Sunshine Lake/Sunrise Waterway Preliminary Results

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Plan Design Enable

What covered here, and why was this work done in the first place?

- Review of preliminary results from this year's monitoring program
- Why a monitoring program?
  - First task within water quality management plan
  - Need to understand the source(s) of nutrients that allowed for the previous Sunshine Lake / Sunrise Waterway algal bloom
  - If we don't know the source(s) of nutrients, we won't know what to act on to prevent its re-occurrence
- What do we do with results?
  - Determine likely source(s) of nutrients
  - Develop strategies to address the source(s) or to mitigate their impacts

Sunshine Lake/Sunrise Waterway Water Quality Monitoring

- Methods of Assessment
  - Data Collection
  - Comparable ranges
    - Nutrient
    - Fecal Coliform Bacteria
- Preliminary Results
  - Nutrients
  - Fecal Coliform
- Interpretation of Preliminary Results
- Recommendations for Additional Efforts

Surface Water

Sampling Frequency: Monthly

Parameters:

- Chlorophyll-a
- Total Nitrogen
- Total Phosphorus
- Total Kjeldahl Nitrogen
- Nitrate+Nitrite
- Ortho-phosphate
- Ammonia
- Fecal Coliform

In-situ readings:

- Temperature
- Salinity
- Conductivity
- Dissolved oxygen

Surficial Aquifer

Sampling Frequency:

Monthly

Parameters:

- Total Nitrogen
- Total Phosphorus
- Total Kjeldahl Nitrogen
- Nitrate+Nitrite
- Ortho-phosphate
- Ammonia
- Fecal coliform

Seepage

Sampling Frequency:

Monthly

Parameters:

- Total Nitrogen
- Total Phosphorus
- Total Kjeldahl Nitrogen
- Nitrate+Nitrite
- Ortho-phosphate
- Ammonia
- Fecal coliform

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Stormwater

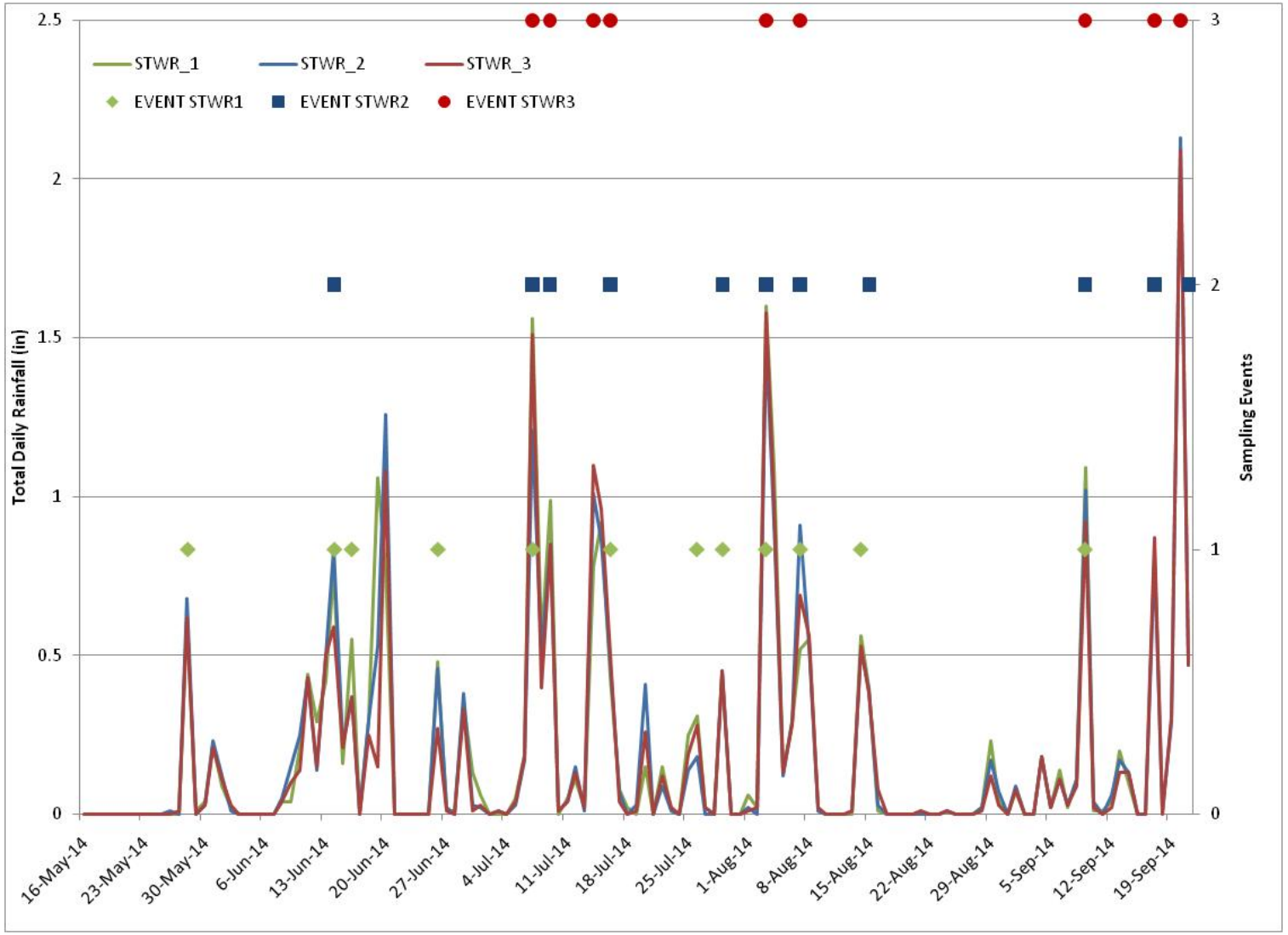
Sampling Frequency:

