Brighton
Westminster
Federal Heigh
Erie Municip Airport
Baseline Rd
Arapahoe Rd
Legend
SubWatershedIntersect
NLCD Landuse
11 Open Water
21 Developed, Open Space
22 Developed, Low Intensity
23 Developed, Medium Intensity
24 Developed, High Intensity
31 Barren Land (Rock/Sand/Clay)
41 Deciduous Forest
42 Evergreen Forest
43 Mixed Forest
52 Shrub/Scrub
71 Grassland/Herbaceous
81 Pasture/Hay
82 Cultivated Crops
90 Woody Wetlands
95 Emergent Herbaceous Wetlands
0 1 2 4 6 8
Miles
N
S
E
W

Load Duration Curve: Upper Portion (Standley Lake to bdc1.5)

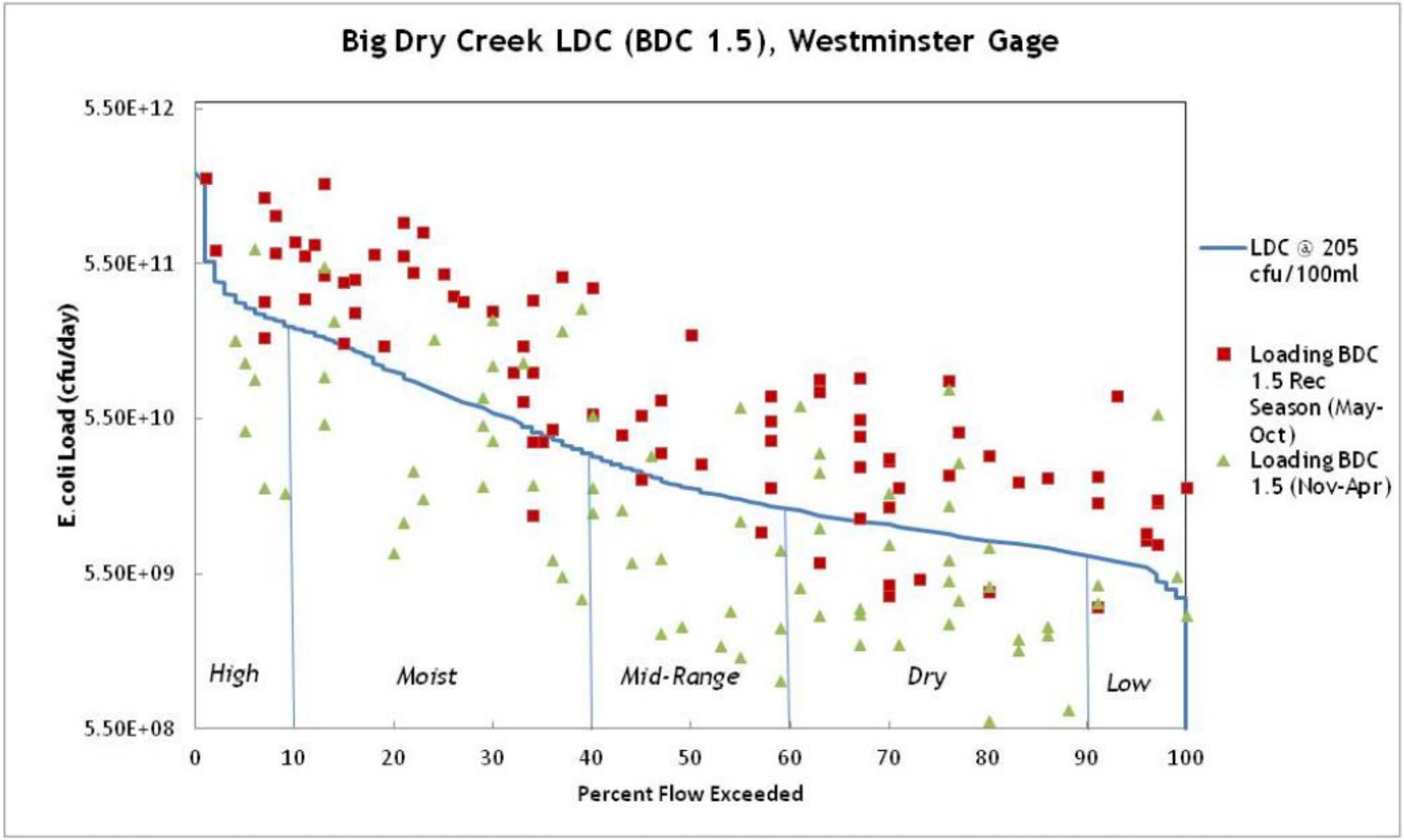


Figure 6.2-1 E. coli data (2003-2014) for bdc1.5 plotted on load duration curve based on Westminster flow gage.

Load Duration Curve: Middle Portion

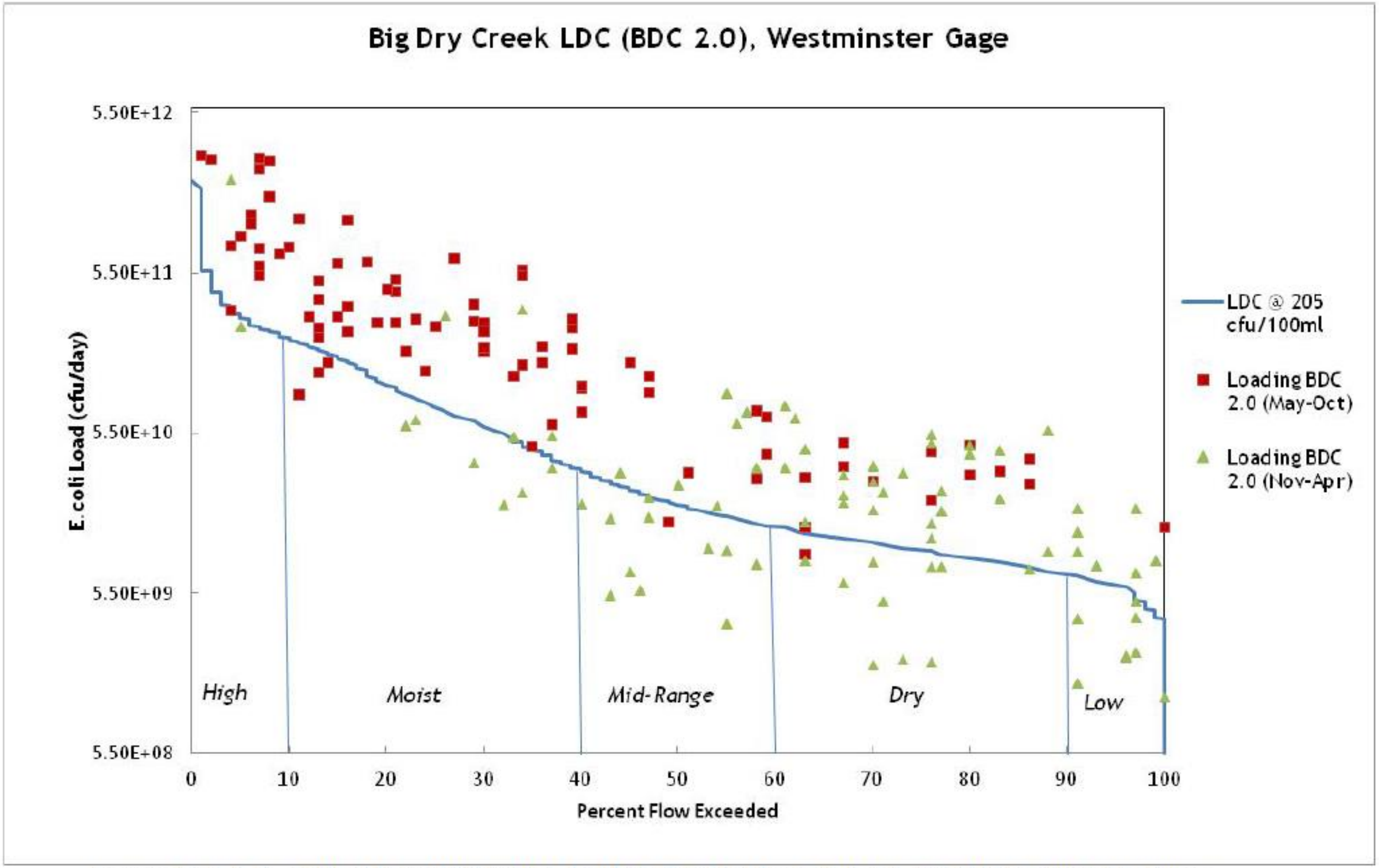


Figure 6.2-1 E. coli data (2003-2014) for bdc2.0 plotted on load duration curve based on Westminster flow gage.

