Sampling/Monitoring for TMDL Implementation

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SESWA Conference
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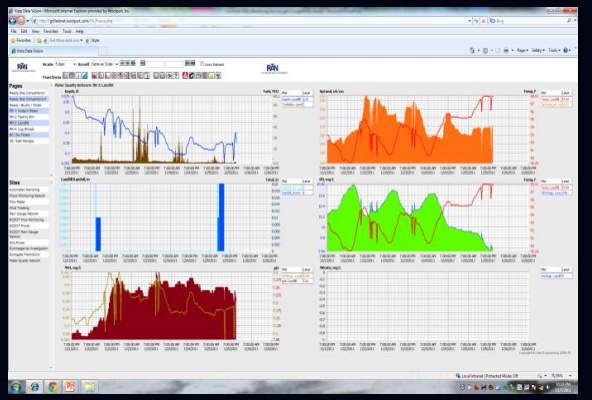
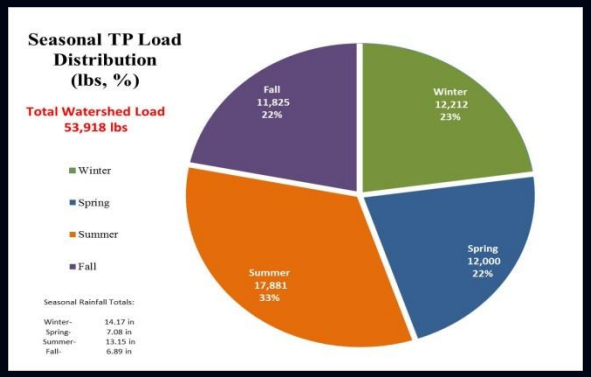




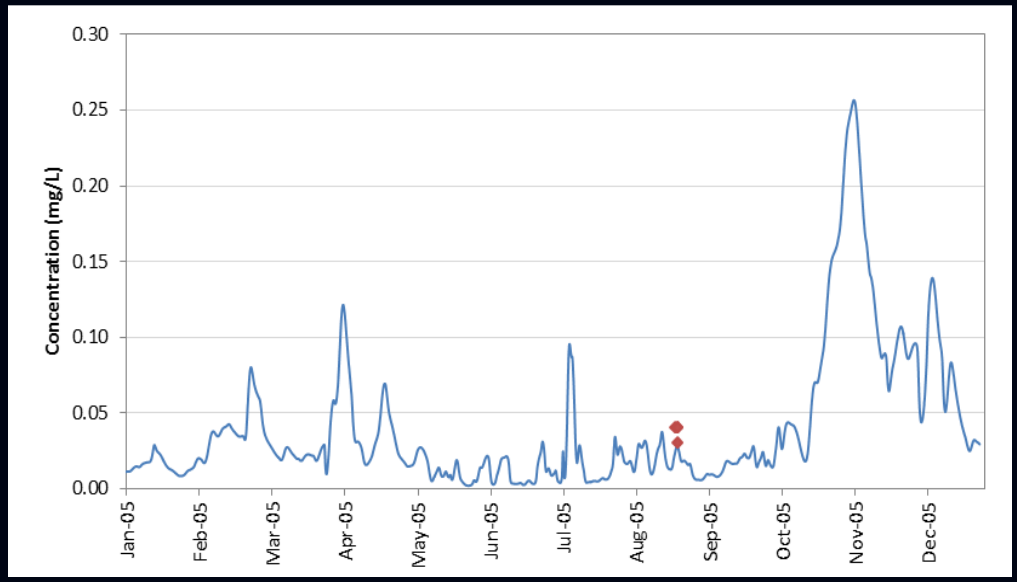
Total Maximum Daily Loads

Typical Supporting Data

- Reliable TMDLs require extensive data
  - Rainfall
  - Flow
  - Water Quality
- Typical Data Sources
  - National Weather Service
  - USGS
  - EPA/State Regulatory Agencies
  - Other Data Sources

Typical Data Limitations

- General Limitations
  - sporadic records due to erratic funding
  - stations discontinued
  - no data within watershed
- Rainfall
  - airport data only
  - lack of time series data
- Flow
  - USGS stations only
  - datum shifts
- Water quality
  - grab samples only
  - insufficient storm water samples
  - no associated weather records or stage information
  - dated data



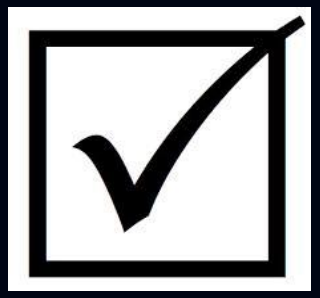
Data is dangerous…
do we really want to know?