Event driven

Parameters:

Total Nitrogen
Total Phosphorus
Total Kjeldahl Nitrogen
Nitrate+Nitrite
Ortho-phosphate
Ammonia
Fecal coliform

Stormwater Events



Dataset for Nutrient Comparisons

Surface Water	Not Problematic	Problematic
TN (mg/L)	1.05 - 1.91	> 1.91
TP (mg/L)	0.03 - 0.09	> 0.09

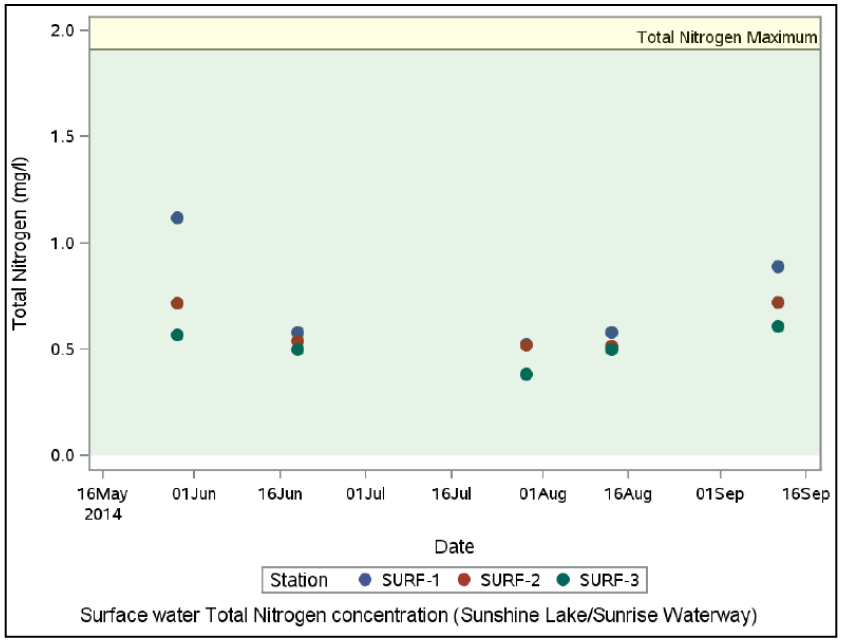
Stormwater	Normal Undeveloped	Lower Range Developed	Elevated Developed	Excessive Developed
TN (mg/L)	0.070 - 1.52	1.02 - 2.07	2.07 - 3.99	> 3.99
TP (mg/L)	0.002 - 0.100	0.102 - 0.327	0.327 - 0.510	> 0.510

Groundwater Seepage	Normal Undeveloped	Lower Range Developed	Elevated Developed	Excessive Developed
TN (mg/L)	< 0.40	0.40 - 2.50	2.50 - 14.3	> 14.3
TP (mg/L)	< 0.002	0.002 - 0.055	0.055 - 0.373	> 0.373

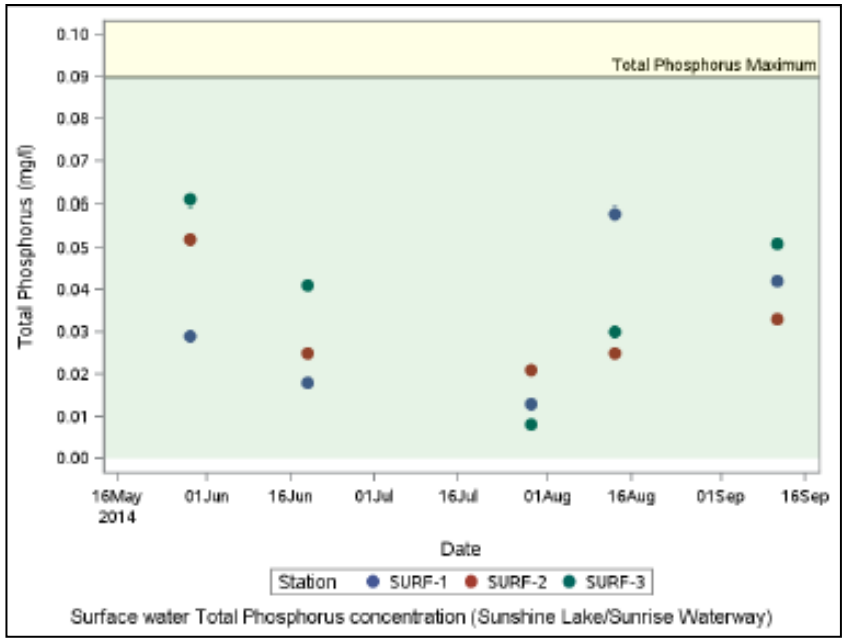
Surficial Aquifer	Normal Undeveloped	Lower Range Developed	Elevated Developed	Excessive Developed
TN (mg/L)	< 0.23	0.23 - 0.35	0.35 - 5.2	> 5.2
TP (mg/L)	< 0.01	0.01 - 0.02	0.02 - 0.07	> 0.07