Load Duration Curve: Lower Portion (152nd to South Platte)

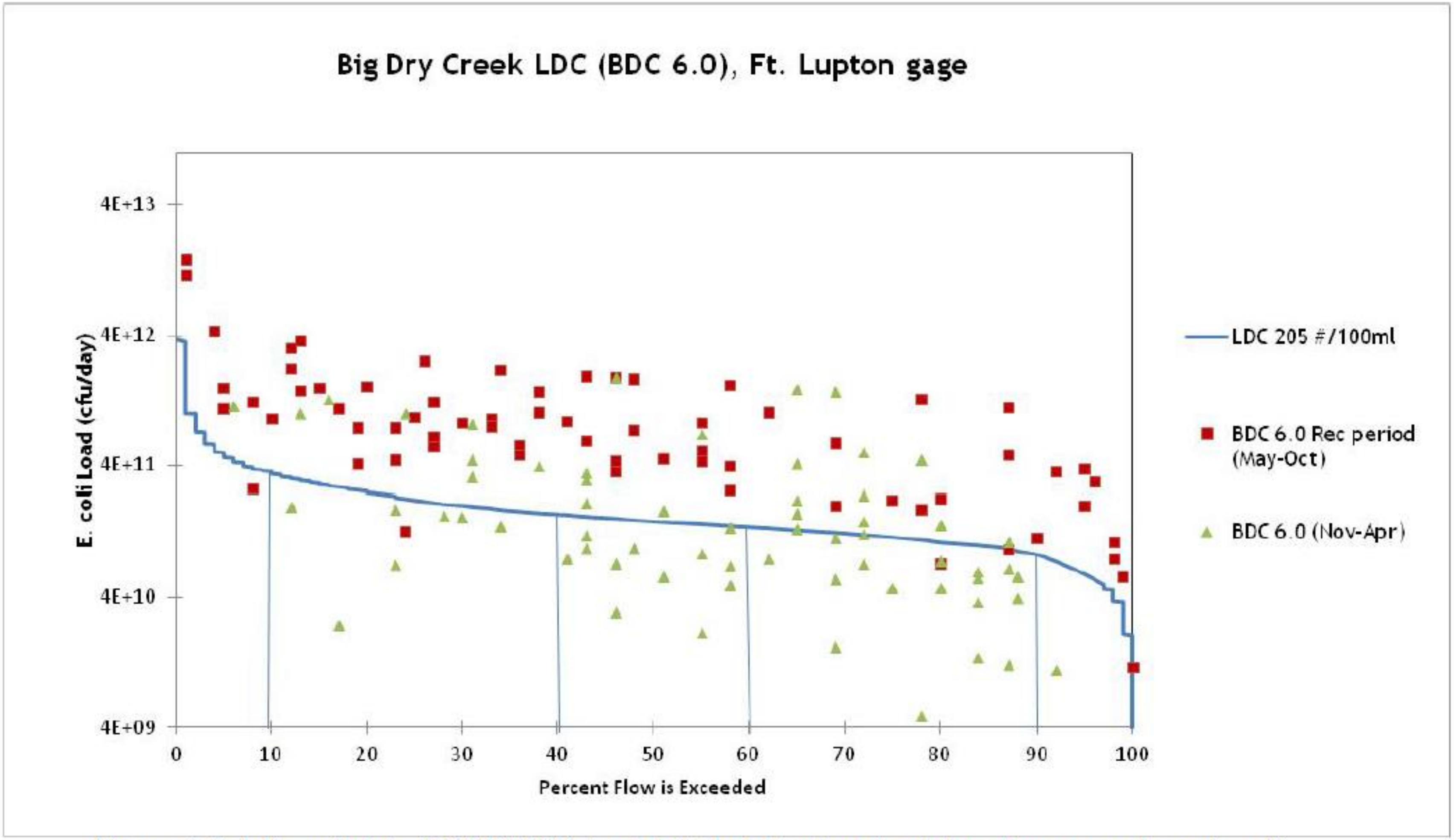


Figure 6.2-1 E. coli data (2003-2014) for bdc6.0 plotted on load duration curve based on Ft. Lupton flow gage.

Upper Reach

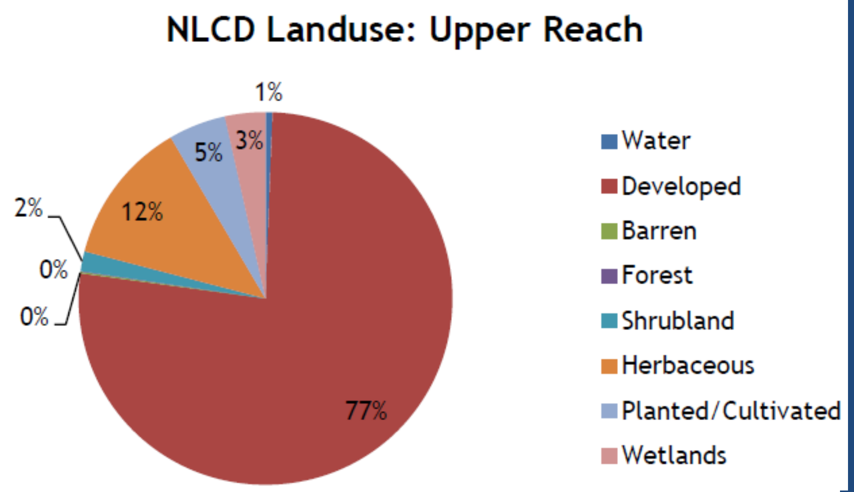


Table 2. Upper Reach *E. coli* TMDL: allowable loading and pollutant reductions necessary to meet the recreation based *E. coli* standard in Big Dry Creek.

Loading Calculations (Giga cfu/day)	High Flow	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flow
TMDL	290.90	80.25	20.06	10.03	6.02
MOS (10%)	29.09	8.02	2.01	1.00	0.60
Allowable Load	261.81	72.22	18.06	9.03	5.42
Existing Load	234.61	124.74	16.69	10.18	12.56
Require Reduction	0%	42%	0%	11%	57%
WLA					
MS4s	201.59	55.61	13.90	6.95	4.17
Reserve Capacity	10.08	2.78	0.70	0.35	0.21
LA					
Nonpoint Source	50.14	13.83	3.46	1.73	1.04

Middle Reach

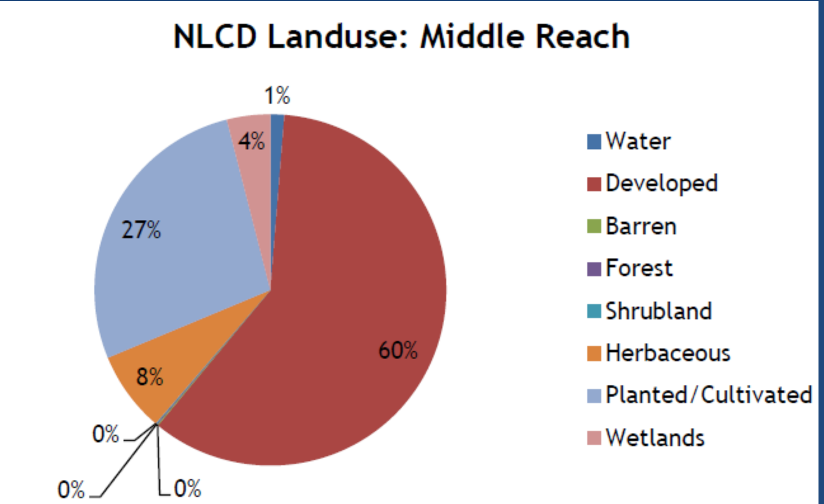


Table 3. Middle Reach *E. coli* TMDL: allowable loading and pollutant reductions necessary to meet the recreation based *E. coli* standard in Big Dry Creek.

Loading Calculations (Giga-cfu/day)	High Flow	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flow
TMDL	423.34	198.56	129.18	73.58	27.94
MOS (10%)	42.33	19.86	12.92	7.36	2.79
Allowable Load	381.01	178.71	116.26	66.22	25.14
Exisiting Load	1119.13	425.48	244.05	114.49	94.98
Required Recuctions	66%	58%	52%	42%	74%
WLA					
Westminster WWTF	58.24	54.32	51.49	31.97	16.99
Broomfield WWTF	74.20	64.00	57.63	31.58	4.92
MS4s	149.14	36.23	4.29	1.60	1.94
Reserve Capacity	7.46	1.81	0.21	0.08	0.10
LA					
Non-point Source	91.97	22.34	2.64	0.99	1.19

