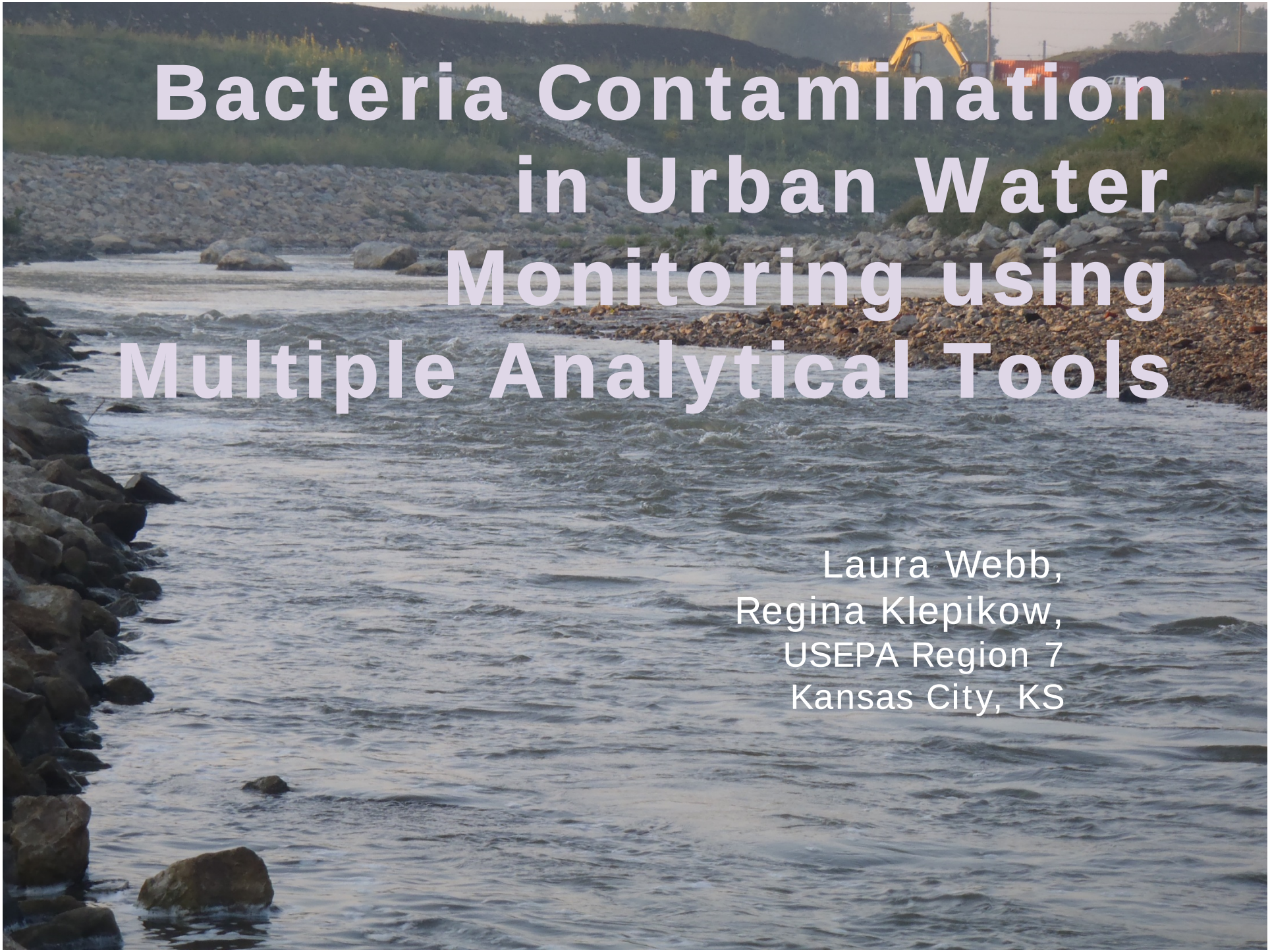


Bacteria Contamination in Urban Water Monitoring using Multiple Analytical Tools

Laura Webb,
Regina Klepikow,
USEPA Region 7
Kansas City, KS

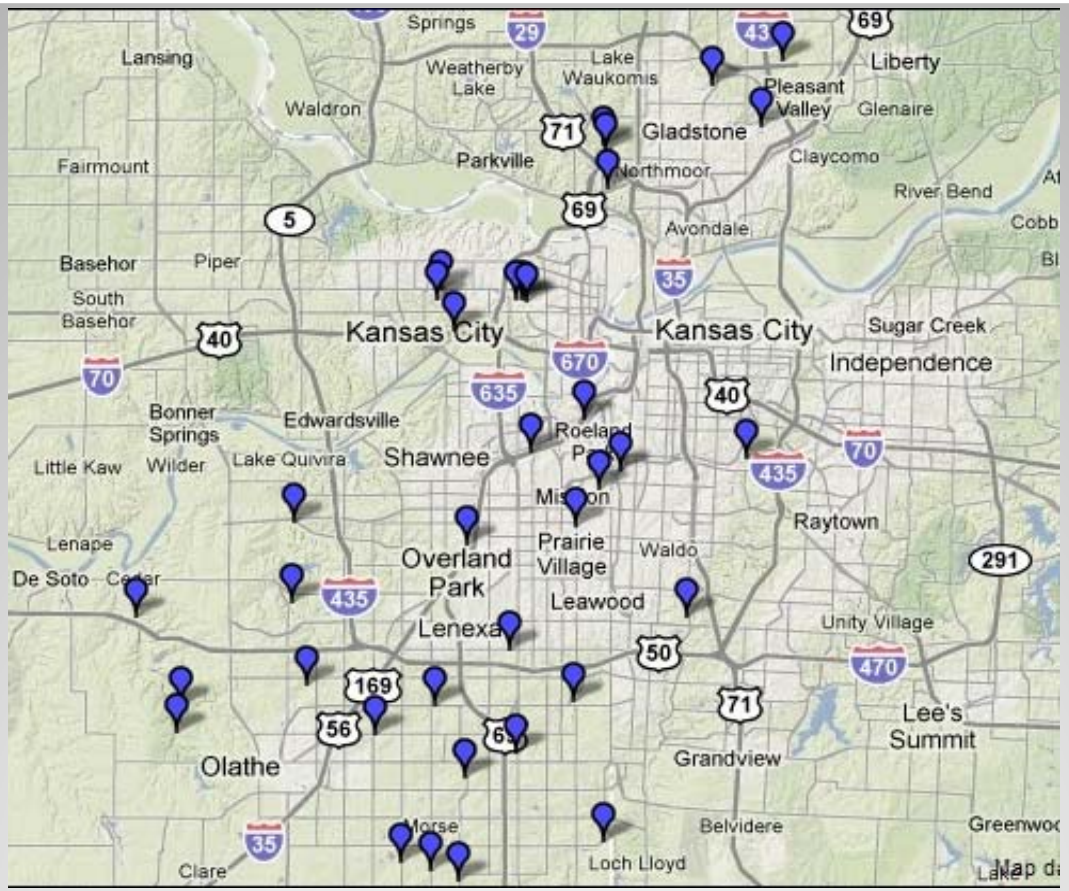
- Urban Stream Network
- Urban Lakes
- Real Time Telemetry Network