Preliminary Results for Surface Water Nutrients

Total nitrogen

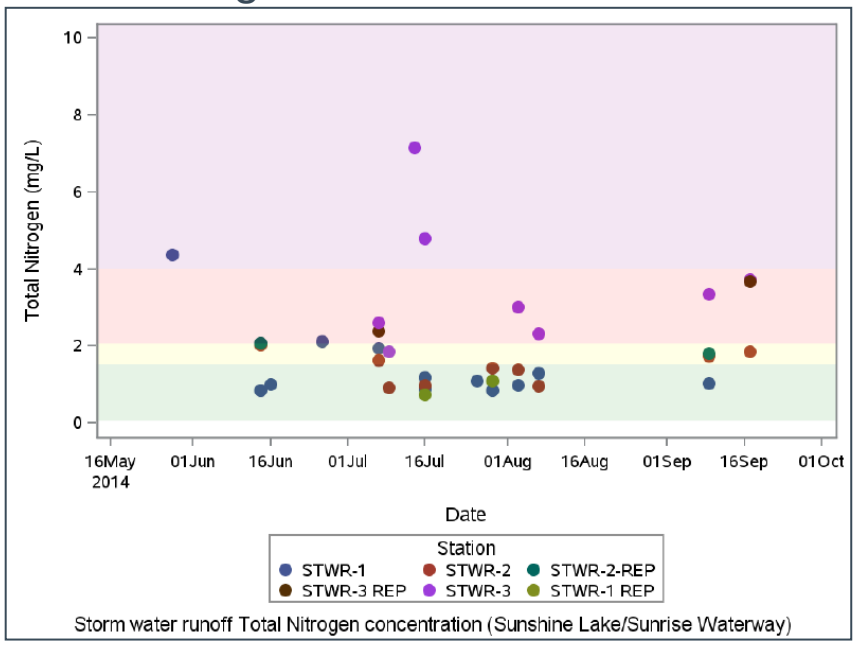


Total phosphorus

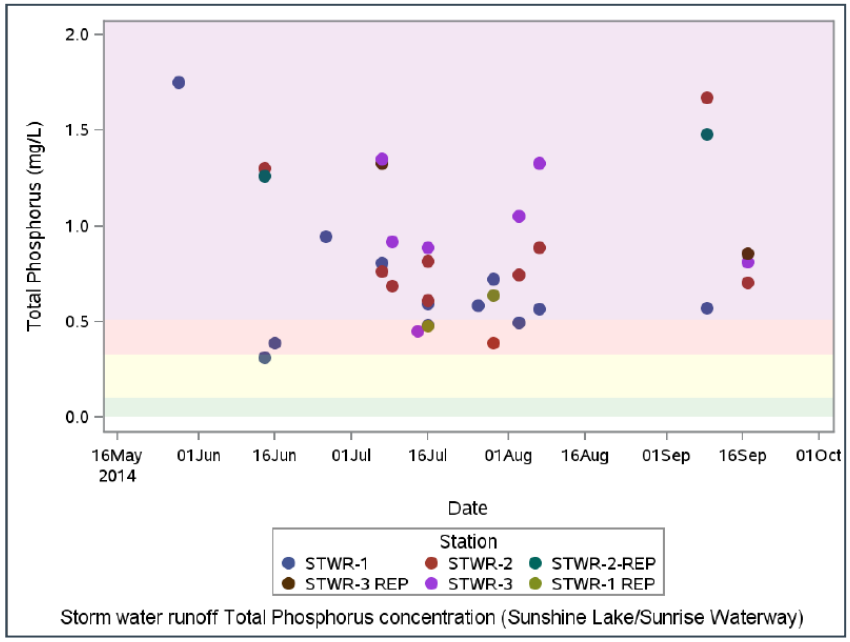


Preliminary Results for Stormwater Nutrients

Total nitrogen

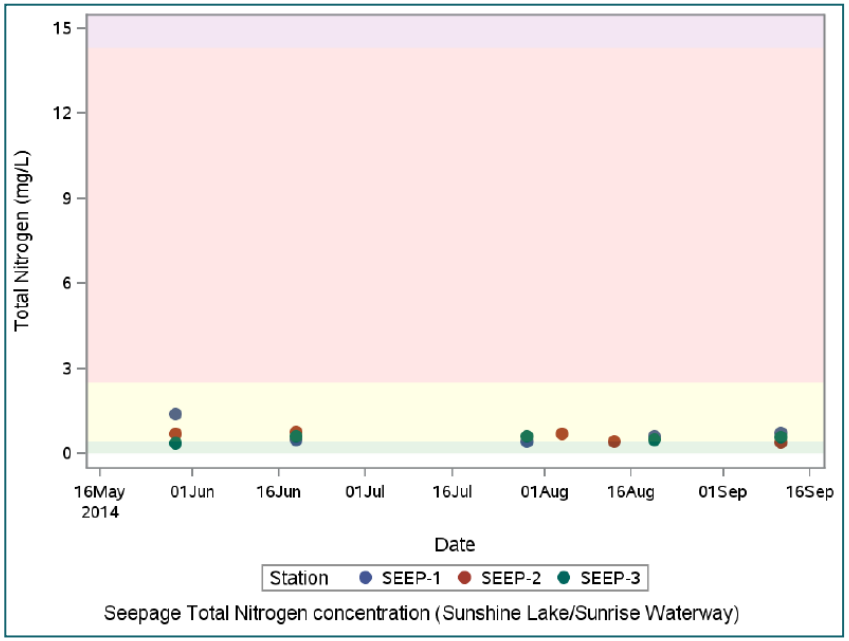


Total phosphorus