Data Collection Challenges

- What type of data does the TMDL model require?
- What is the implementation schedule?
- Do I have staff available to collect reliable data?
- Does my staff have the required experience/expertise?
- How much data is needed?
- Do I need ambient or storm water data?
- Should I evaluate BMPs or watershed-scale improvements?

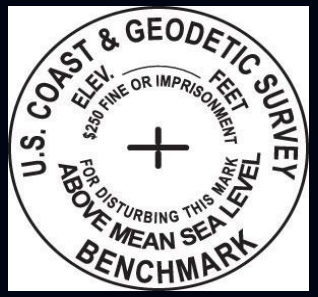
- What type of data collection can my budget support?!?

Possible Paths



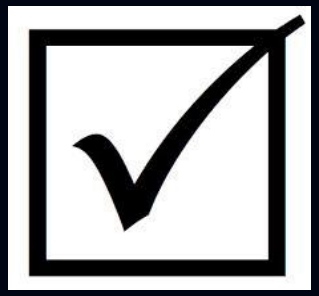
Compliance

Best Practices



Benchmark

Possible Paths



Compliance

Compliance Approach

- Grab sampling only
- Analysis of pollutant of concern (POC)
- Minimal samples
  - One storm per quarter
  - Monthly samples

Compliance Approach

- Basic statistics
- Direct comparison to water quality standards

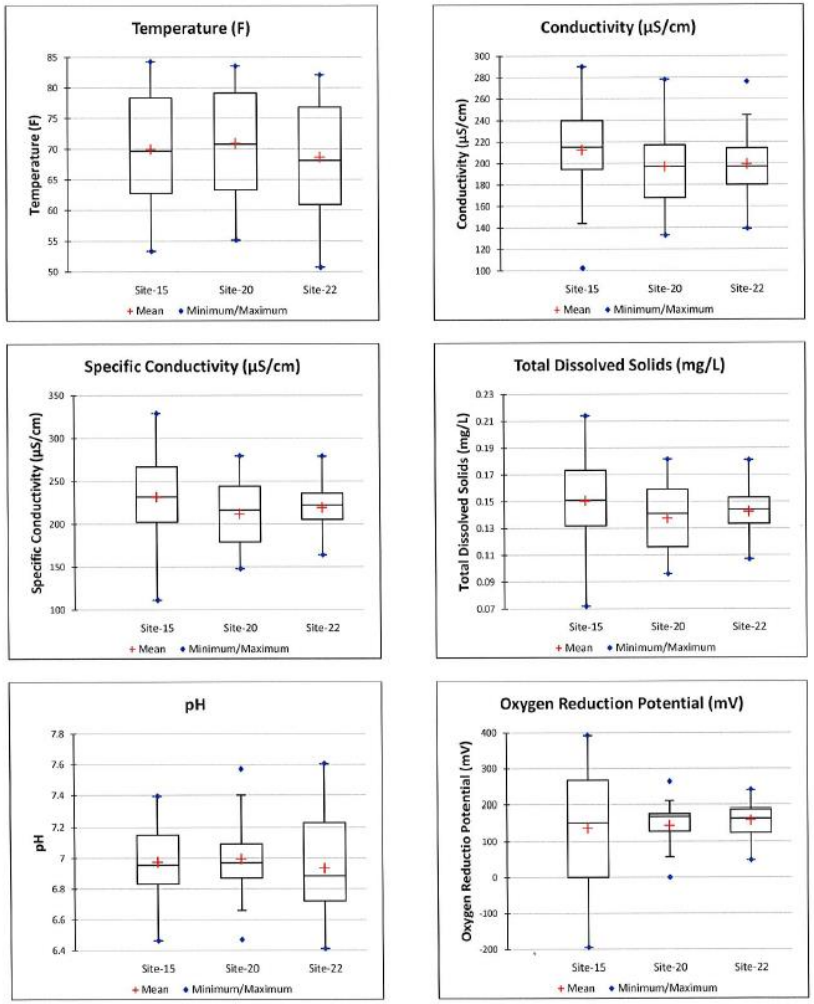
TABLE. Biological Parameter Results and Water Quality Ratings

Client: Greenville County
Stream: BE-020 HorsePen Creek @ Georgia Road
County: Greenville, SC
Collection Date: 6 October 2010

BIOLOGICAL PARAMETER RESULTS Parameters	Qualitatitive
1. Taxa Richness	55
(Total Number of Organisms / Site)	585
2. EPT Index	15.0
3. EPT / Chironomid Ratio	6.6
4. Scraper / Filterer Ratio	0.21
5. Biotic Index	5.74
6. % Dominant Taxon	28%
7. Shredder / Total # of Organisms Ratio	0.04
8. Density (#organisms/m^2)	NA

SCDHEC BIOCLASSIFICATION SCORE	
EPT Index Score	2.4
Biotic Index Score	3.6
Average Score	3.0
Bioclassification	Good-fair
Aquatic Life Use Support	Partially Supporting