KCWATERS.org

EPA Region 7 Water Monitoring Team

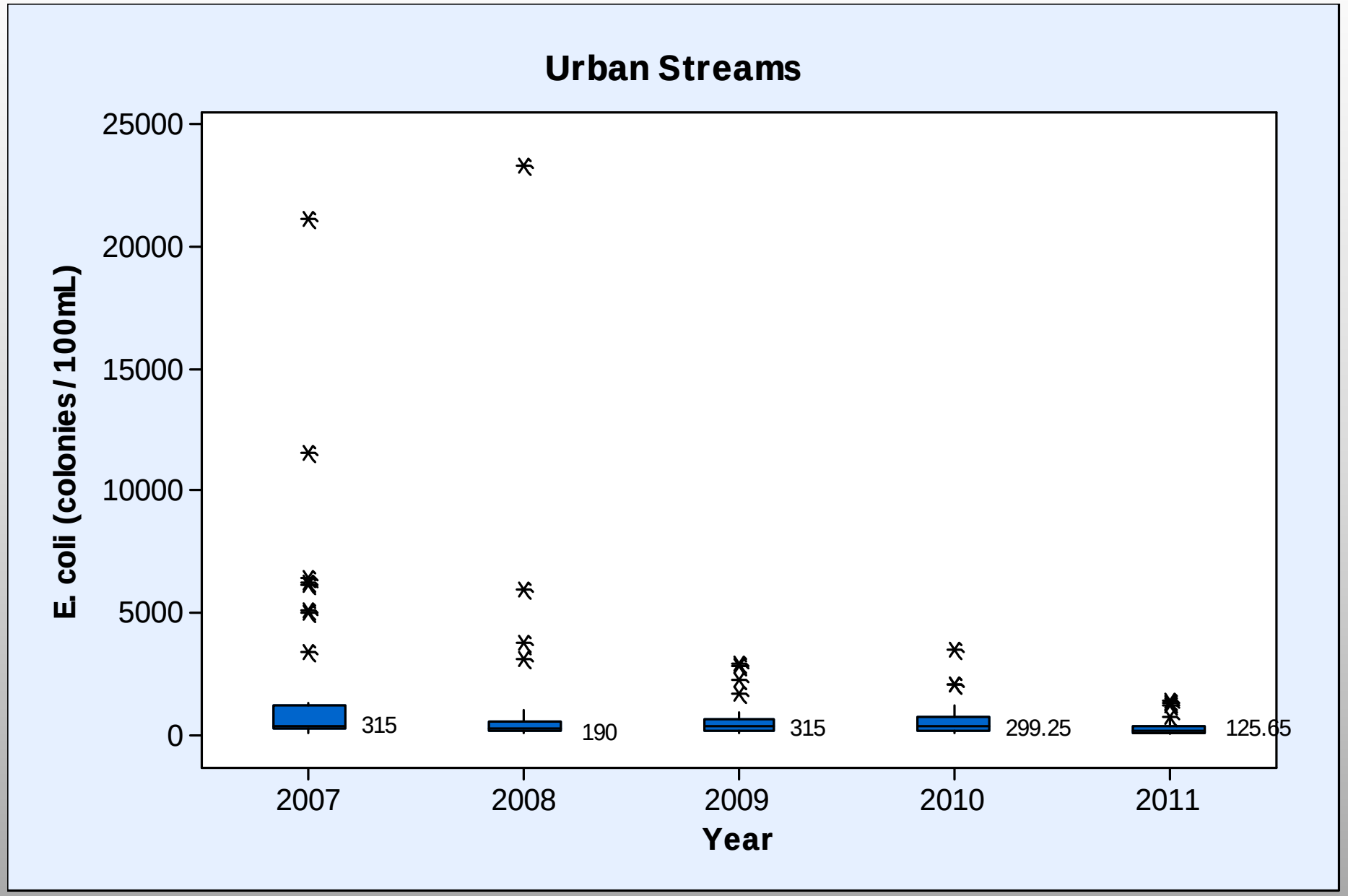
Colilert©

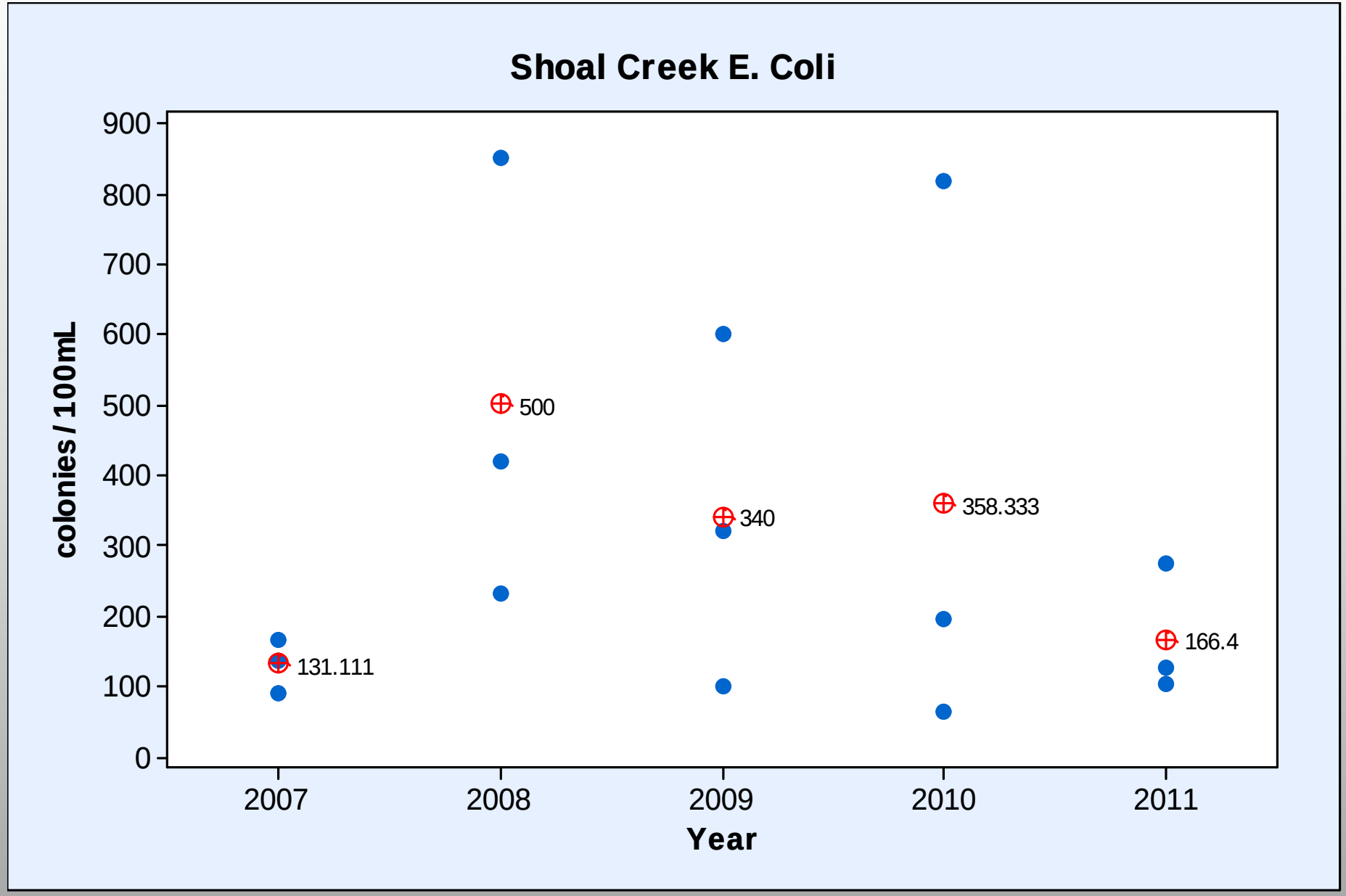
Primary Tool for Bacteria Monitoring

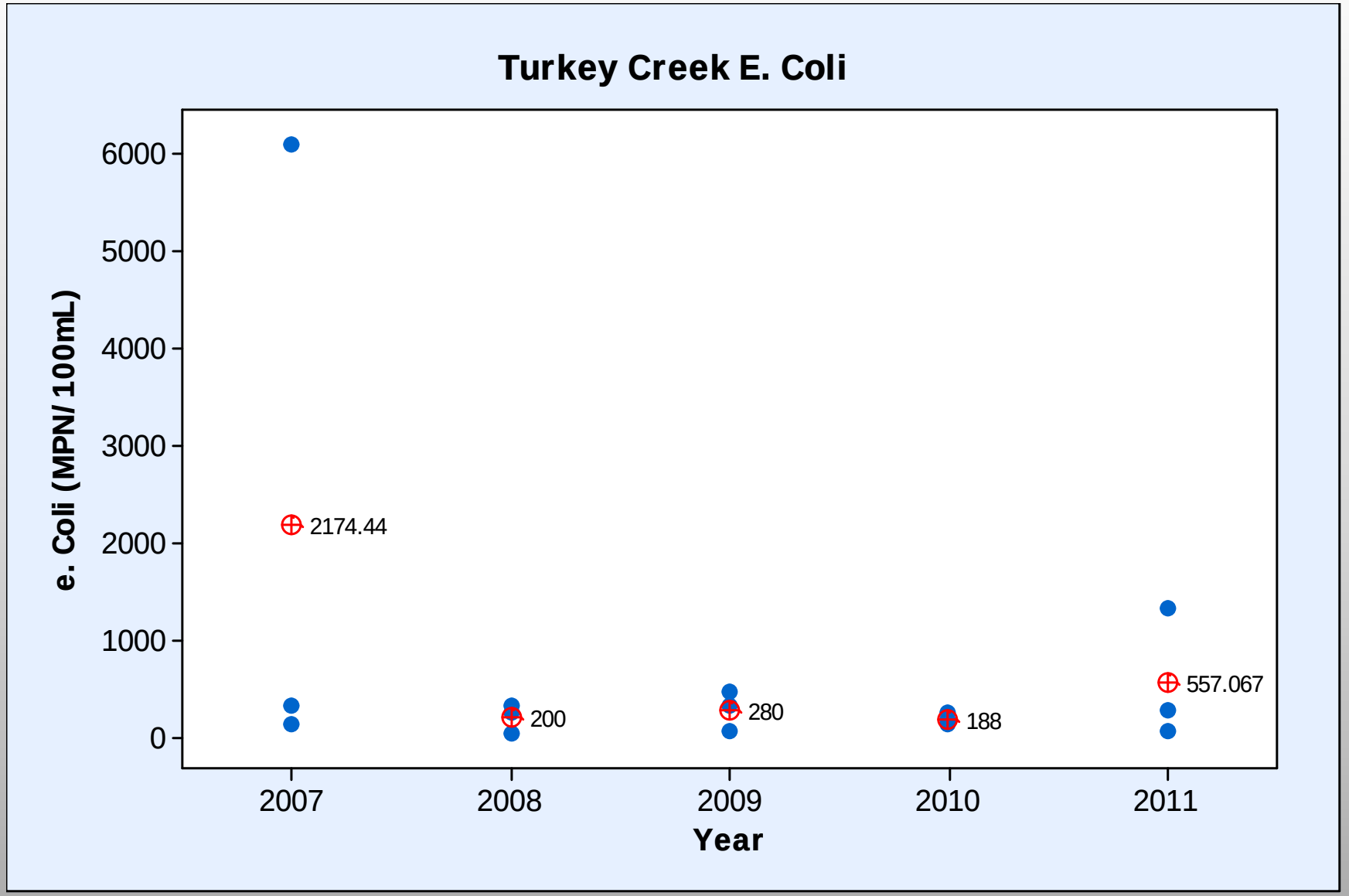