Lower Reach

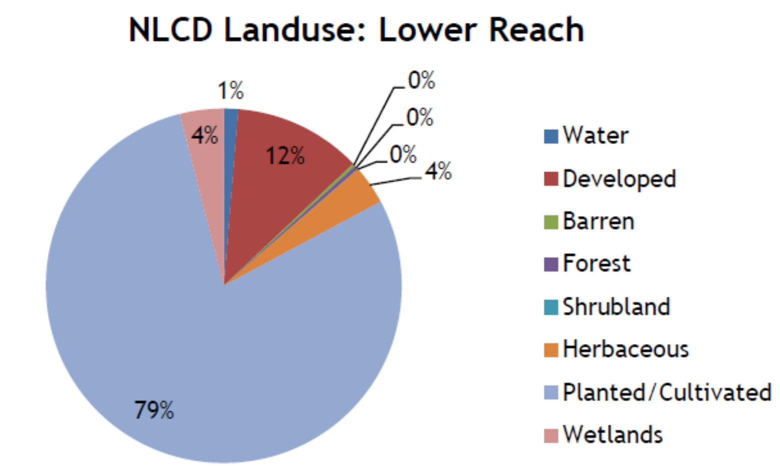


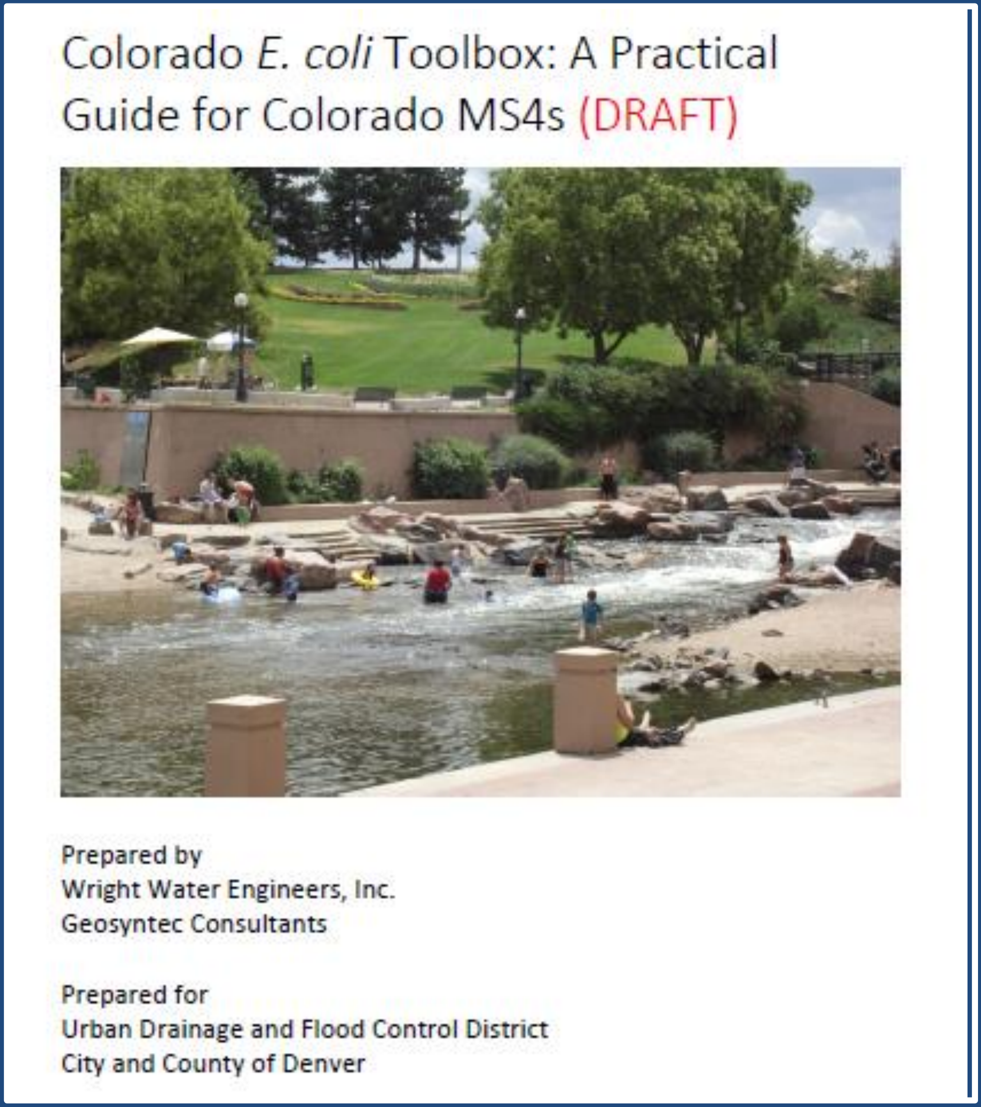
Table 4. Lower Reach *E. coli* TMDL: allowable loading and pollutant reductions necessary to meet the recreation based *E. coli* standard in Big Dry Creek.					
Loading Calculations (Giga cfu/day)	**High Flow**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flow**
TMDL	461.43	225.70	150.47	115.36	65.20
MOS (10%)	46.14	22.57	15.05	11.54	6.52
Allowable Load	415.28	225.70	150.47	115.36	65.20
Existing Load	1682.14	619.55	256.30	134.65	140.81
Required Reductions	75%	64%	41%	14%	54%
WLA					
Northglenn WWTF	50.44	50.44	50.44	50.44	50.44
MS4s	43.78	18.32	10.20	6.41	0.99
Reserve Capacity	4.38	1.83	1.02	0.64	0.10
LA					
Non-point Source	316.68	132.53	73.76	46.33	7.15

Implementation Take-Aways

- Iterative process with CDPS (MS4) permittees and non-point sources
- Additional reductions from WWTPs not required
- MS4 permittees—programs in place, however additional requirements anticipated based on BMP approach
- Coordinated BDCWA approach encouraged, but each MS4 will have permit requirements
- Recognition of benefits of source identification and data limitations at time of TMDL development
- May require additional monitoring
- Concept of site-specific standard based on QMRA recognized as option

Colorado E. coli Toolbox: A Practical Guide for Colorado MS4s

- Introduction
  - Colorado regulations
  - Extent of problem
  - TMDLs
- Finding the sources
- Developing a control strategy
  - Progression of controls
  - Modeling
- Source controls
- Structural BMPs
- Regulatory considerations/site-specific standards



Colorado *E. coli* Toolbox: A Practical Guide for Colorado MS4s (DRAFT)

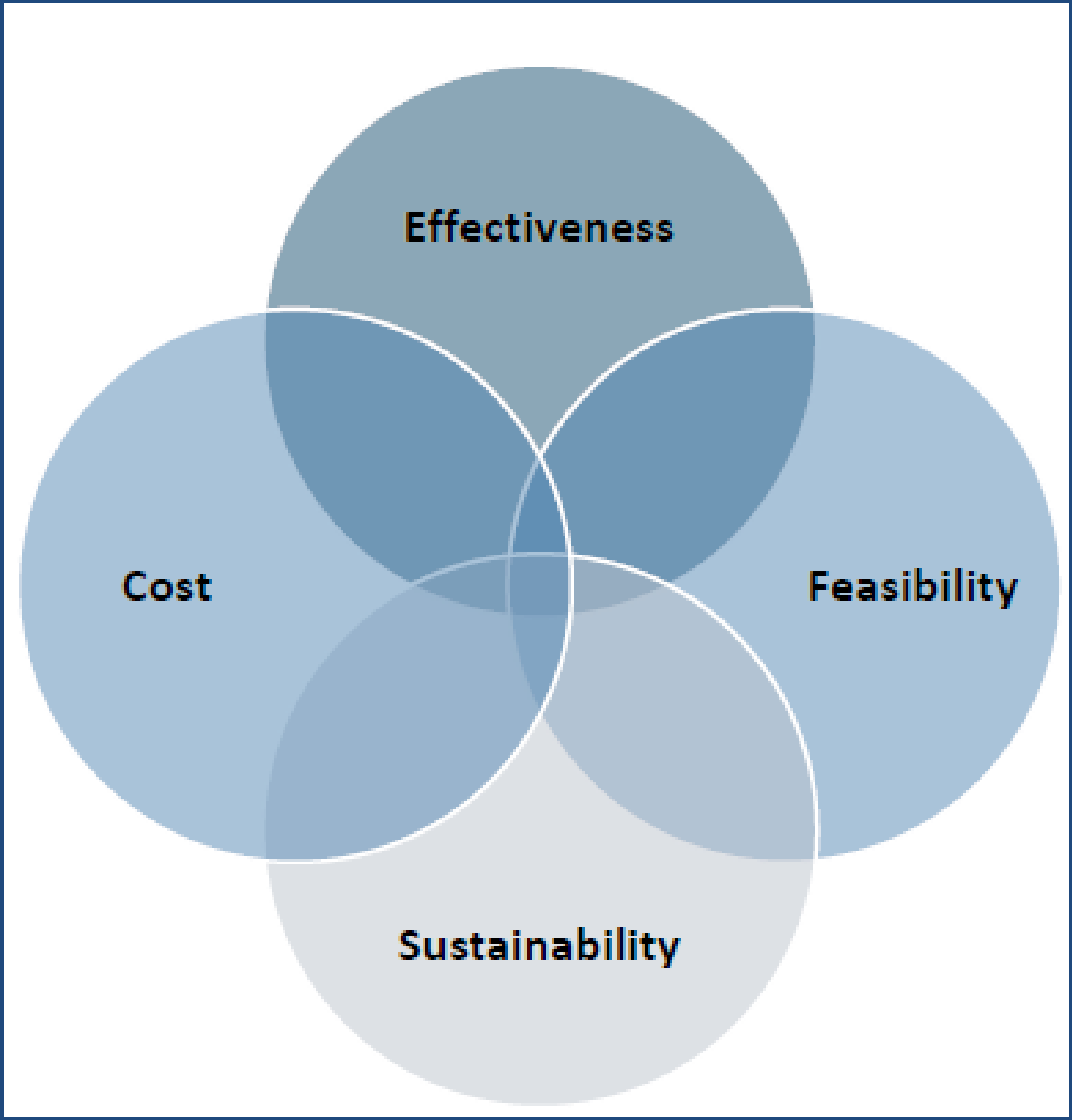
Prepared by
Wright Water Engineers, Inc.
Geosyntec Consultants

Prepared for
Urban Drainage and Flood Control District
City and County of Denver

Developing a Control Strategy

General Themes:

- Address human source first, then other sources
- Address dry weather first, then wet weather
- Implement nonstructural/ source controls, then structural