Box and whisker plots for Shingle Creek Sites: 2008-2012 grab sample and corresponding continuous data



Compliance Approach

- Macroinvertebrate Assessments

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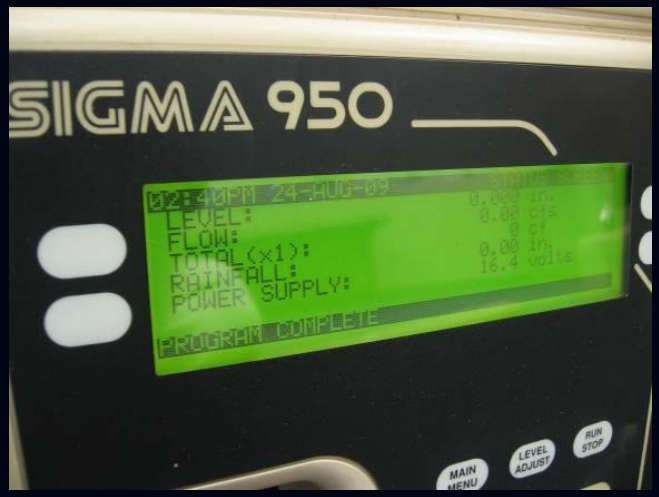
Possible Paths

Best Practices

Best Practices Approach

- Varied collection strategies
  - Grab samples
  - Automated samples
  - Targeted or temporary sensor deployment
- Analysis of pollutant of concern (POC) and other indicators
- Sample collection intervals
  - Multiple samples/storm
- Sample frequency
  - ≥2 storm events per season
  - Dry and wet weather sampling
- Flow measurement/approximation