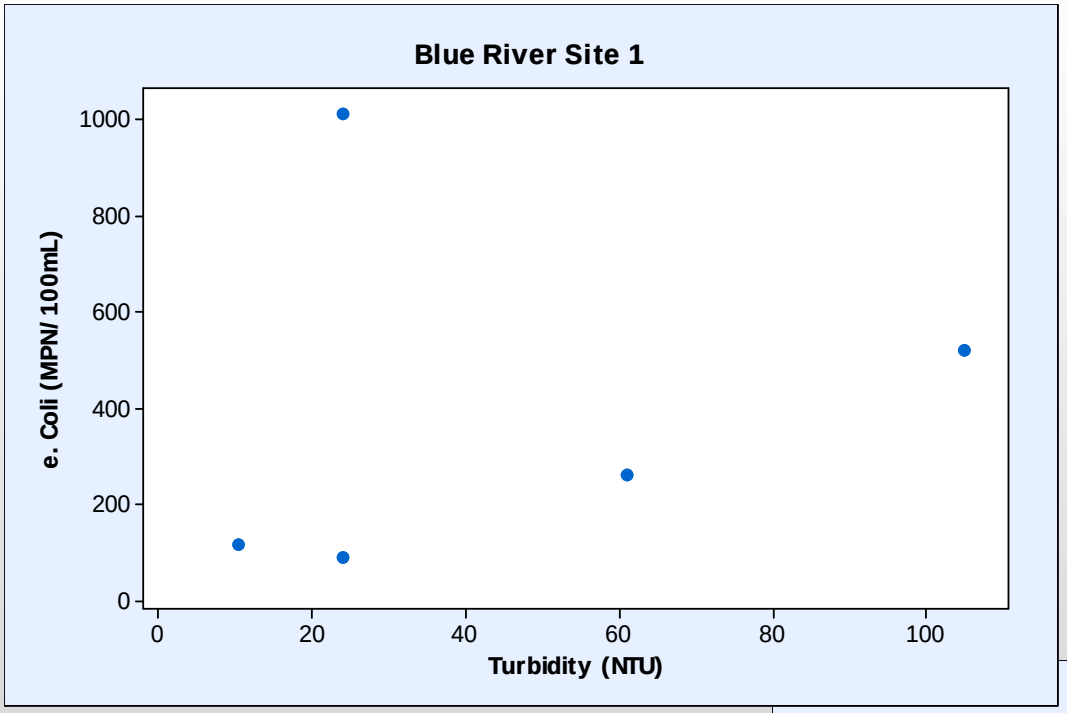
Results

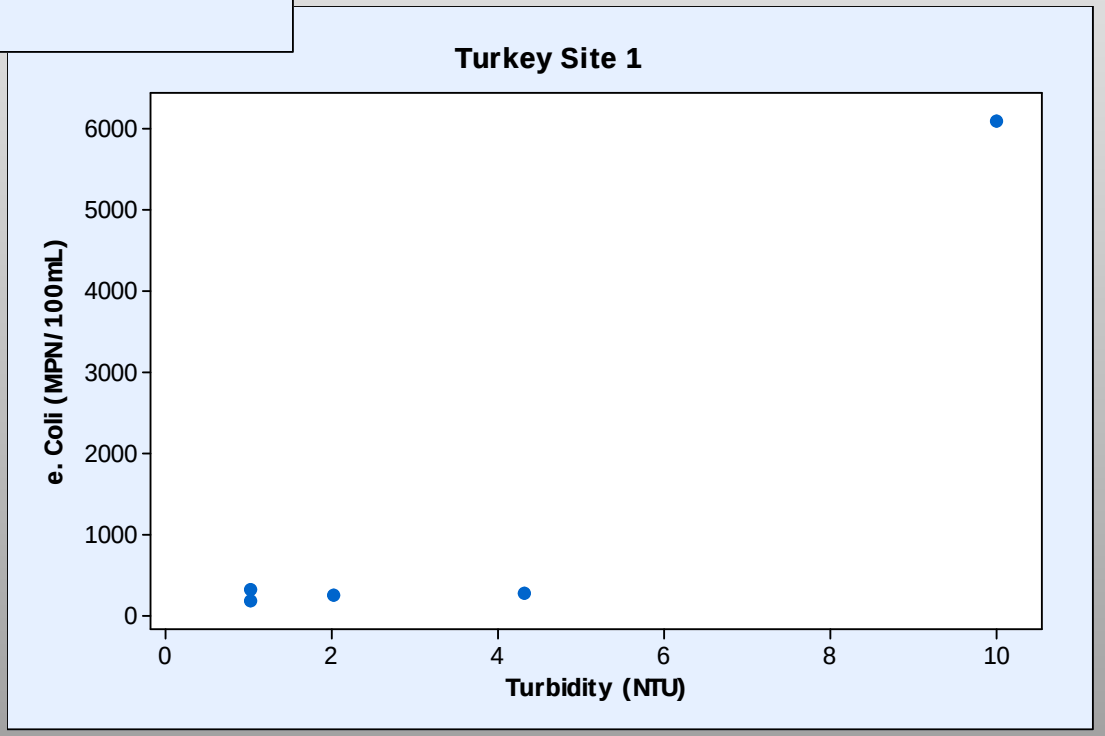
Urban Stream Sampling


Urban Streams
E. coli (colonies / 100mL)
25000
20000
15000
10000
5000
0
315
190
315
299.25
125.65
2007
2008
2009
2010
2011
Year