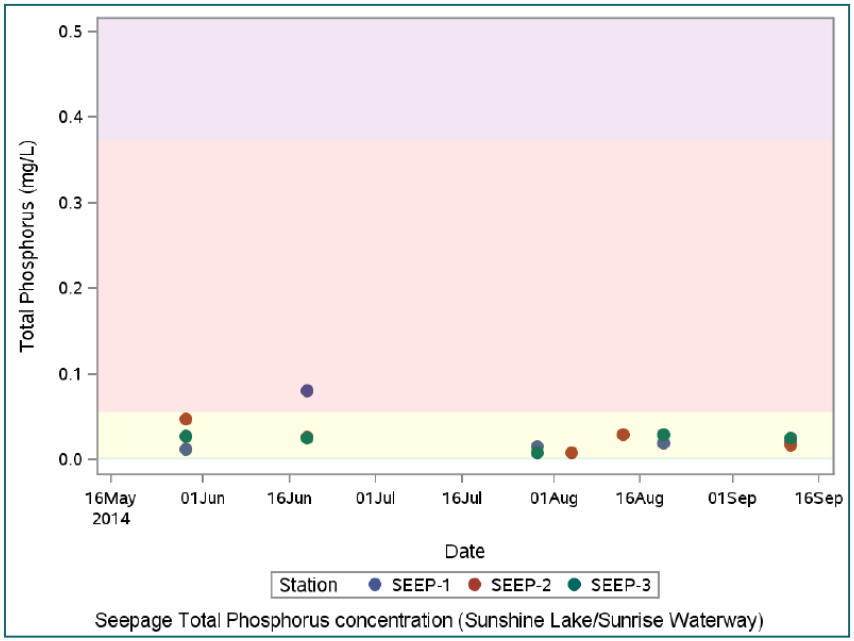


Preliminary Results for Groundwater Seepage Nutrients

Total nitrogen

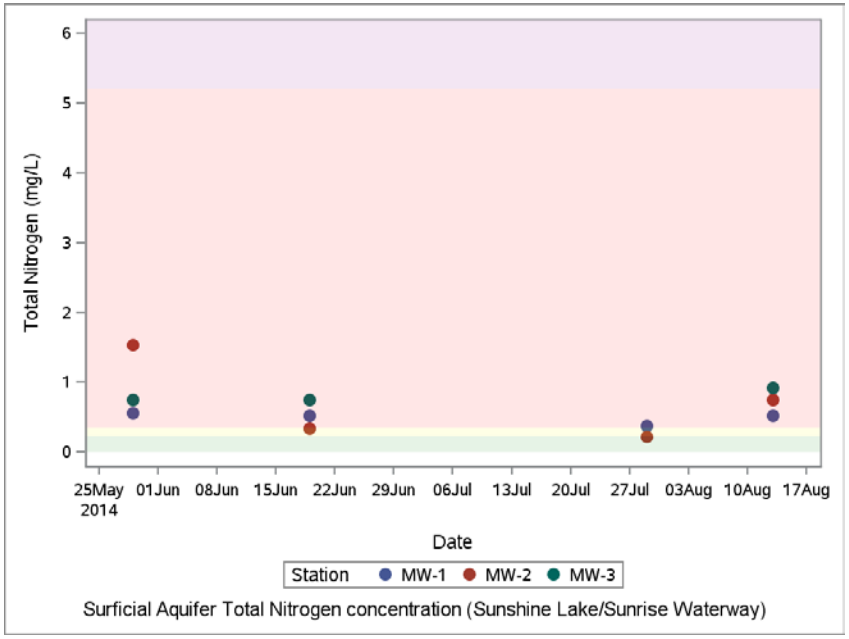


Total phosphorus

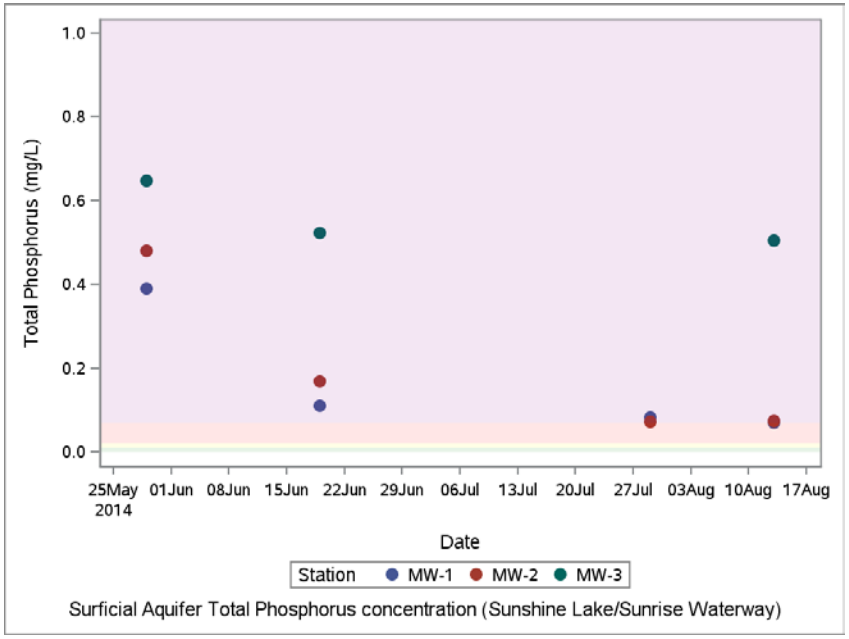


Preliminary Results for Surficial Aquifer Nutrients

Total nitrogen



Total phosphorus