METALS
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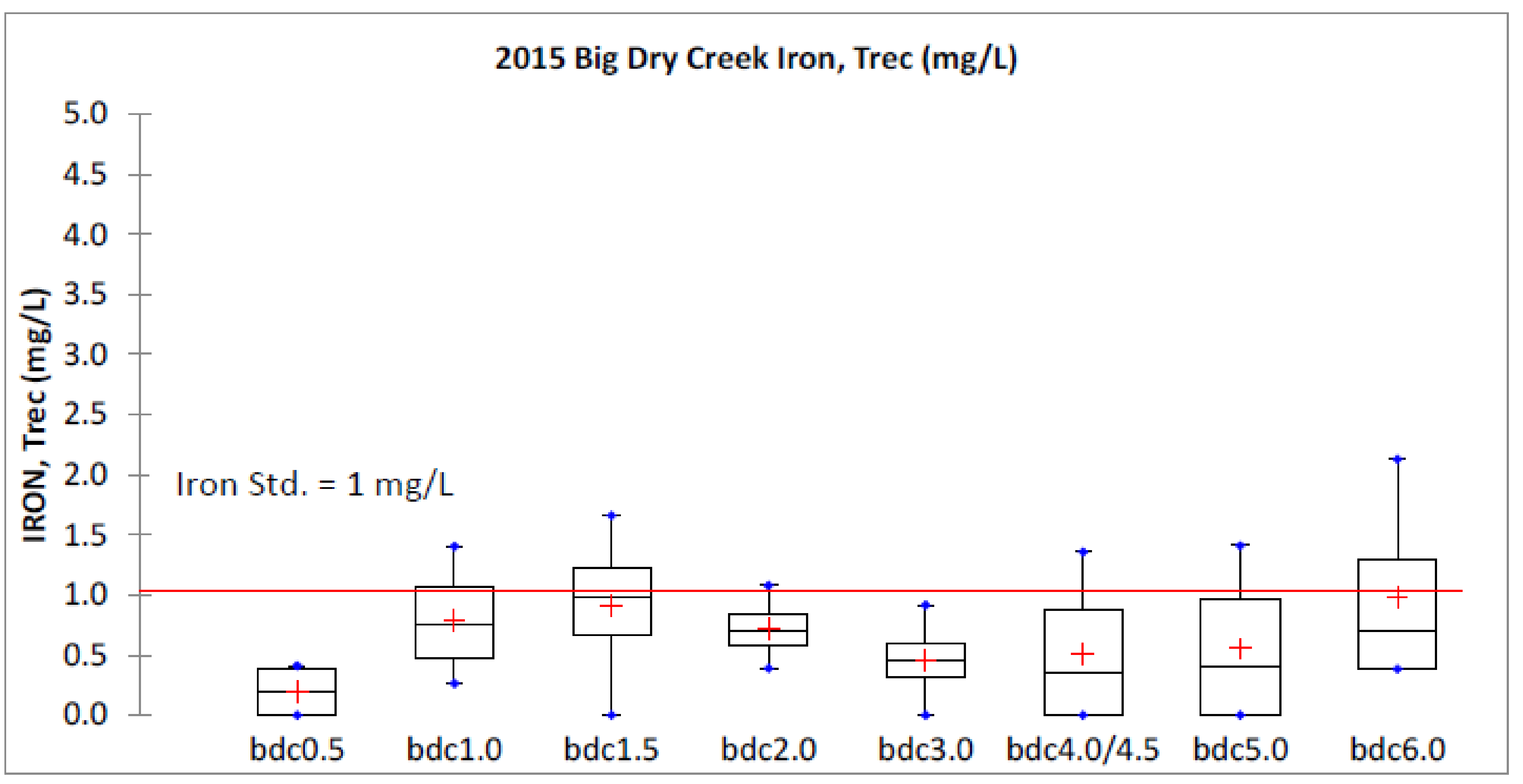
Selenium: No Longer on 303(d) List

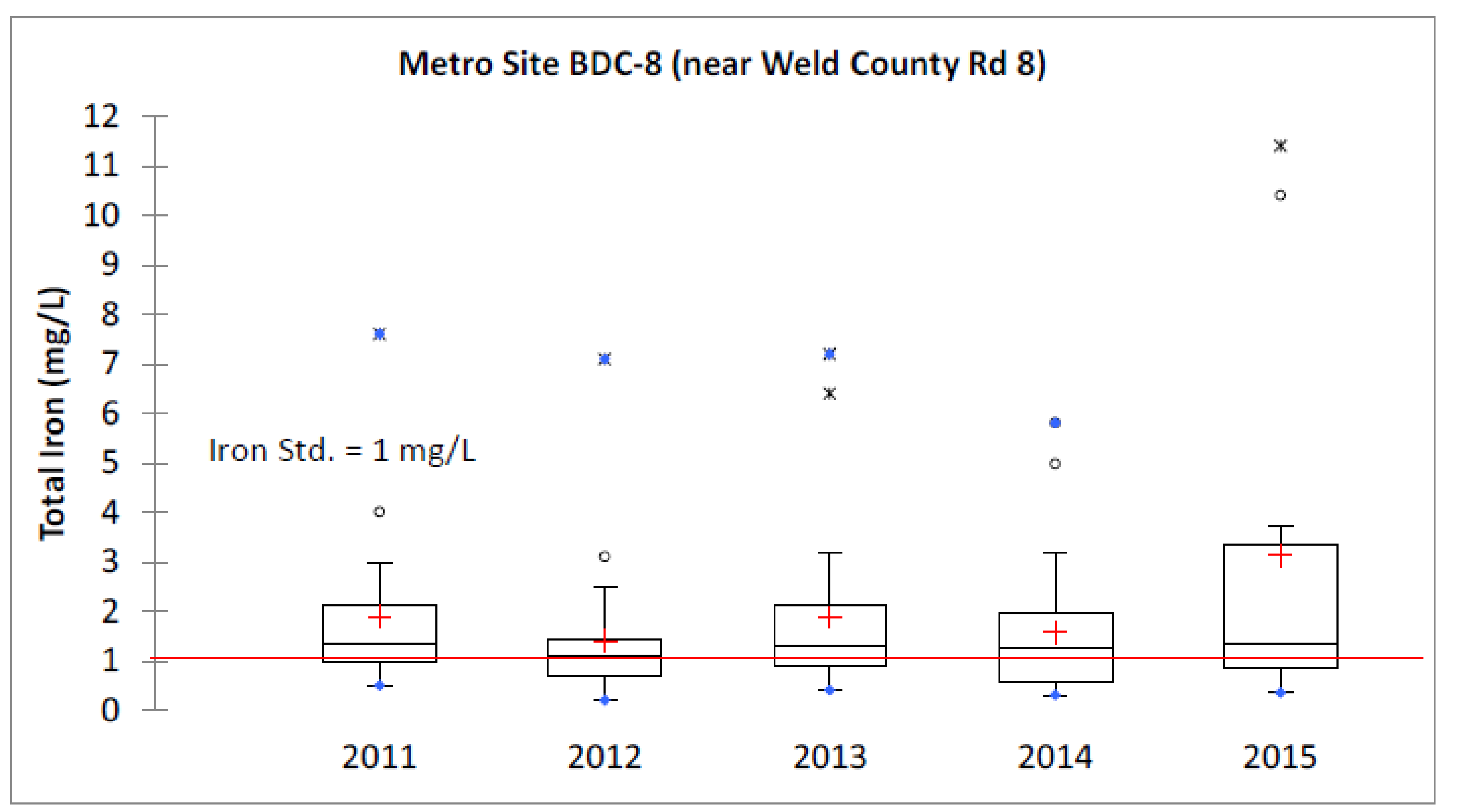
Selenium (µg/L)				
	Irrigation Season		Non-irrigation Season	
	2011-2015 (Apr-Oct)	Reg. 38 Standard	2011-2015 (Nov-Mar)	Reg. 38 Standard
All Sites (85th %)	5.0	N/A	8.3	N/A
bdc1.5, 2.0, 4.0/4.5 (85th %)	5.1	7.4 (ch)	10.7	15.0 (ch)
bdc1.5, 2.0, 4.0/4.5 (Max)	11.0	18.4 (ac)	13.0	19.1 (ac)

- Big Dry Creek on 2012 303(d) list for selenium—0.5 ug/L over the irrigation season site-specific standard.
- 5-year analysis meets stream standards.
- Sampling frequency switched to quarterly in 2013, consistent with other metals.
- Removed from 303(d) list in 2016.
- Also new statistical methodology for site-specific standards for 2016 303(d) Listing Methodology