Shoal Creek E. Coli
colonies / 100mL
900
800
700
600
500
400
300
200
100
0
500
340
358.333
131.111
166.4
2007
2008
2009
2010
2011
Year

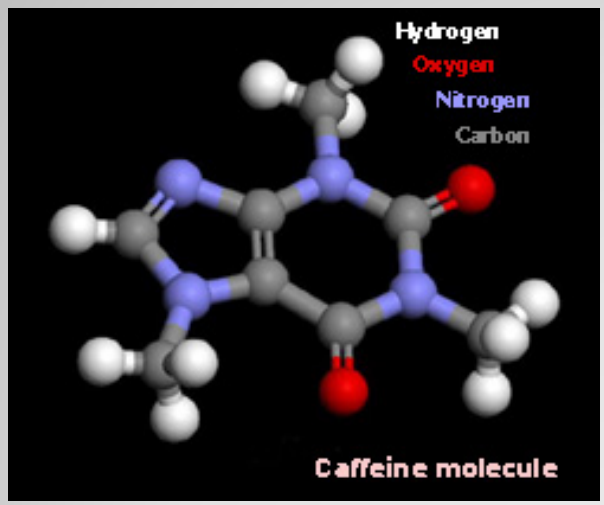

Turkey Creek E. Coli
e. Coli (MPN/100mL)
6000
5000
4000
3000
2000
1000
0
2174.44
200
280
188
557.067
2007
2008
2009
2010
2011
Year


Blue River Site 1
e. Coli (MPN/ 100mL)
1000
800
600
400
200
0
0
20
40
60
80
100
Turbidity (NTU)

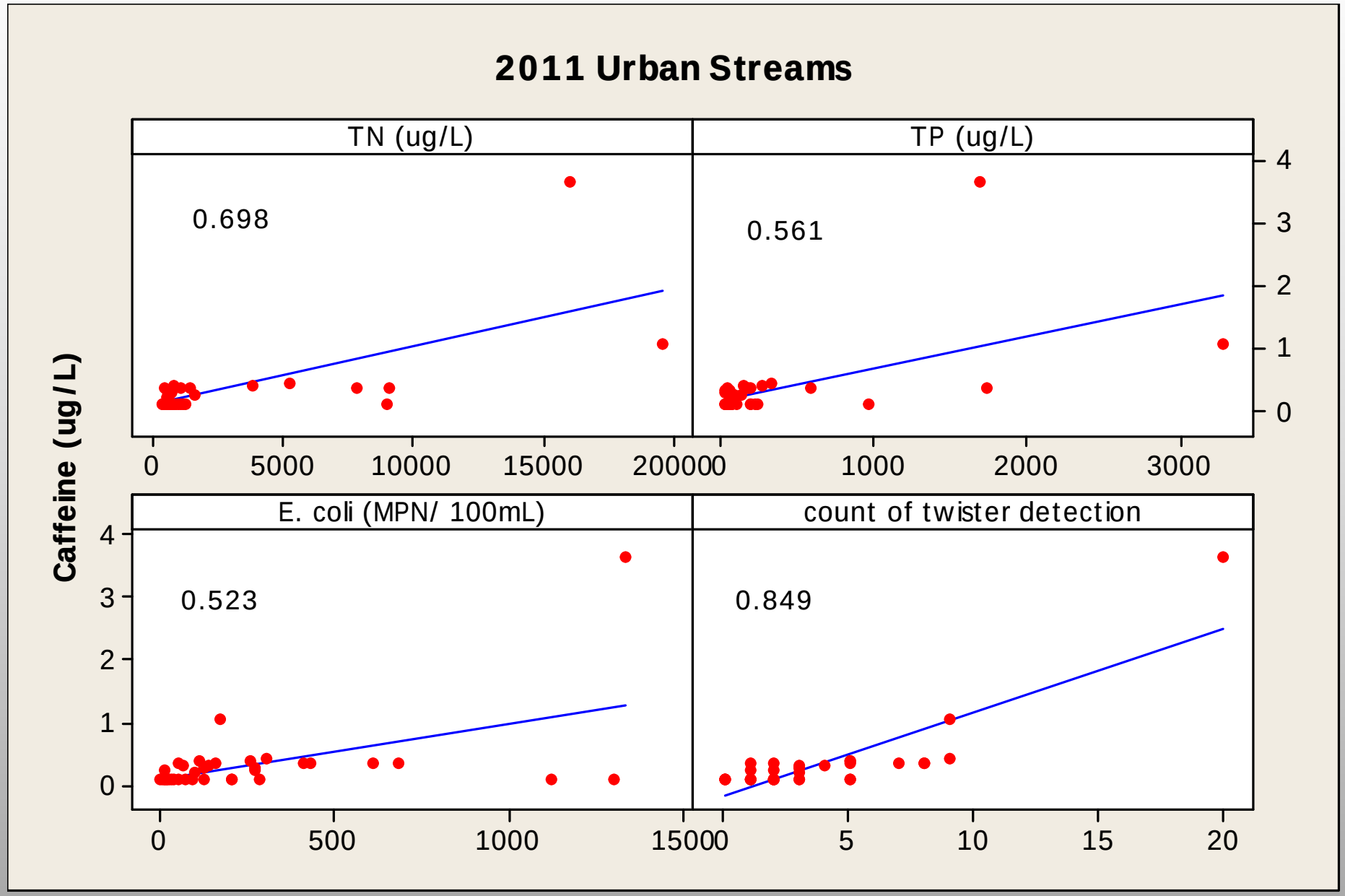

Turkey Site 1
e. Coli (MPN/ 100mL)
6000
5000
4000
3000
2000
1000
0
0
2
4
6
8
10
Turbidity (NTU)