Automated Samplers



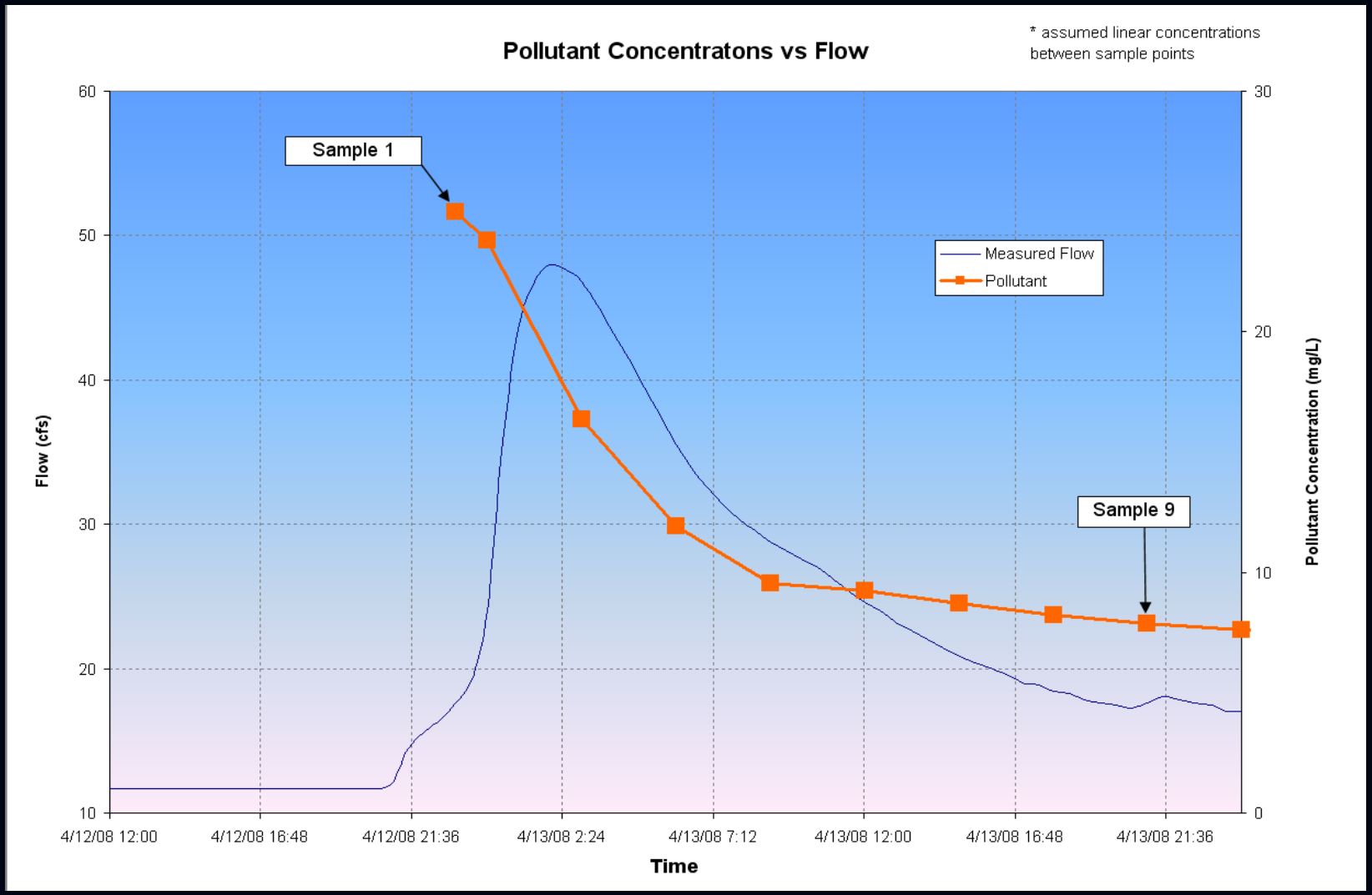
Handheld Sonde/Sensors

Discharge Measurement

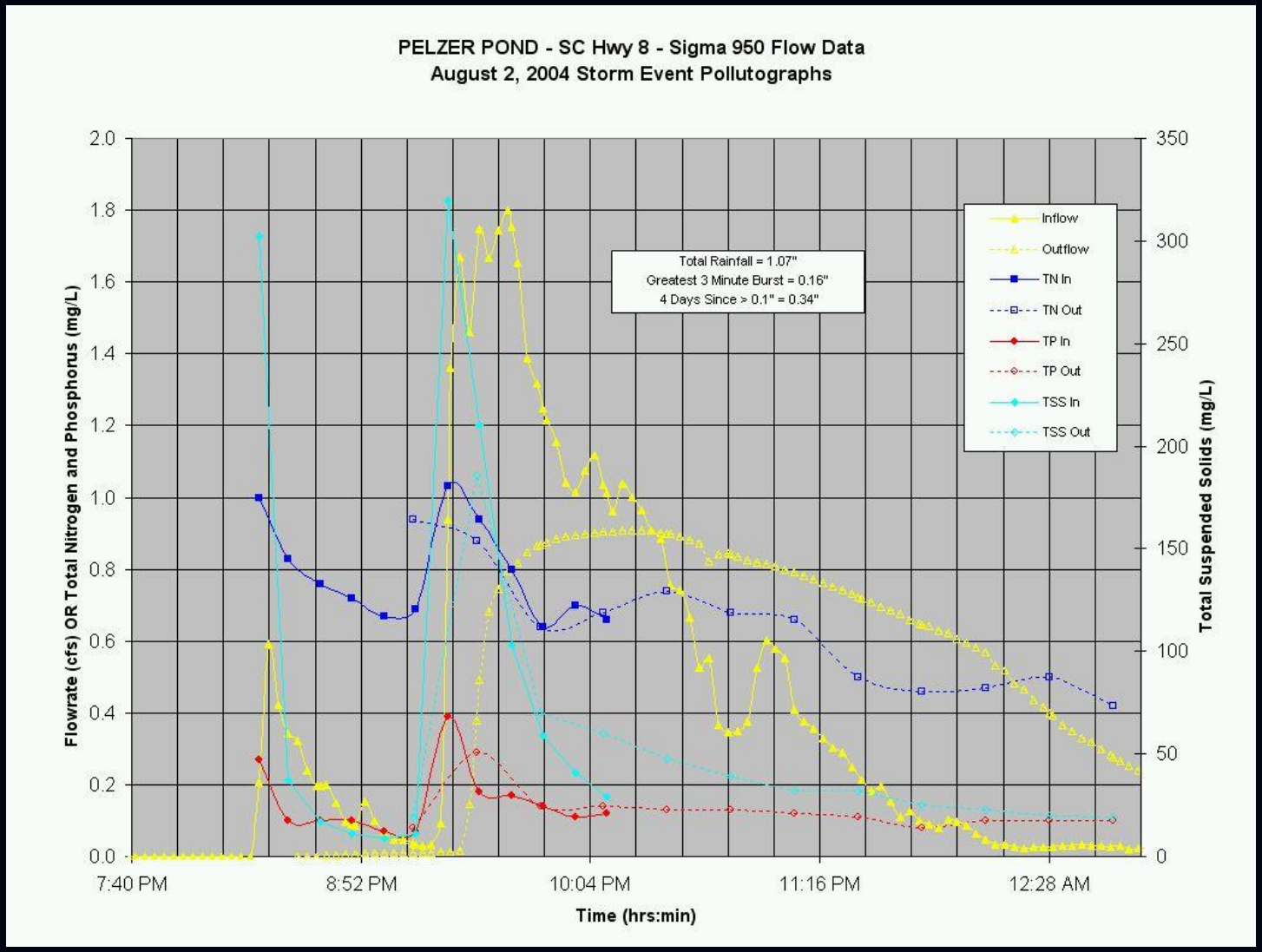
Results

Pollutant	Single Family Residential	Industrial	Office	Commercial	Golf
Total Suspended Solids (TSS), mg/l	187	131	72	77	249
Total Dissolved Solids (TDS), mg/l	69	131	50	45	85
Bio-Chemical Oxygen Demand (BOD5), mg/l	18	6	12	11	12
Chemical Oxygen Demand (COD), mg/l	112	38	40	42	85
Total Phosphorous (TP), mg/l	0.4	0.1	0.2	0.1	0.6
Dissolved Phosphorous (DP), mg/l	0.14	0.03	0.06	0.05	0.20
Total Nitrogen (TN), mg/l	2.82	1.44	1.86	1.53	3.11
Total Kjeldahl Nitrogen (TKN), mg/l	2.23	0.81	1.32	1.12	2.50
Total Cadmium (TCD), mg/l	0.0003	0.0007	0.0003	0.0003	0.0002
Total Copper (TCU), mg/l	0.019	0.135	0.032	0.017	0.016
Total Lead (TPB), mg/l	0.025	0.017	0.011	0.023	0.009