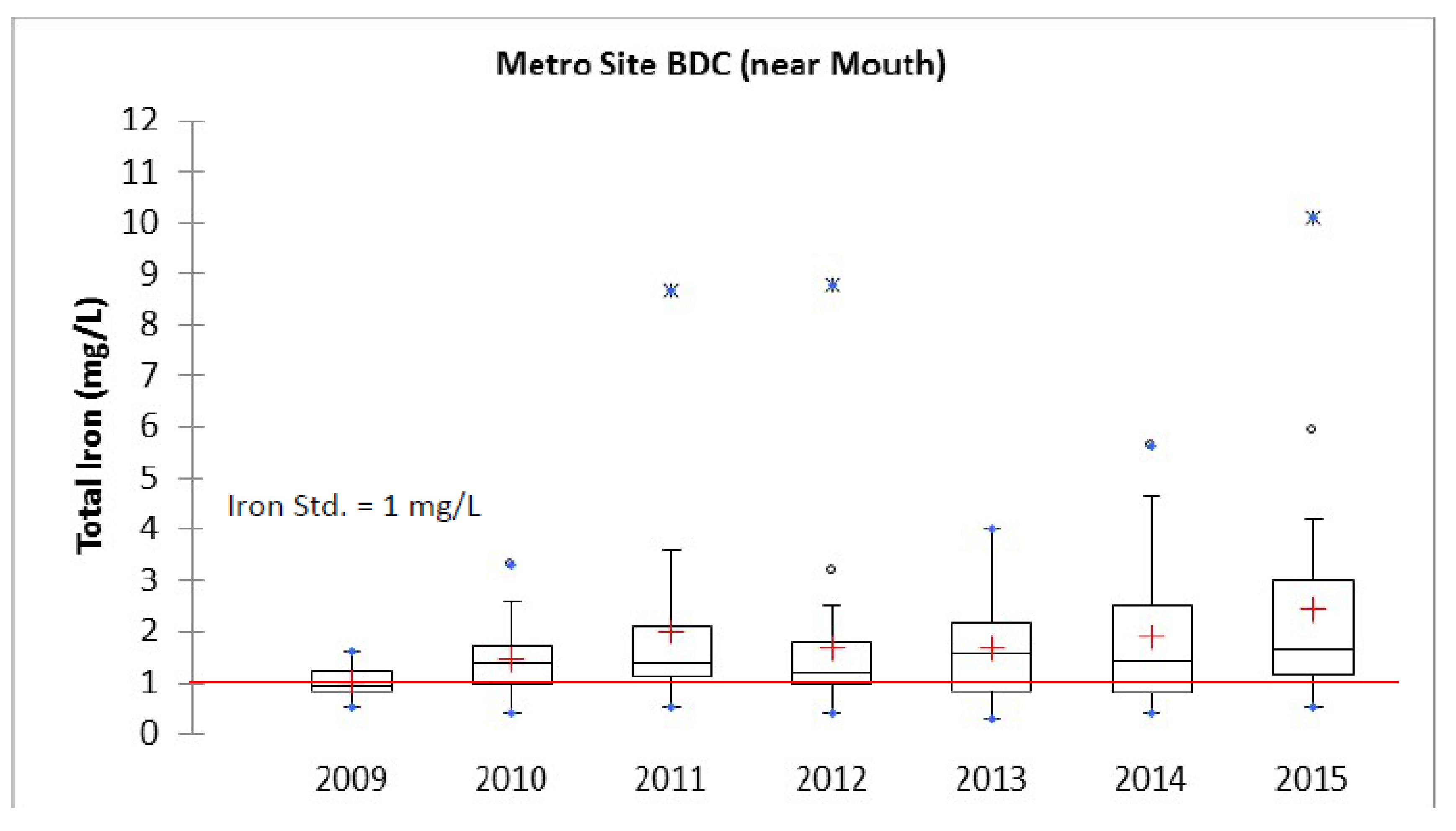
BDCWA Quarterly Iron Results



Metro Wastewater Iron Results
2 stations monitored bimonthly



Metro Site BDC Near Mouth/Fort Lupton




NUTRIENTS
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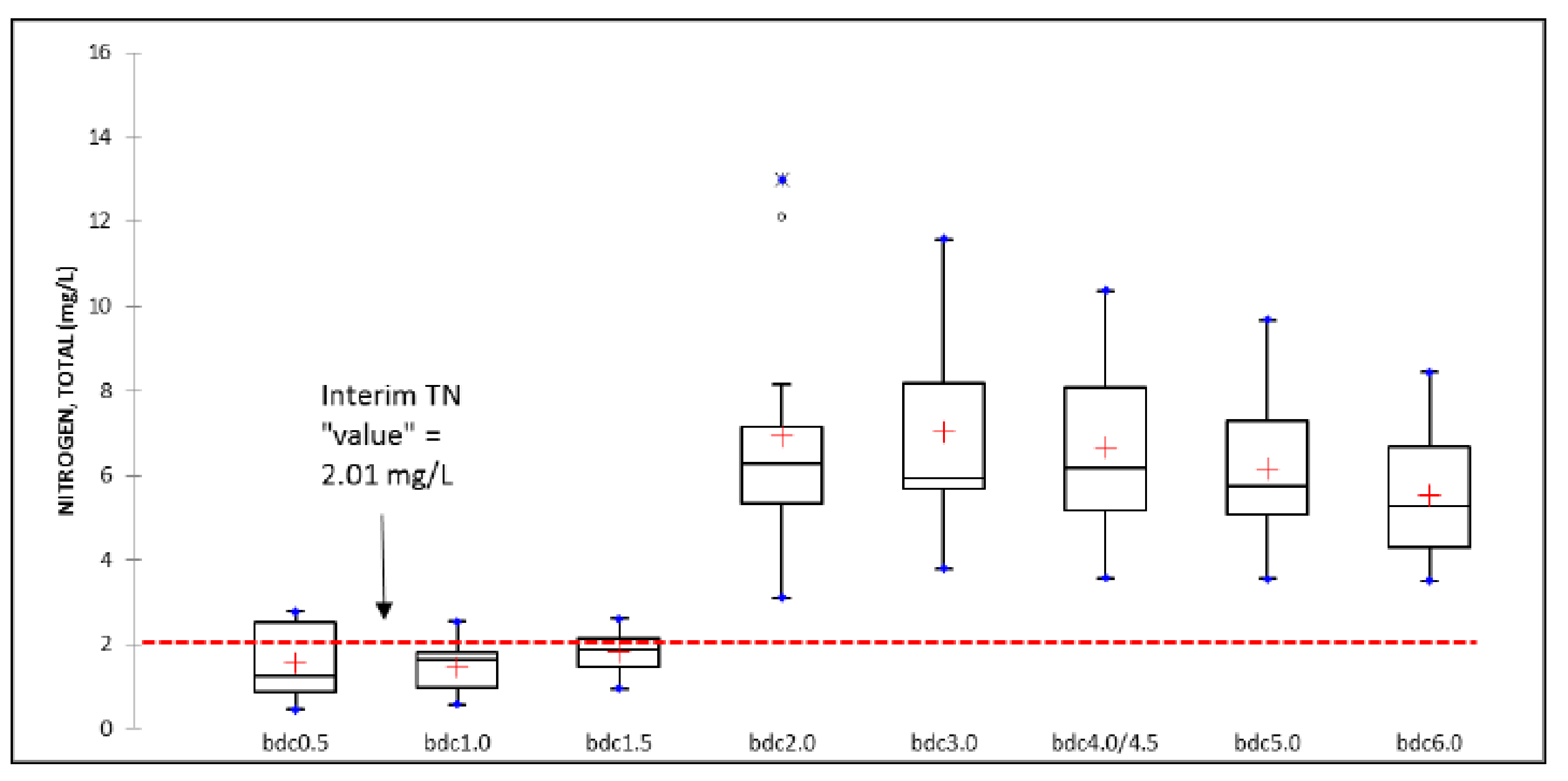
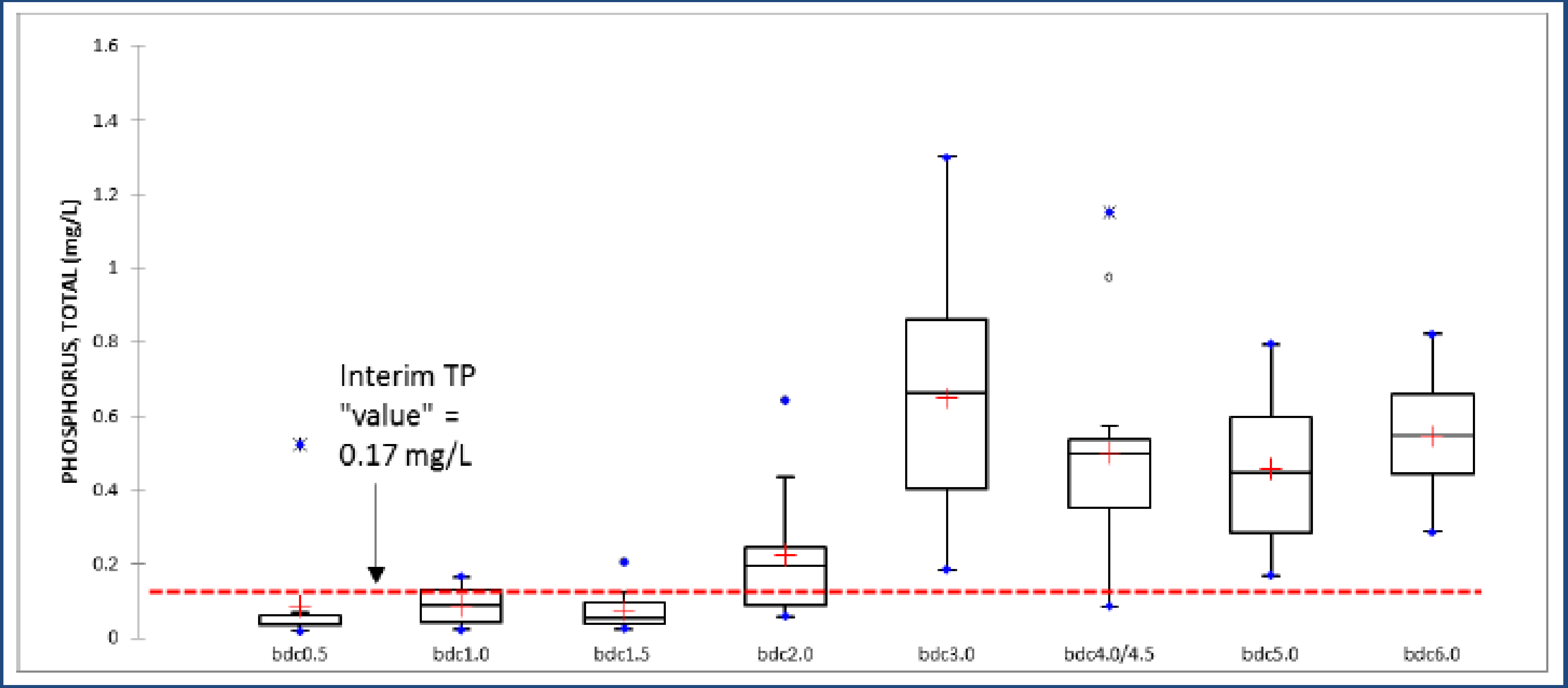
Big Dry Creek Total Nitrogen (2015)

- Third year of TN data (due to adding TKN to monitoring program)
- Does not meet interim values below WWTPs to South Platte.