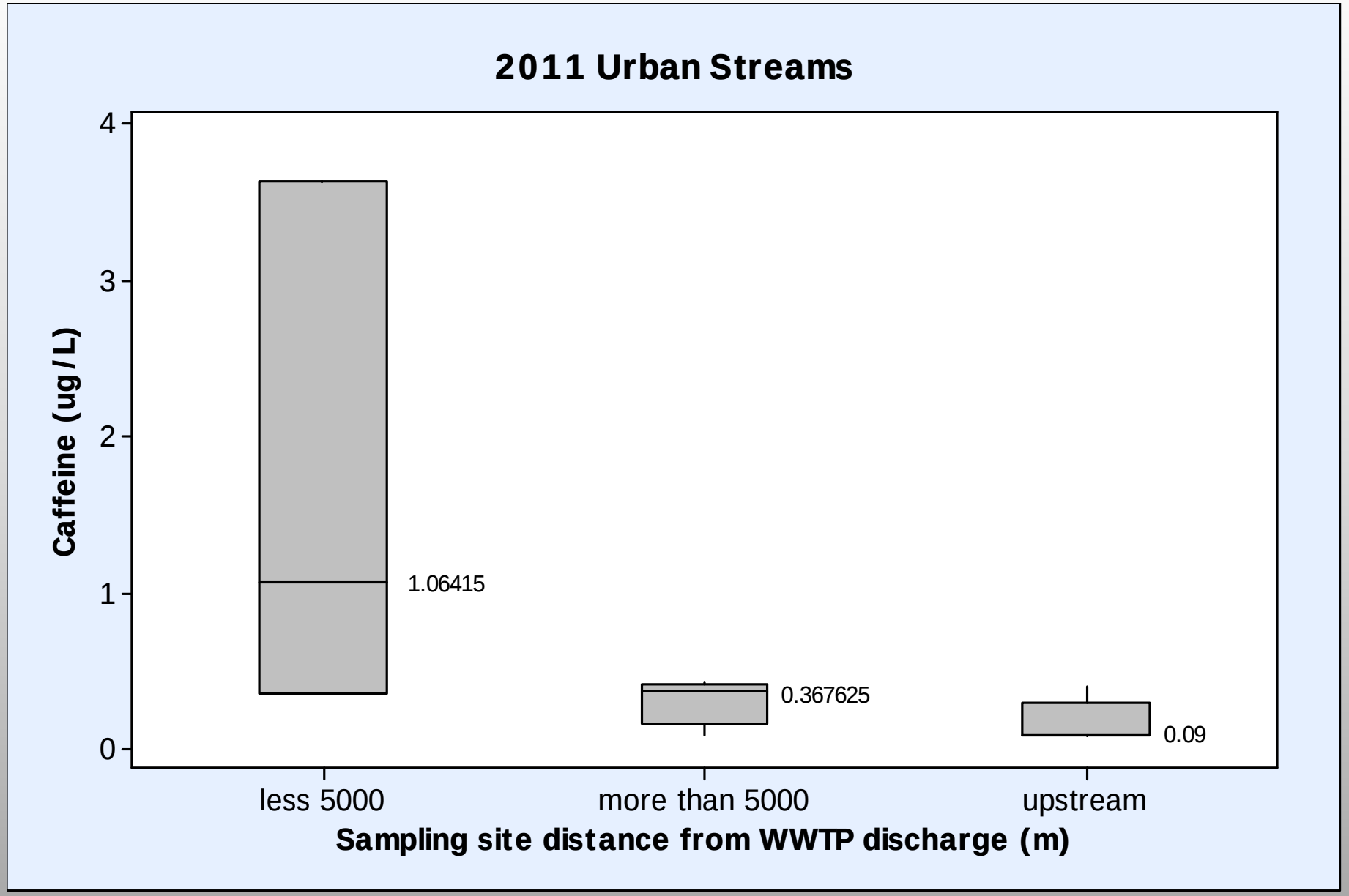
New Tools in 2011

- Caffeine
- ELISA by Abraxis
- Used as indicator of human waste influence

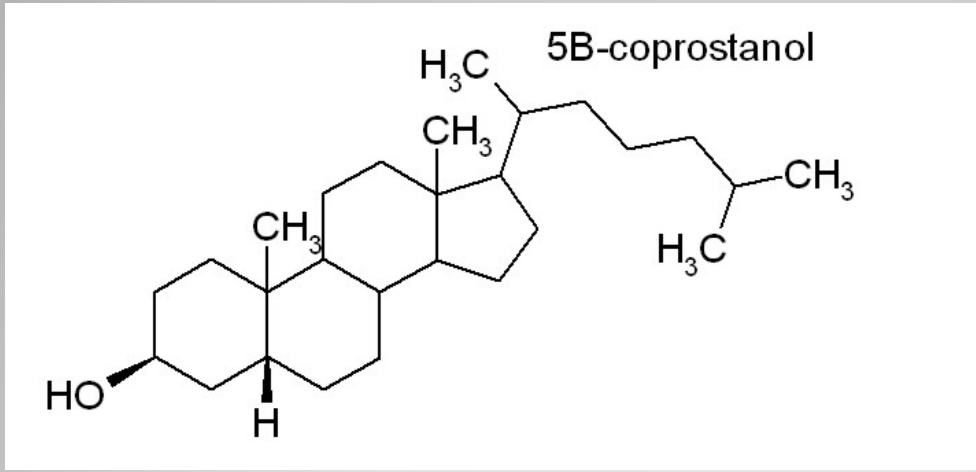


- Personal Care Products and Pharmaceuticals (PPCP)
- New SBSE GC/MS method (Twister©)
- BPA, TCEP, NPs, Coprostanol, Triclosan, Estrogens


2011 Urban Streams
TN (ug/L)
TP (ug/L)
E. coli (MPN/ 100mL)
count of twister detection
Caffeine (ug/L)
0.698
0.561
0.523
0.849
0
5000
10000
15000
20000
1000
2000
3000
500
5
10
15
20
0
1
2
3
4


2011 Urban Streams
Caffeine (ug/L)
4
3
2
1
0
1.06415
0.367625
0.09
less 5000
more than 5000
upstream
Sampling site distance from WWTP discharge (m)

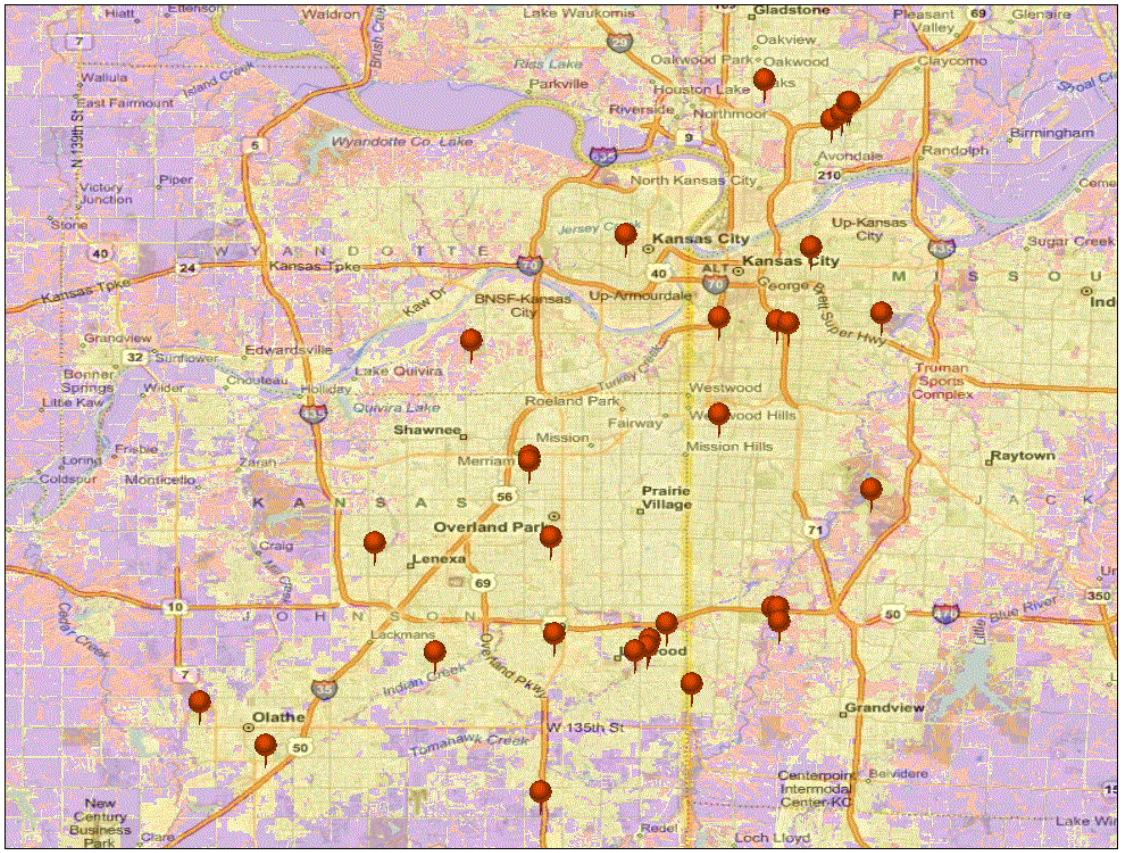
Coprostanol



- Formed by the degradation of cholesterol in higher animals and birds (carnivores)
- Used as a biomarker for human feces
- RL = 0.2 µg/L
- Range 0.03 to 0.84
- Found at 2 sites above the RL, the two most influenced by WWTP discharge
- Also found at two highly urbanized sites between RL and MDL