Dataset for Fecal Coliform Bacteria Comparisons

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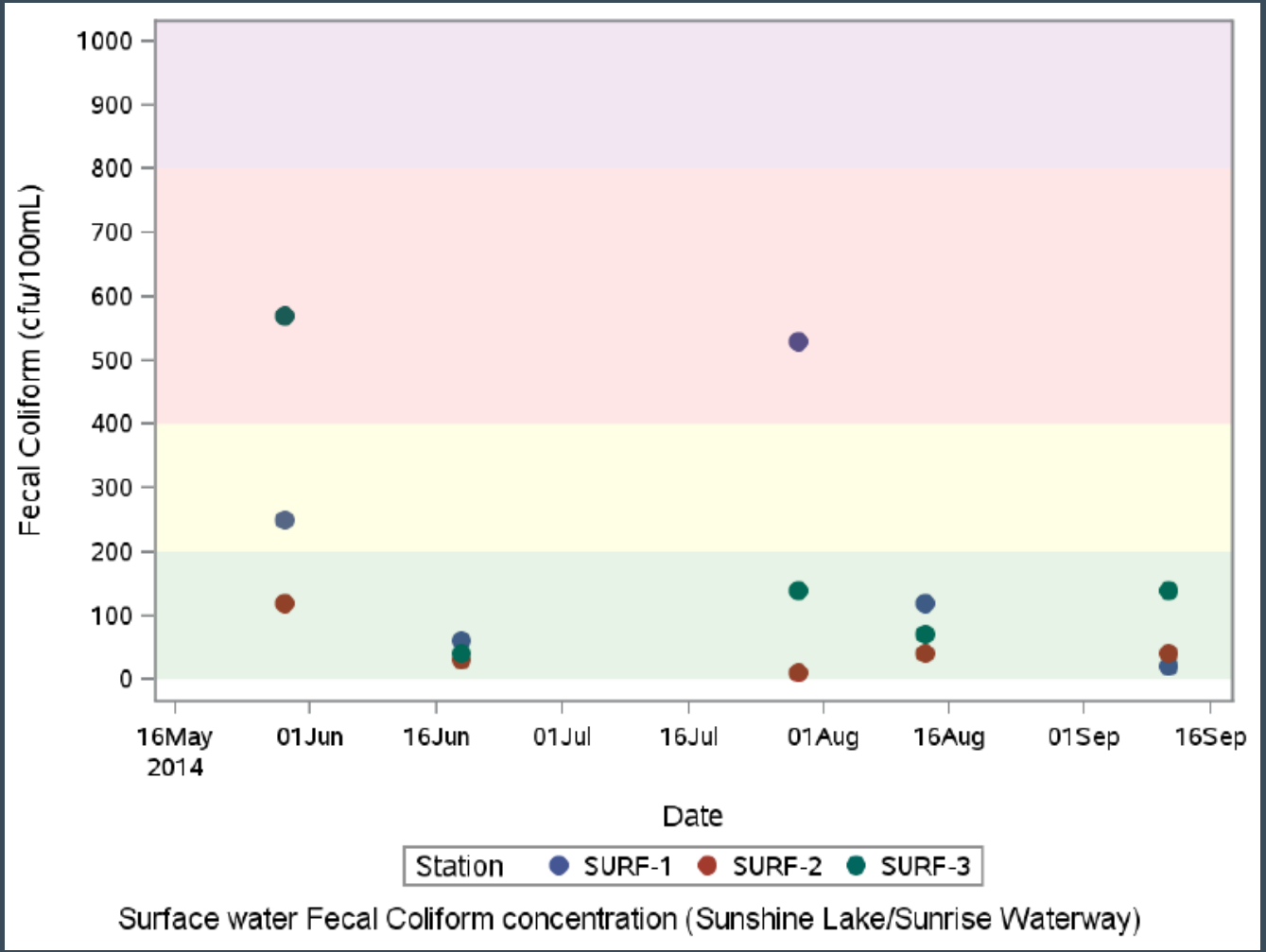
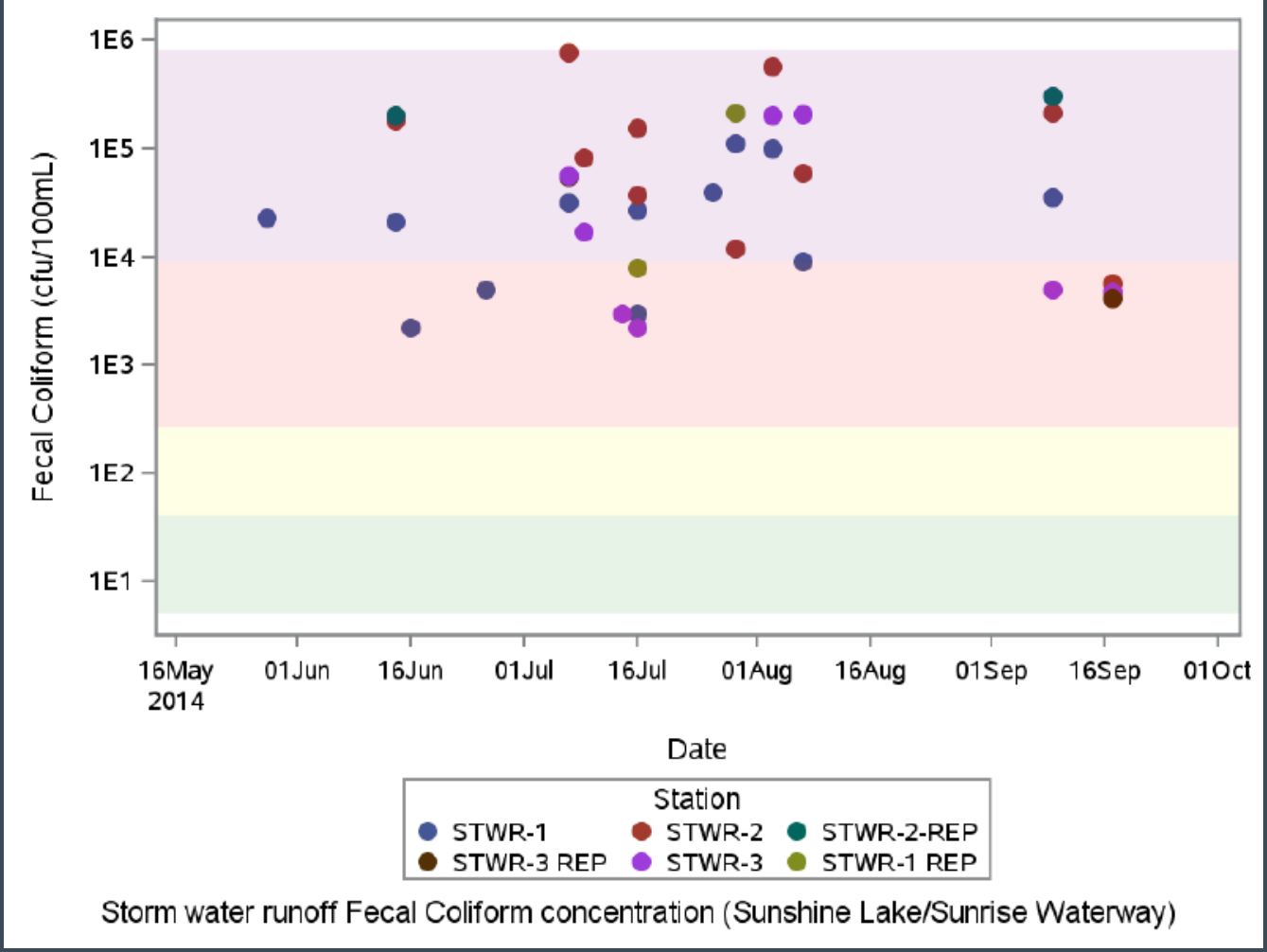
Surface Water	Normal Undeveloped	Lower Range Developed	Elevated Developed	Excessive Developed
Bacteria (cfu/100mL)	0 - 200	200 - 400	400 - 800	> 800