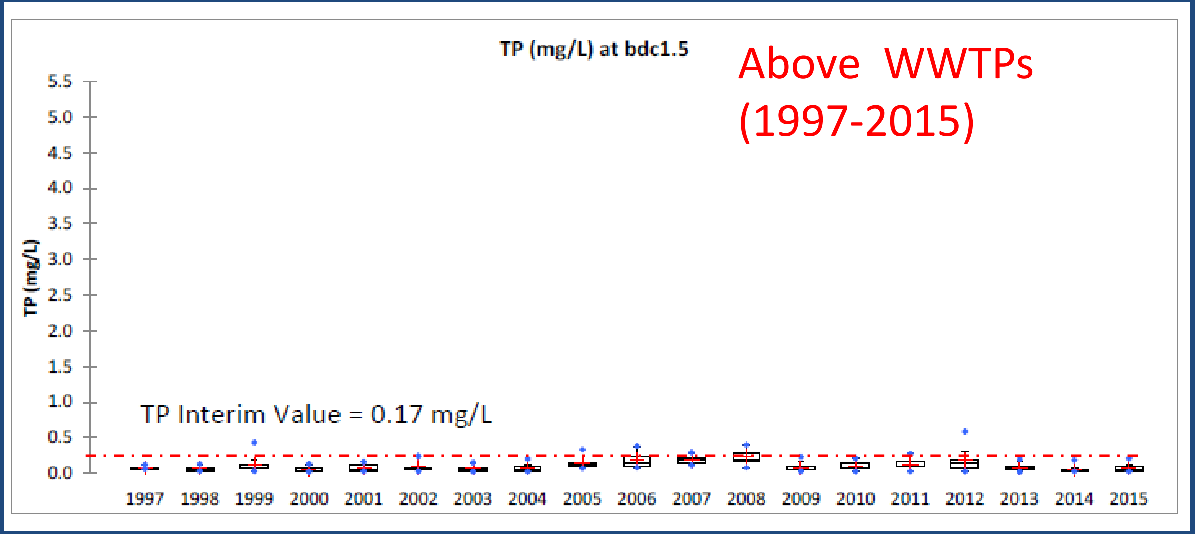


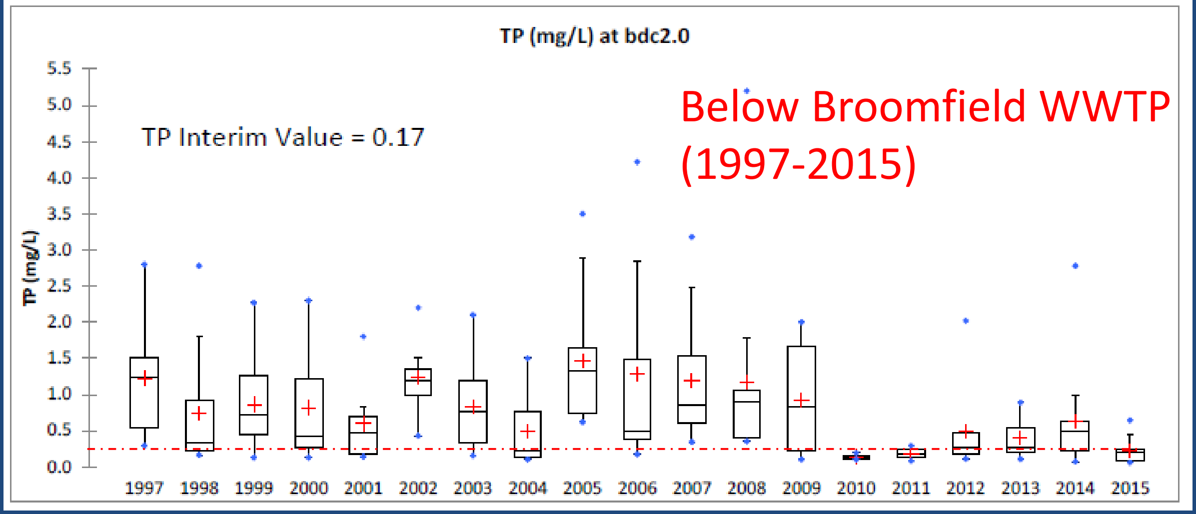
2015 Total Phosphorus



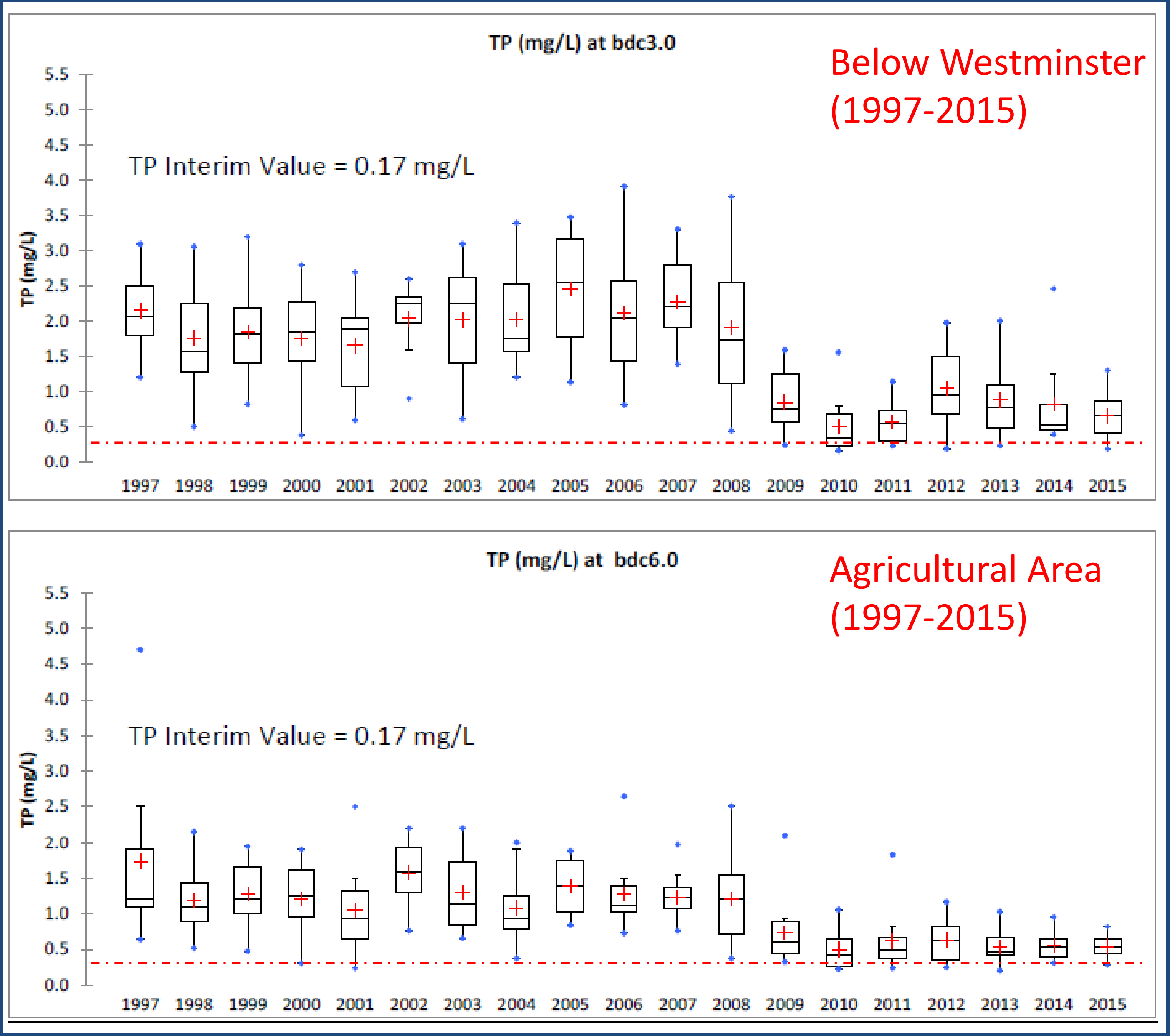
Temporal and Spatial Variation for TP

- Above WWTPs can meet standard
- Despite significant reductions over time, currently not meeting interim value below WWTPs & agricultural area