Site Name	Positive Caffeine Concentration (µg/L)	PPCP count	E. coli (MPN/100 mL)
Tomahawk 1	0.31	1	65
Tomahawk 2	0.28	0	126.7
Indian 3	0.36	2	410.6
Brush Creek 1	0.39	2	259.5
Brush Creek 2	0.35	3	435.2
Brush Creek 3	0.34	1	686.7
Shoal 1	0.26	1	273.2
Shoal 2	0.20	1	101.4
Line Creek 1	0.23	1	272.3
Jersey 2	0.36	0	613.1
Jersey 3	0.22	0	14.6

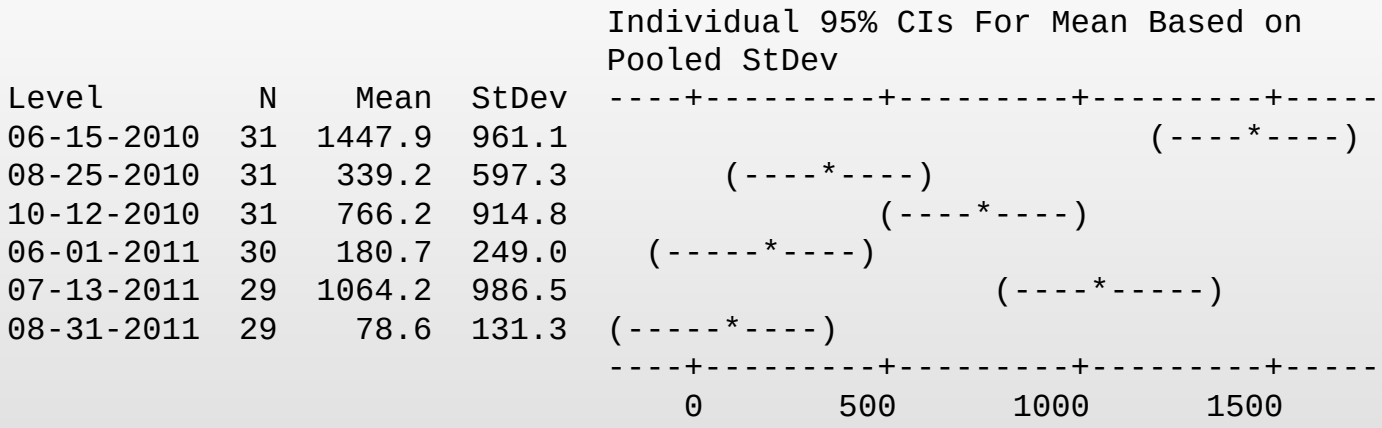
Sites without WWTP discharge



Results

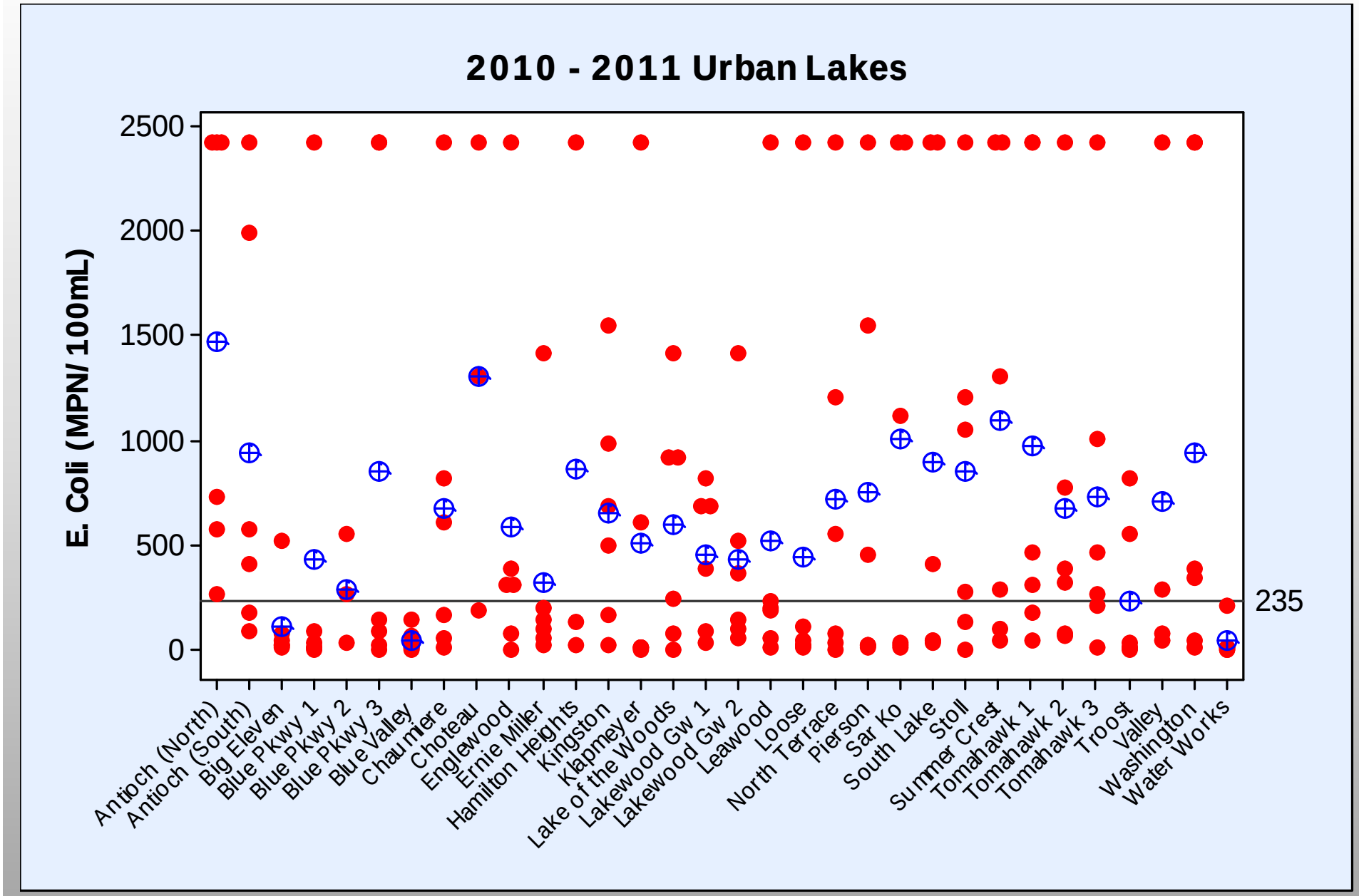
Urban Lake Sampling

One-way ANOVA: E. Coli versus date



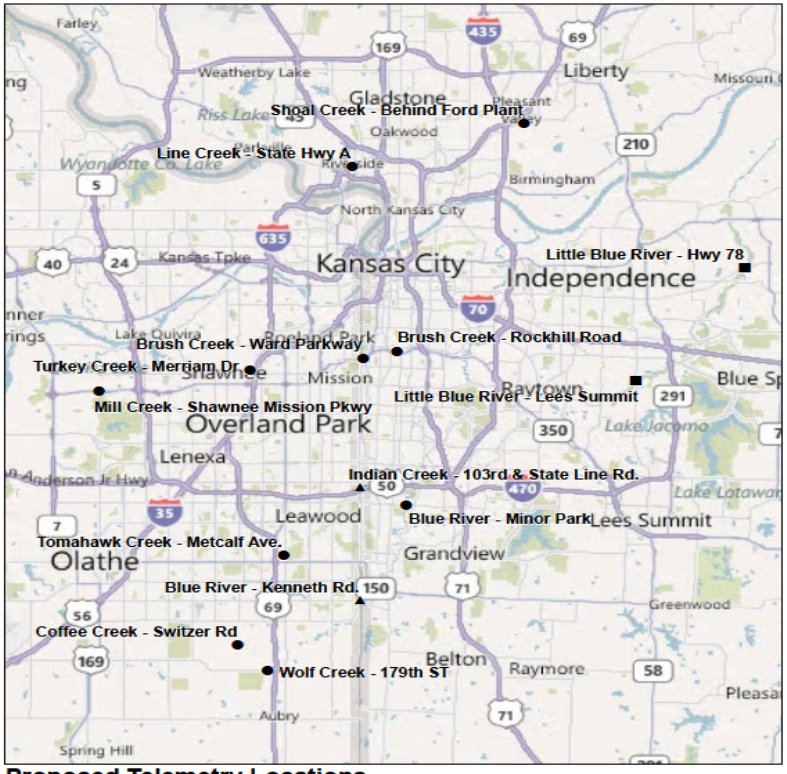
Pooled StDev = 729.2

48 Hour Rain Fall	North		East		South	
	Amount (in)	Hours prior	Amount (in)	Hours prior	Amount (in)	Hours prior
6/15/10	0.59	24-30	1.8	24-32	4.7	24-32
8/25/10	0		0		0	
10/12/10	.63	0-24	.47	12-24	.51	0-24