Total Zinc (TZN), mg/l	0.08	0.14	0.14	0.11	0.07

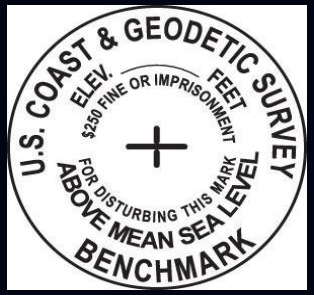
Results


Pollutant Concentratons vs Flow
* assumed linear concentrations between sample points
Sample 1
Sample 9
Measured Flow
Pollutant
Flow (cfs)
Pollutant Concentration (mg/L)
Time
60
50
40
30
20
10
30
20
10
0
4/12/08 12:00
4/12/08 16:48
4/12/08 21:36
4/13/08 2:24
4/13/08 7:12
4/13/08 12:00
4/13/08 16:48
4/13/08 21:36

Results


PELZER POND - SC Hwy 8 - Sigma 950 Flow Data
August 2, 2004 Storm Event Pollutographs
Total Rainfall = 1.07"
Greatest 3 Minute Burst = 0.16"
4 Days Since > 0.1" = 0.34"
Inflow
Outflow
TN In
TN Out
TP In
TP Out
TSS In
TSS Out
Flowrate (cfs) OR Total Nitrogen and Phosphorus (mg/L)
Total Suspended Solids (mg/L)
Time (hrs:min)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0
50
100
150
200
250
300
350
7:40 PM
8:52 PM
10:04 PM
11:16 PM
12:28 AM