Stormwater	Normal Undeveloped	Lower Range Developed	Elevated Developed	Excessive Developed
Bacteria (cfu/100mL)	5 - 40	40 - 264	264 – 8,900	> 8,900

Preliminary Results for Surface Water Bacteria



Preliminary Results for Stormwater Bacteria



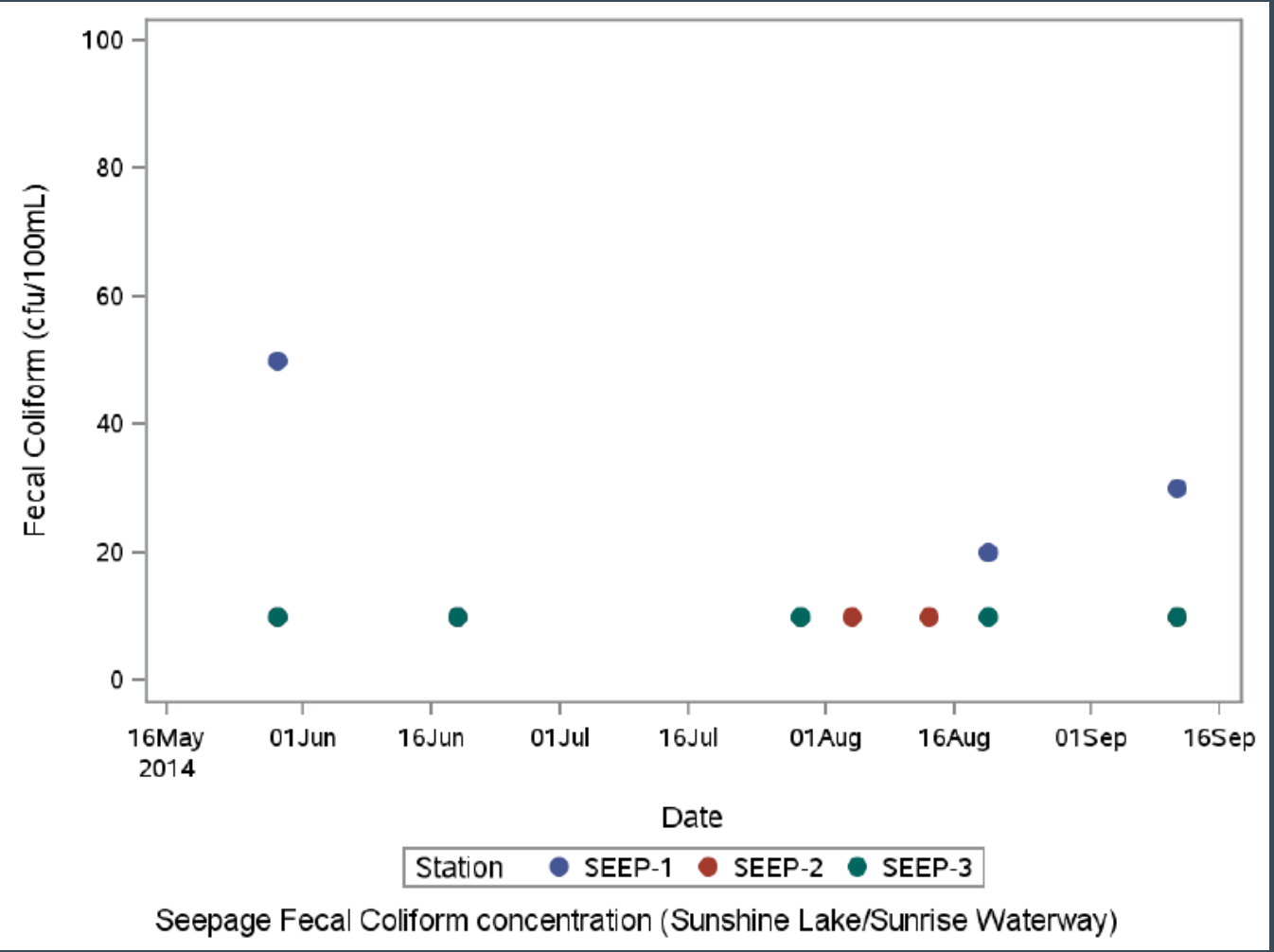
Supplemental source identification

- Elevated fecal coliform bacteria concentrations alone are not sufficient evidence to indicate the source of bacteria
  - Fecal coliform bacteria
    - Gram-negative bacteria generally associated with warm-blooded animals
    - Also identified in sediments and other sources
- Microbial Source Tracking (MST) completed due to elevated fecal coliform bacteria in Stormwater samples
  - Tool to determine host (origin of bacteria producer)
    - Qualitative: presence or absence