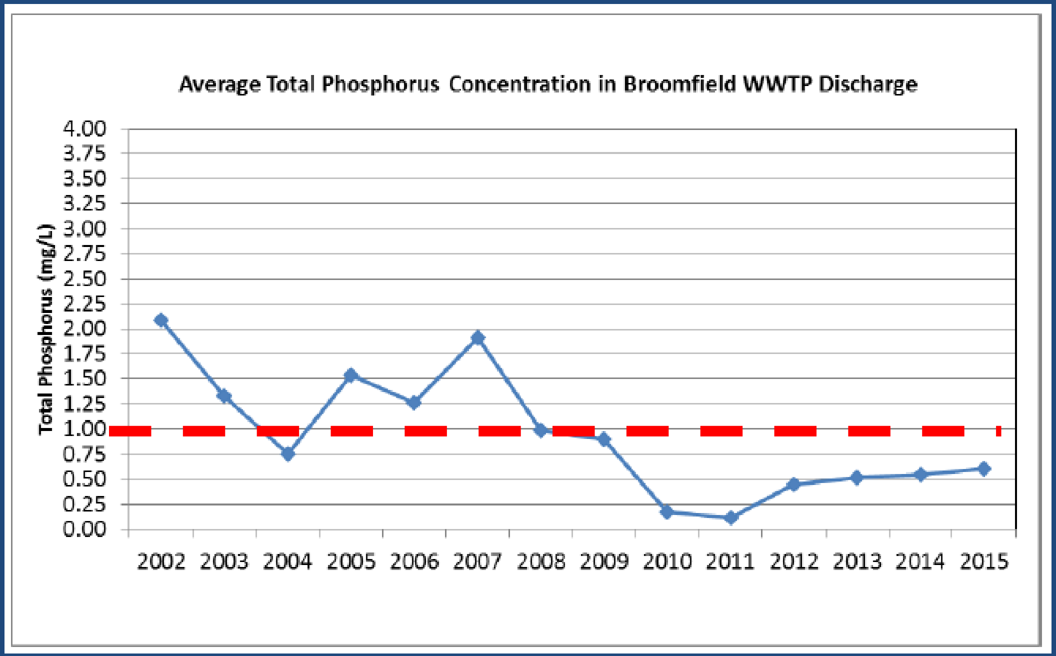


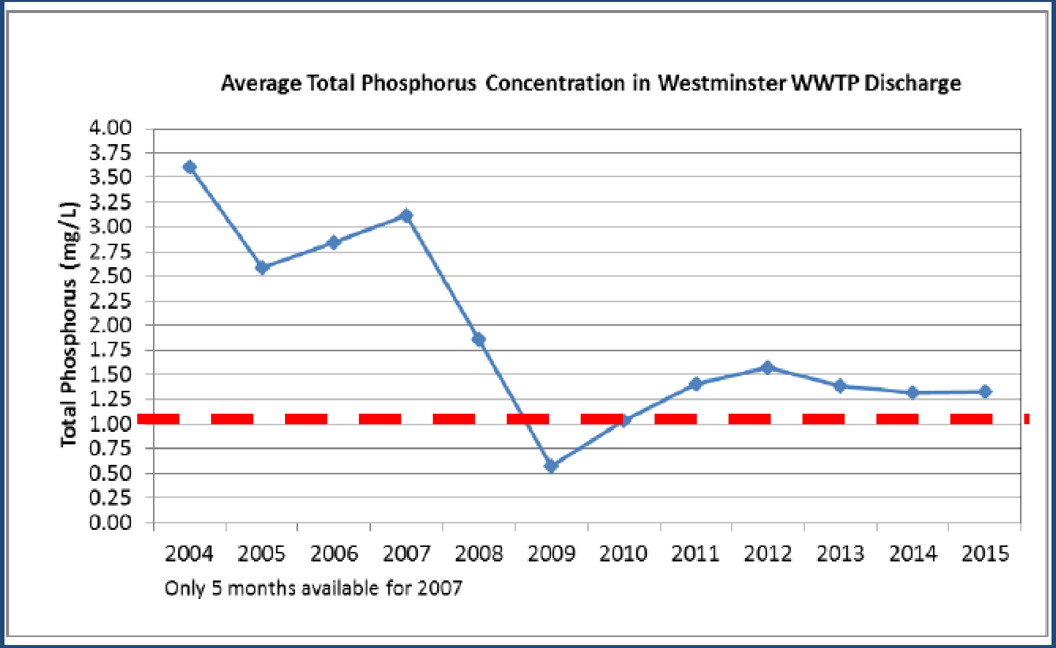
Temporal and Spatial Variation for TP (cont.)



Decreases in TP @ Broomfield and Westminster WWTPs

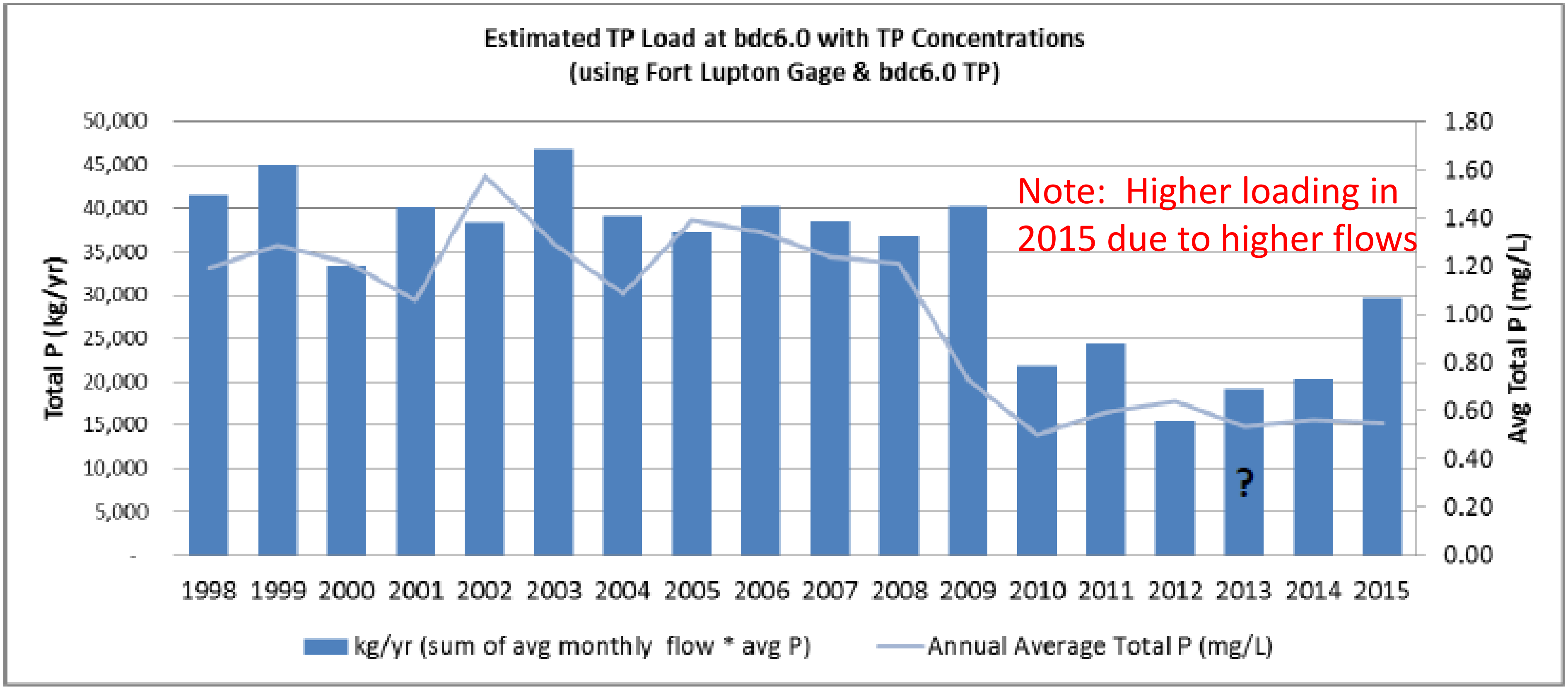
- Biological nutrient removal at Broomfield and Westminster WWTPs.
- No sooner than July 1, 2013, Reg 85 Limits for WWTPs > 2 MGD = 1 mg/L TP as annual median





Positive Effect from WWTP Upgrades TP Concentration (mg/L) @bdc6.0

- BMW Target 20% load reduction relative to 2004.
- 2015 Load 50-60% lower than 2003-2004.
- Flow variations affect load.

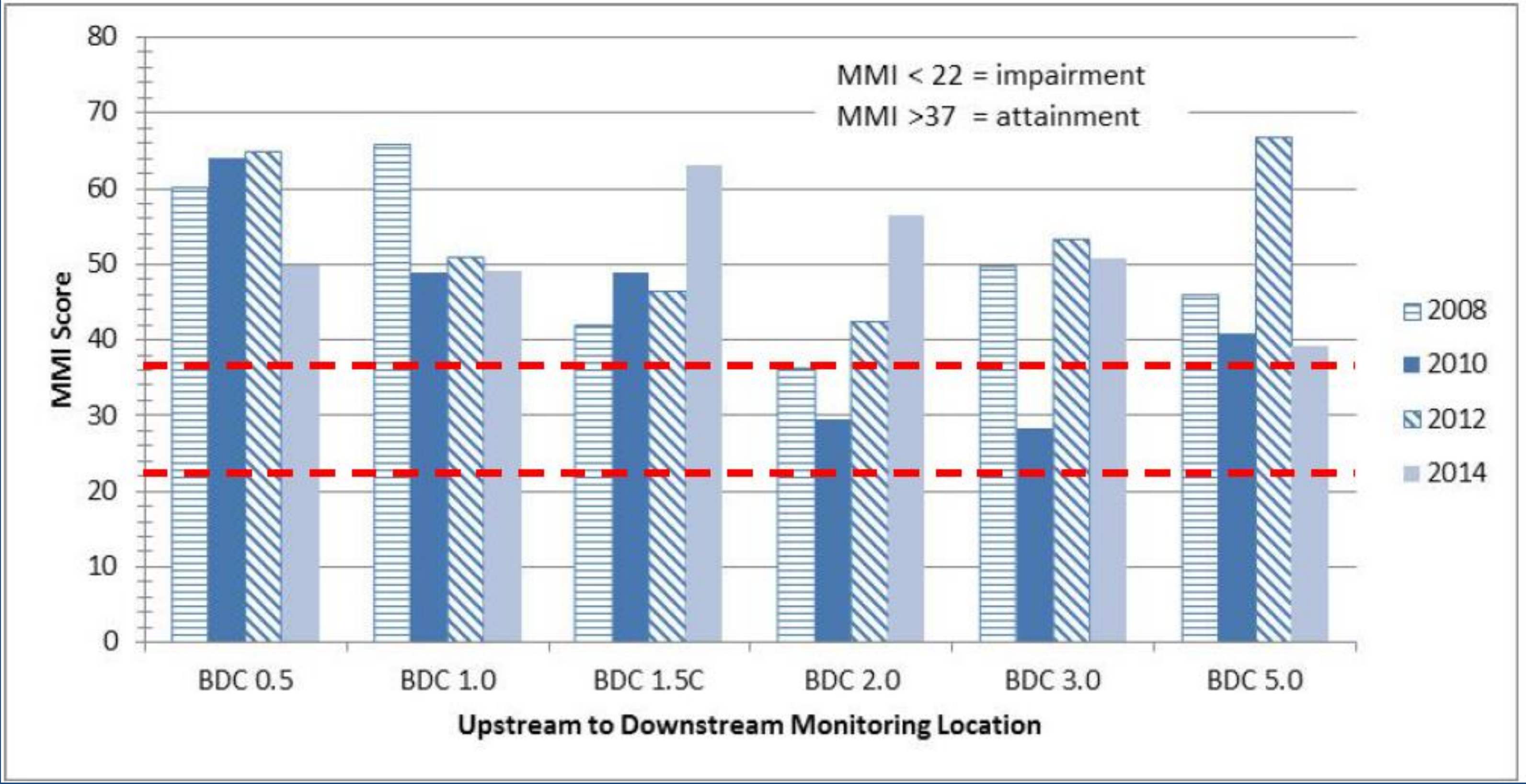


Biennial Biological Monitoring

- 2014 Sampling
- Fish
- “Bugs”
- Habitat
- Overall trends in aquatic life health
  - Over time
  - By location

Big Dry Creek MMI Scores

- Higher scores are better.
- Uses attained for all years, all sites.
- Note site-to-site and annual variability—could have 303(d) implications.