Possible Paths



Benchmark

Manual Grab Sampling

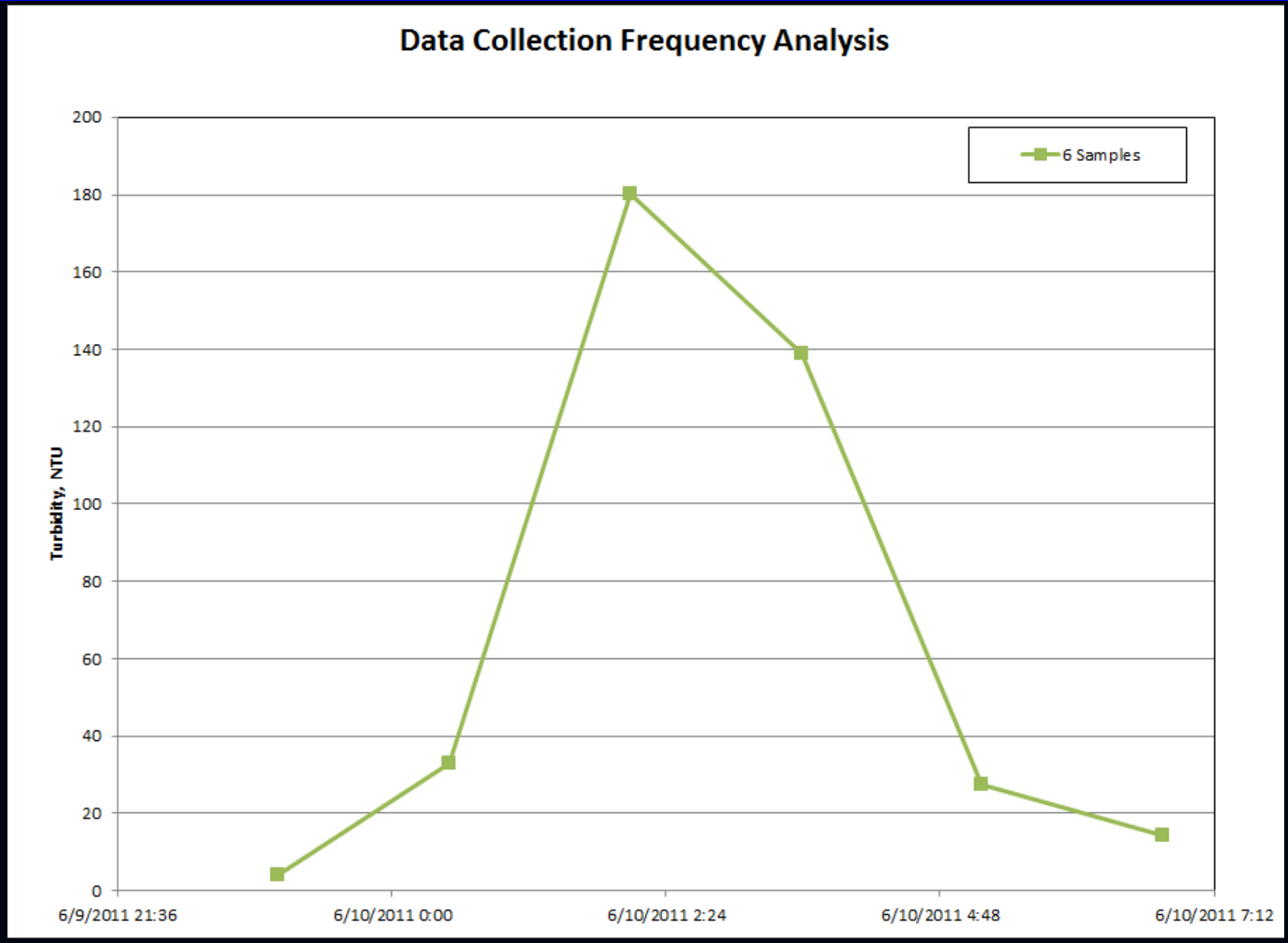
+ Advantages
  - Sample for target pollutant
  - Low costs
  - Flexibility

+ Disadvantages
  - Highly difficult during storm events
    + Timing/staff availability
    + Safety
    + Non-working hours
    + Laboratory overtime expenses
  - Limited snapshot of water quality, no flow data, and unlikely to detect spills