6/1/11	.16	24	.16	12-24	.08	24
7/13/11	.83	0-8	.98	6-8	.87	6-8
8/31/11	.04	18	0		0	


2010 - 2011 Urban Lakes
E. Coli (MPN/100mL)
2500
2000
1500
1000
500
0
235
Antioch (North)
Antioch (South)
Big Eleven
Blue Pkwy 1
Blue Pkwy 2
Blue Pkwy 3
Blue Valley
Chaumiere
Choteau
Englewood
Ernie Miller
Hamilton Heights
Kingston
Klapmeyer
Lake of the Woods
Lakewood Gw 1
Lakewood Gw 2
Leawood
Loose
North Terrace
Pierson
Sar Ko
South Lake
Stoll
Summer Crest
Tomahawk 1
Tomahawk 2
Tomahawk 3
Troost
Valley
Washington
Water Works

Bacteria Source?

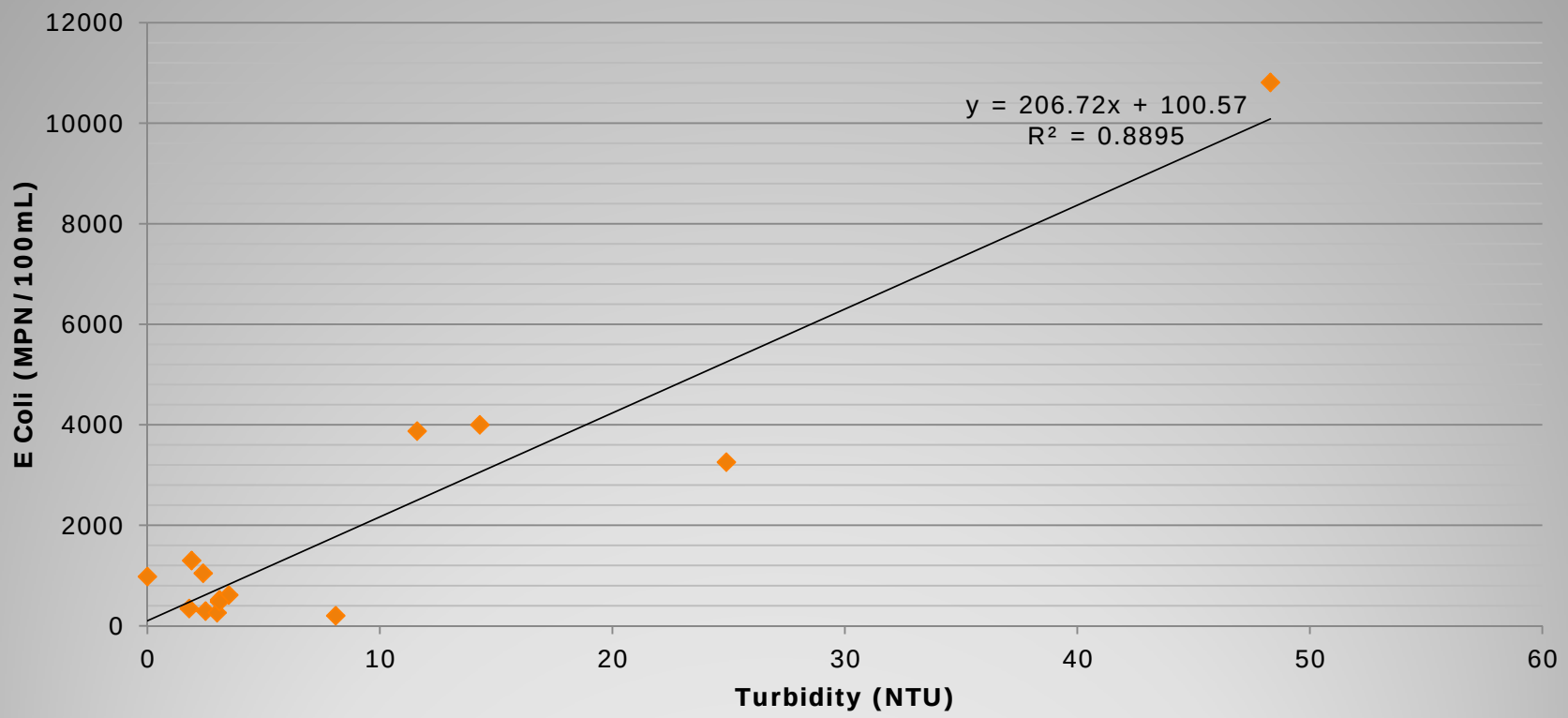
- Until we have a marker for geese…
- Could eliminate human and bovine with PCR – expensive and time consuming
- Could use caffeine ELISA or other chemical indicator
- Could change our PCR approach to do library source matching