    - Quantitative: amount of bacteria associated with marker
  - Multiple MST Tools available: Humans, Dog, Bird, etc.
    - Humans
      - » Bacteroides dorei: human-specific gram-negative bacteria indicative of recent contamination
      - » EPA-Patented Target: EPA developed assay to target human fecal pollution
    - Dog
      - » Bacteroidetes ID: dog-specific gram-negative bacteria

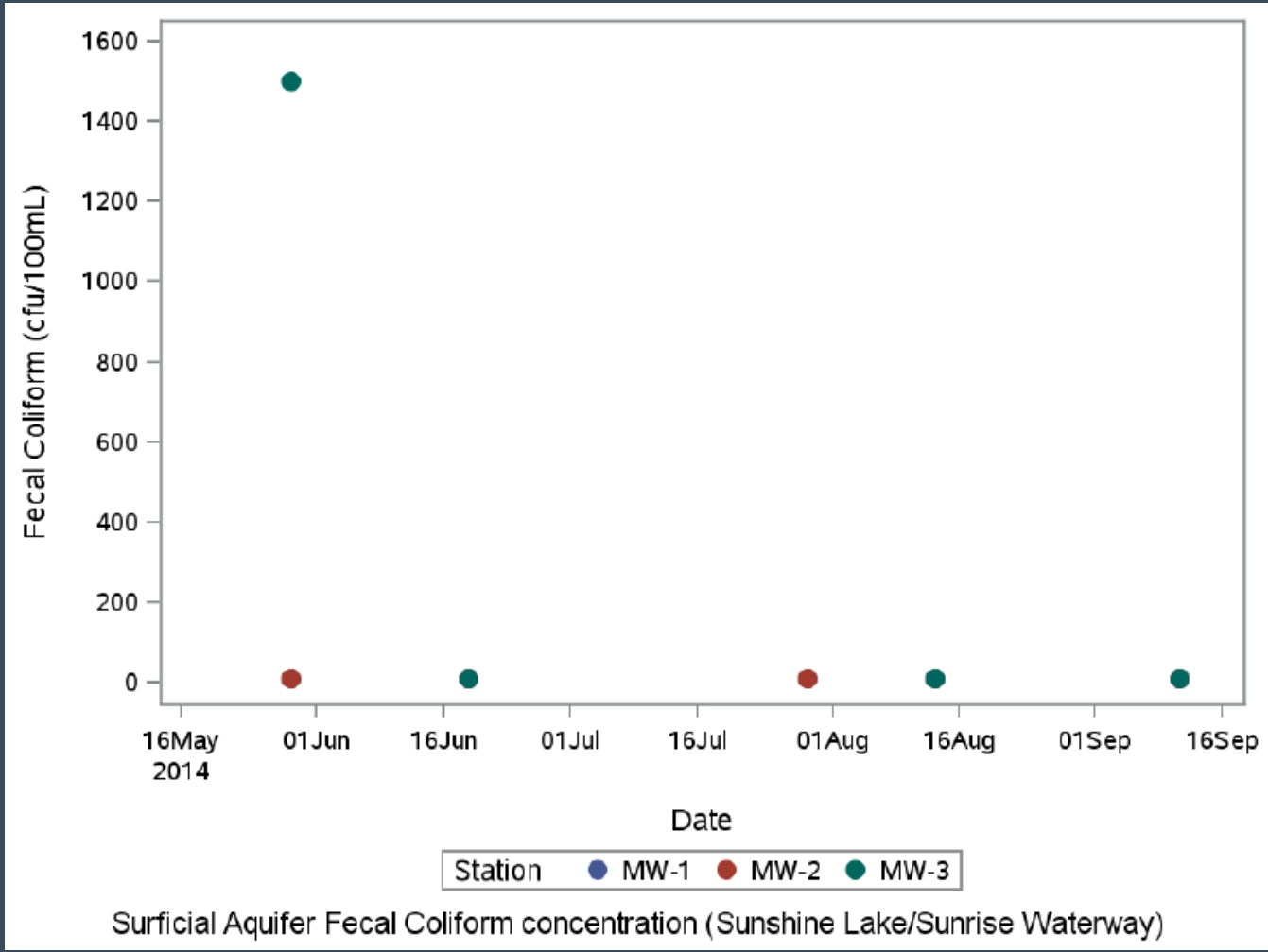
MST Analysis

- Samples collected July 8, 2014
  - Test for Human source: Negative at all three sites
- Samples collected August 4, 2014
  - Test for Human source
    - Positive at STWR-3
    - Quantification indicated a small percent (< 1%) of bacteria due to human source
  - Test of Dog source
    - Positive at STWR-1 and STWR-2
    - Quantification indicated a small percent (< 1%) of bacteria due to dog source