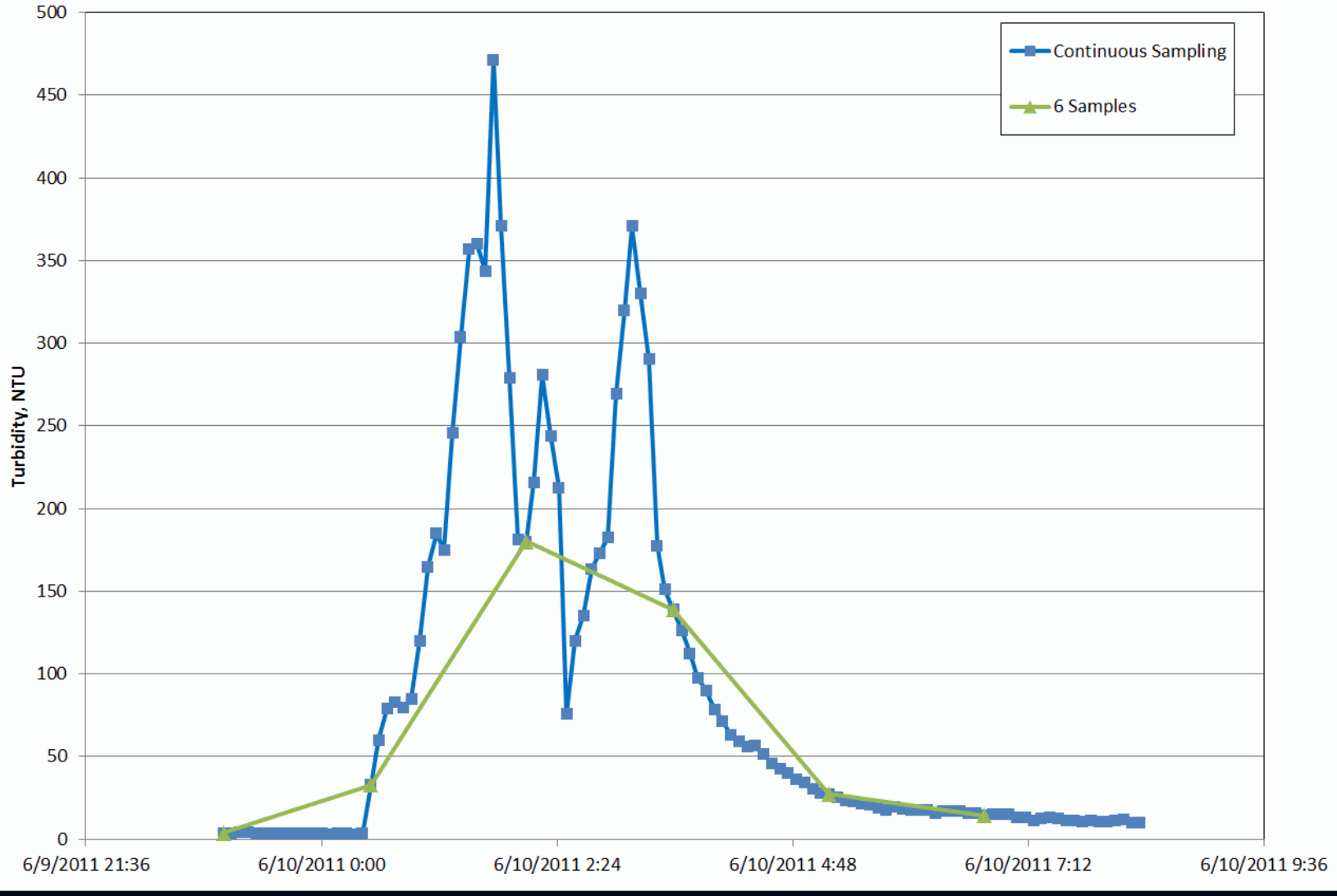
Continuous Monitoring

+ Advantages
  - Highly detailed, representative data
  - Collection of unattended data
  - Detection of illicit discharges
  - Stage/flow data
  - Proactive

+ Disadvantages
  - Sensors require routine calibration
  - Detection of limited number of parameters
  - Higher costs


Data Collection Frequency Analysis
Turbidity, NTU
200
180
160
140
120
100
80
60
40
20
0
6 Samples
6/9/2011 21:36
6/10/2011 0:00
6/10/2011 2:24
6/10/2011 4:48
6/10/2011 7:12