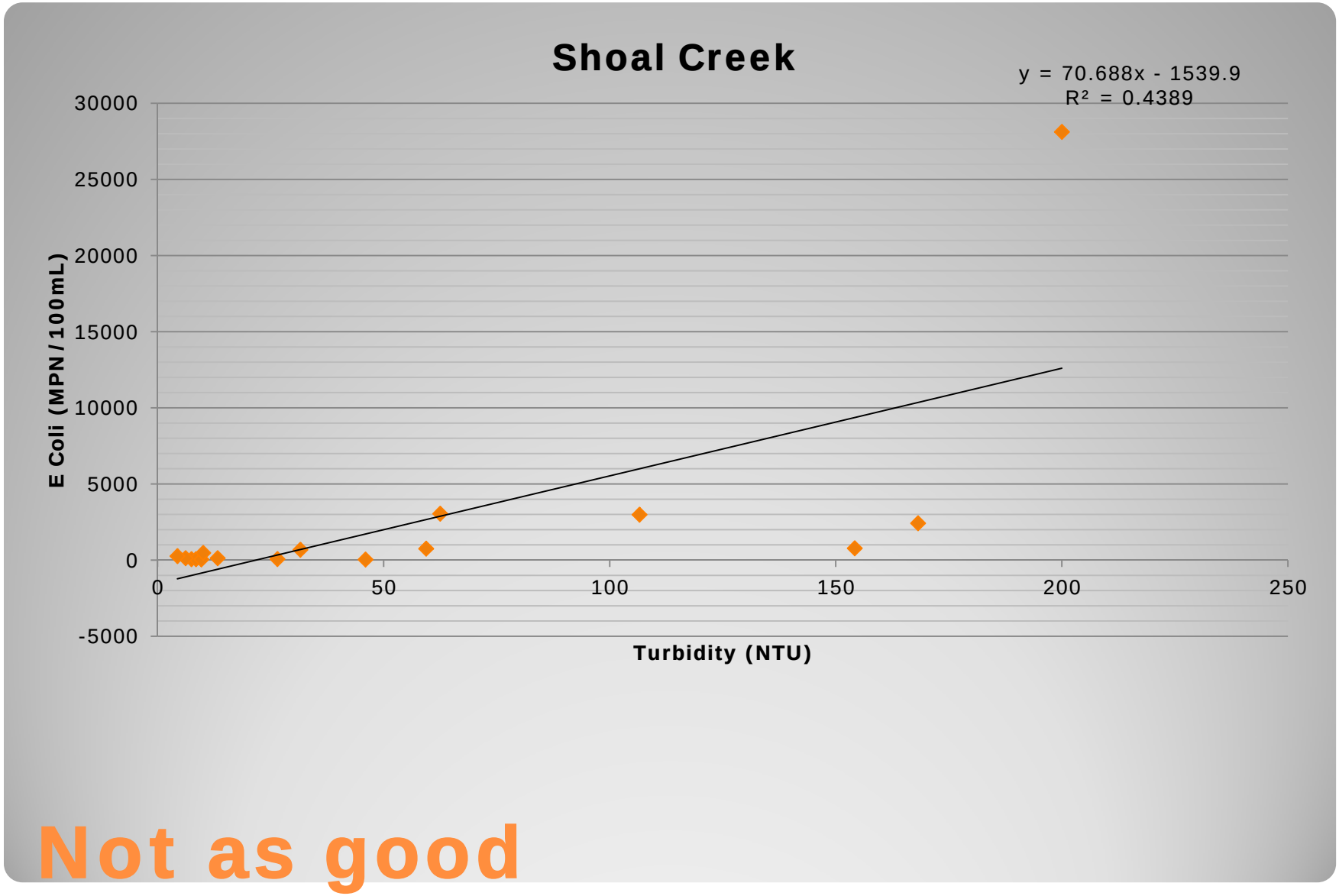
Results

Real Time Telemetry Network

Real-Time Site



Good Correlation

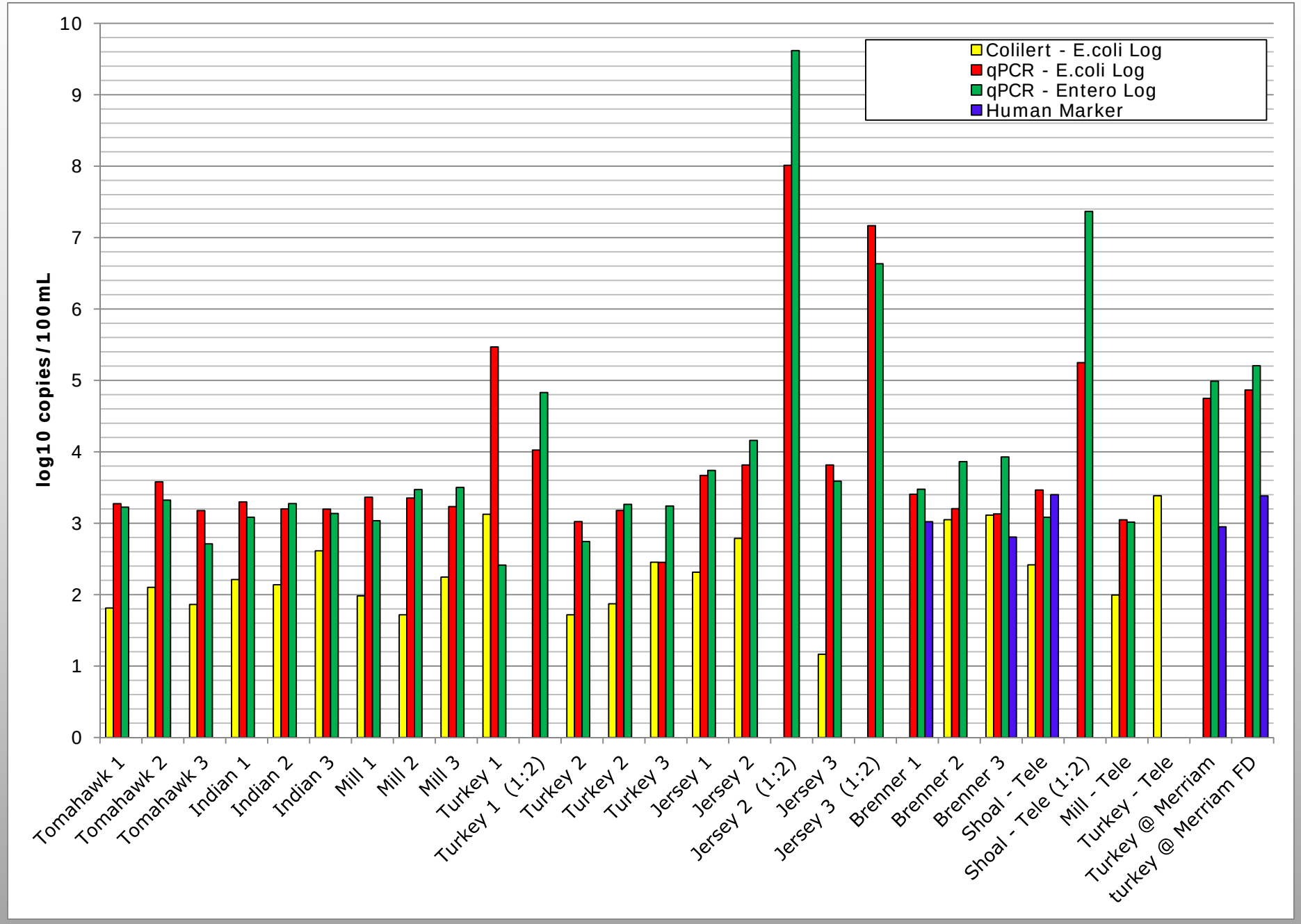

Shoal Creek
y = 70.688x - 1539.9
R² = 0.4389
30000
25000
20000
15000
10000
5000
0
-5000
E Coli (MPN/100mL)
0
50
100
150
200
250
Turbidity (NTU)

Not as good

PCR Results

Microbial Source Tracking

Method


log10 copies / 100 mL
0
1
2
3
4
5
6
7
8
9
10
Colilert - E.coli Log
qPCR - E.coli Log
qPCR - Entero Log
Human Marker
Tomahawk 1
Tomahawk 2
Tomahawk 3
Indian 1
Indian 2
Indian 3
Mill 1
Mill 2
Mill 3
Turkey 1
Turkey 1 (1:2)
Turkey 2
Turkey 2
Turkey 3
Jersey 1
Jersey 2
Jersey 2 (1:2)
Jersey 3
Jersey 3 (1:2)
Brenner 1
Brenner 2
Brenner 3
Shoal - Tele
Shoal - Tele (1:2)
Mill - Tele
Turkey - Tele
Turkey @ Merriam
turkey @ Merriam FD

Next Steps

- Focus on high EC events
- Investigate the surprises
- Develop more markers
- Improve method
- Once we find the problem, work on fixing it!
- Questions???