Big Dry Creek Case Study:
CLEAN Center Research Project 4:
Fluvial instability and riparian degradation

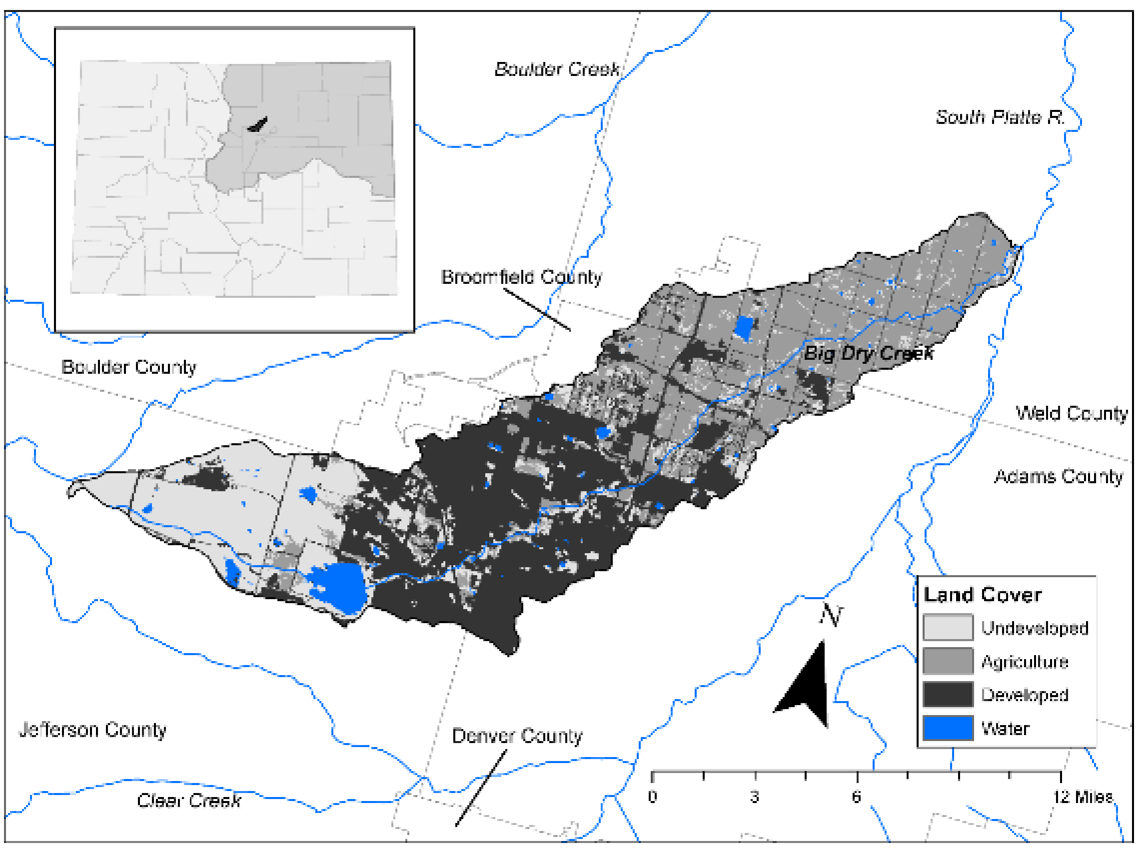
Roderick Lammers

Co-PI: Dr. Brian P. Bledsoe, Ph.D., P.E.

Co-PI: Dr. Daniel Baker, Ph.D., P.E.

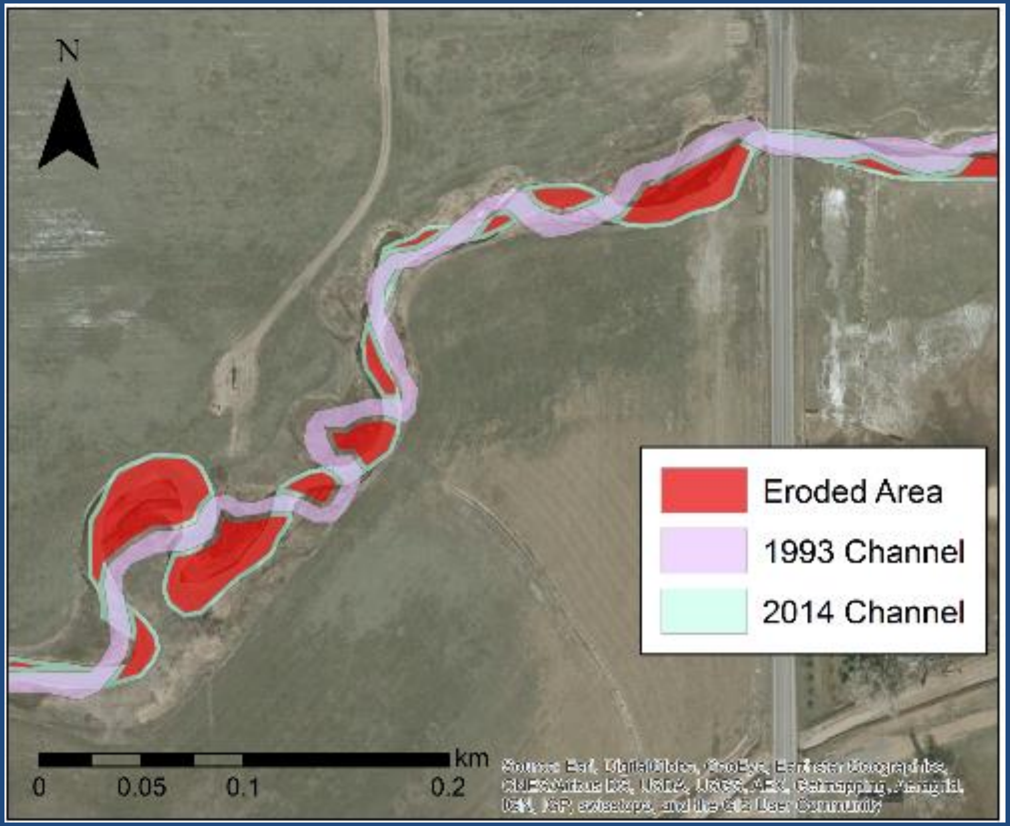
CLEAN Center Big Dry Creek Streambank Study

- Desktop analysis
  - Channel change
  - Reach delineation
- Field data collection
  - Bank geometry
  - Bank P content



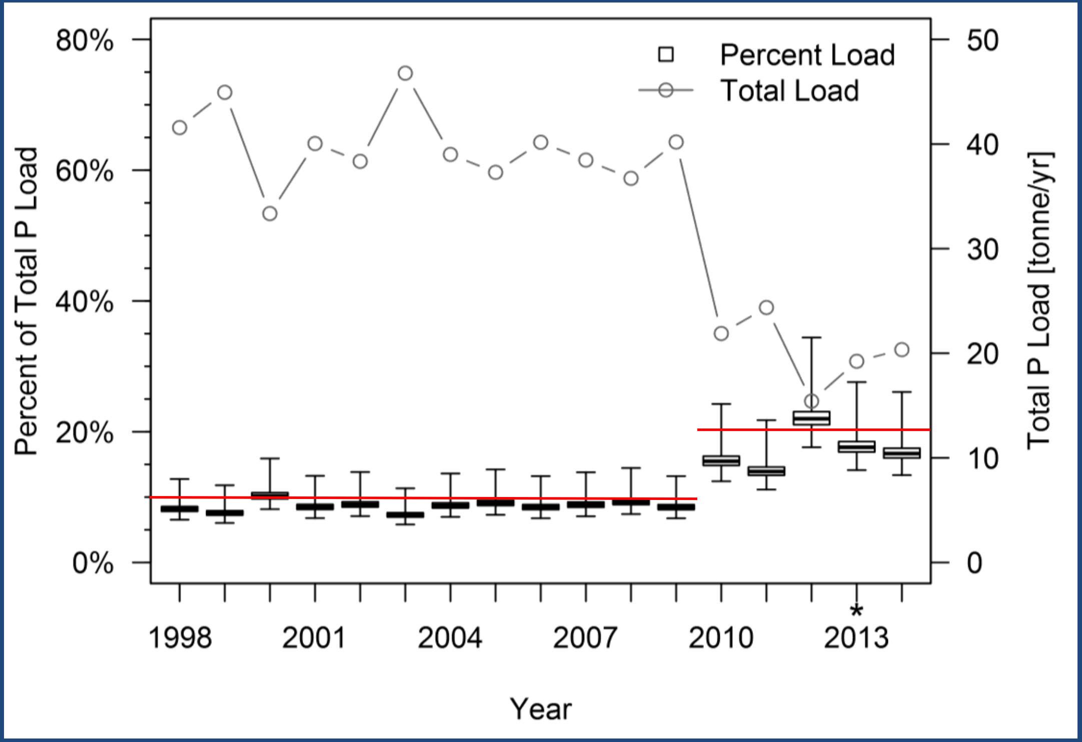
Preliminary results

- Eroded area (satellite imagery)
- Bank heights (field)
- Soil bulk density (US Soil Survey)
- Bank P concentrations (field)



Preliminary results (cont.)

- Historically average of ~10% of total watershed P load
- Recently, contribution percentage may be higher
- Future of channel erosion uncertain



CLEAN Center Project Next Steps

- Develop tool for modeling channel evolution and phosphorus loading
- Field work and tool application to Lick Creek, NC and Big Dry Creek, CO
- Collaborate with Project 3 on impacts of stormwater management on channel response potential

Summary of What's New

1. E. coli TMDL
2. Iron impairment below Weld County Road 8
3. TP concentrations and loads decreasing due to WWTP upgrades
4. TP and TN above interim standards below WWTPs.
5. Aquatic Life/MMI scores are good.
6. Participating in CSU CLEAN Center—watershed tools and stream channel study
7. Continuing baseline program of monitoring and evaluation, sharing information with stakeholders

Questions?

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www.bigdrycreek.org