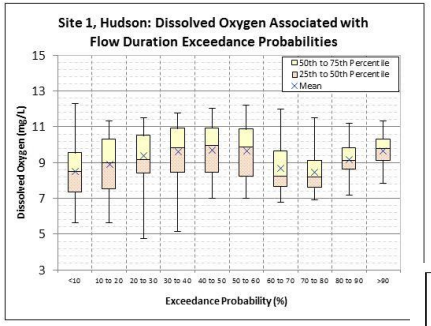
Data Collection Frequency Analysis

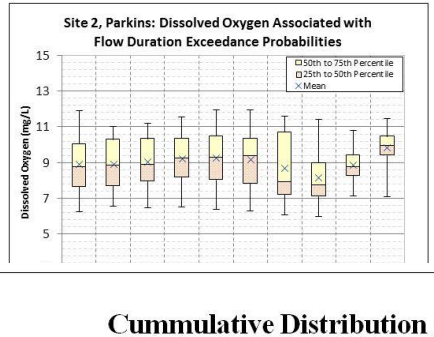


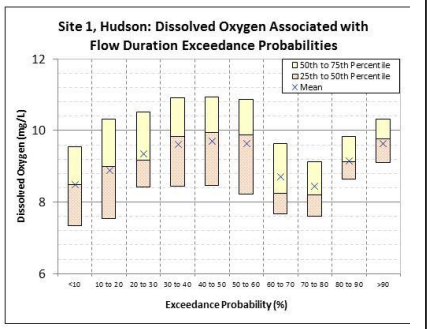
Permanent Monitoring Station

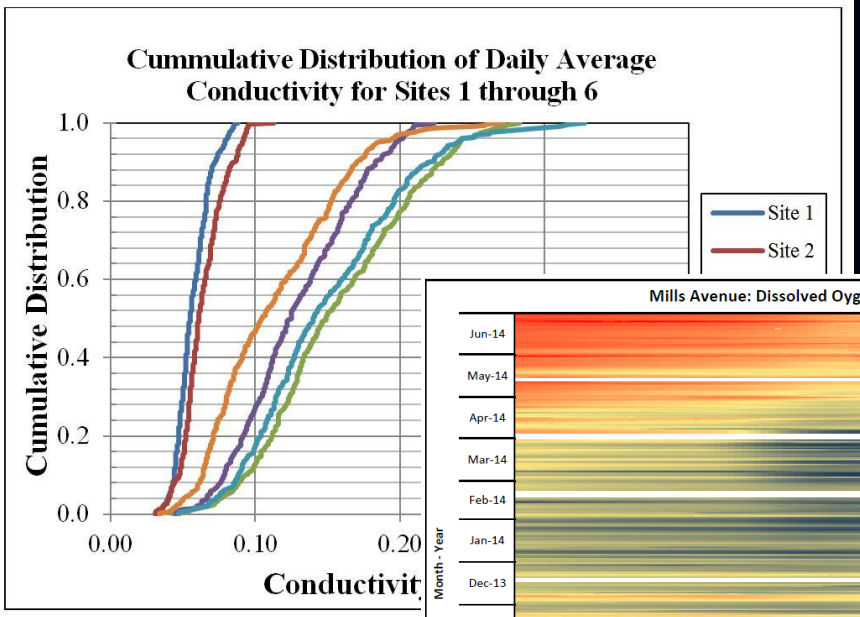
Additional Stations

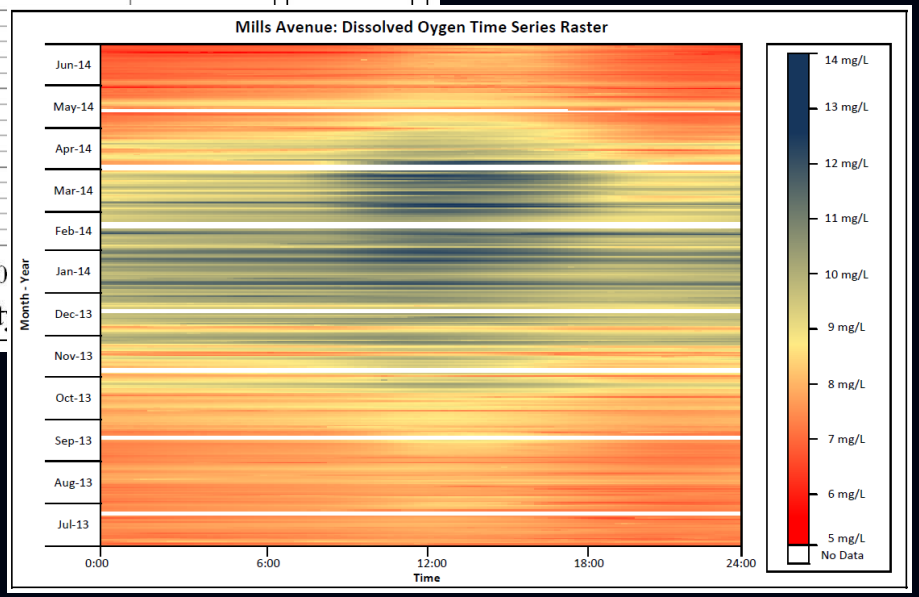
Data Analysis



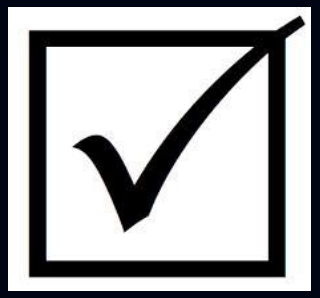






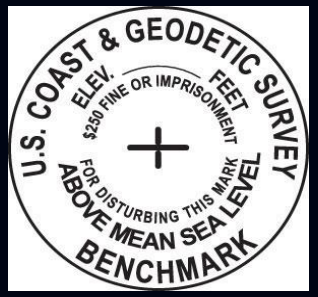


Advantages/Disadvantages

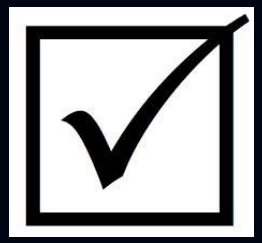


Compliance

Best Practices



Benchmark

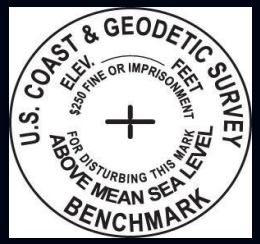


Compliance

- Advantages
  - Low front end costs
  - Sample for POC
  - Could use City/County staff
  - Sufficient for Bio sampling
- Disadvantages
  - Limited data – insufficient to identify trends
  - Highly unlikely to identify pollutant sources
  - Implementation of incorrect BMPs
  - Potentially high back end costs

Best Practices

- Advantages
  - Reasonable costs
  - Use municipal staff
  - Sufficient data to analyze individual storms
  - Ability to narrow focus of pollutant sources
  - Less likely to implement inappropriate BMPs
- Disadvantages
  - Higher front end costs
  - Unlikely to identify pollutant sources
  - Unlikely to identify causes of Bio issues
  - Not enough data to dispute load allocations



Benchmark

- Advantages
  - Model MS4 program
  - Sufficient data to identify pollutant sources and challenge TMDL load allocations
  - Considerable long term cost saving due to selection of appropriate BMPs if needed
- Disadvantages
  - Expensive on front end
  - Likely requires on-going consultant assistance

Questions?