Preliminary Results for Groundwater Seepage Bacteria



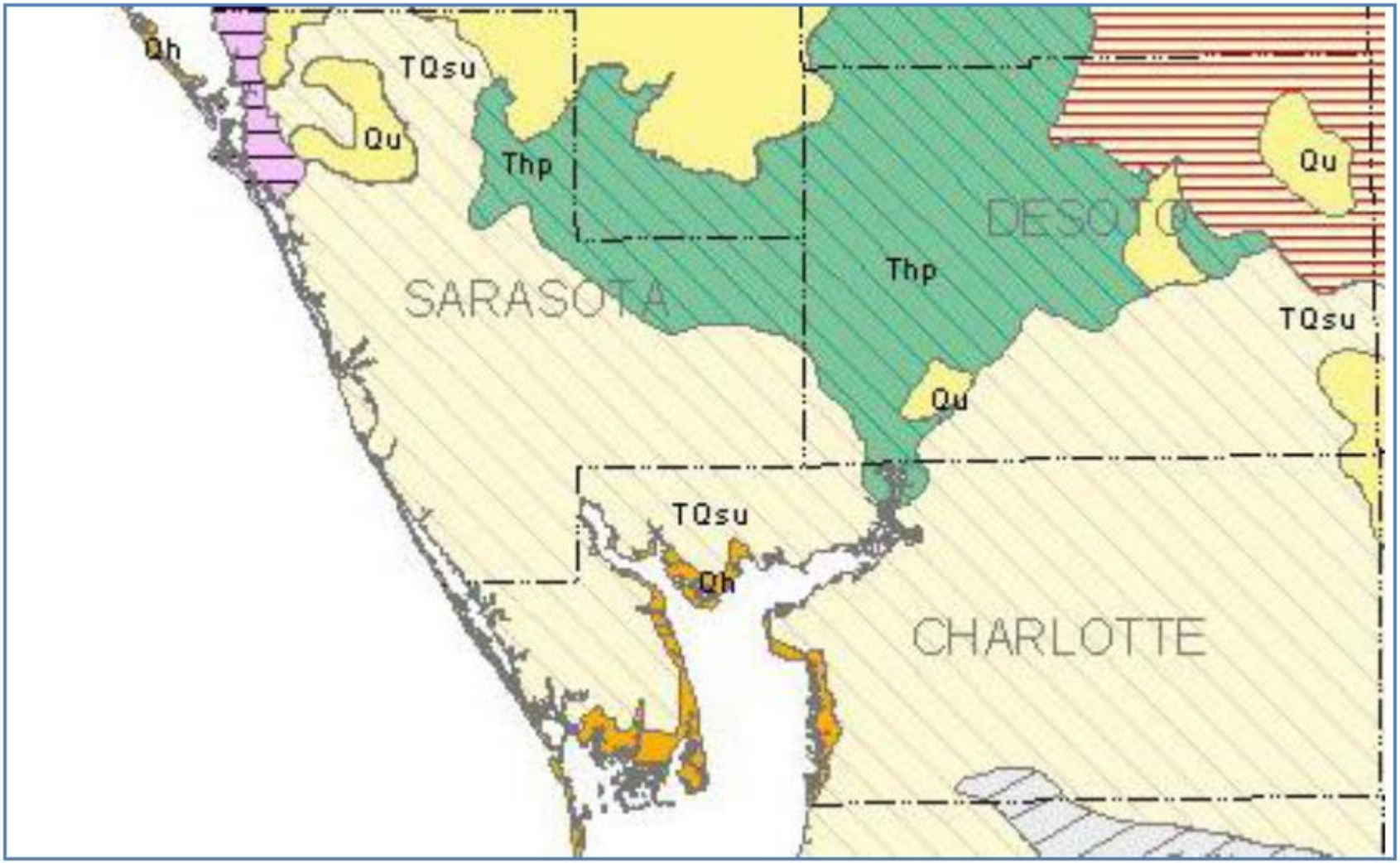
Preliminary Results for Surficial Aquifer Bacteria



Overall conclusions, so far

- Levels of bacteria in lake enough for impairment determination (> 400 cfu / 100 ml)
- Levels of bacteria in stormwater very high
  - But not predominantly due to humans or dogs
  - Other sources?
    - Soils, vegetation, etc.
- Levels of nitrogen in stormwater, aquifer and groundwater seepage not excessive
  - Nitrogen within algal mat possibly from nitrogen fixation
- Levels of phosphorus in stormwater (and less so in aquifer) very high
  - But no evidence that high values from fertilizer (N not high) or sewage (N not high and bacteria mostly not from humans)
  - So where did high phosphorus come from???

Surface Geology in the Vicinity



From Scott et al. 2001

1984 Soils Maps

2013 Matlacha Soils-Urban land complex (soil type “7”)

“VERY HIGH potential for P movement from the site
and for and an adverse impact on surface waters.”-Hurt et al. 2013

Interpretation of Preliminary Results

- **Nutrient levels lower in water column than stormwater and groundwater, indicative of potential appropriate nutrient assimilative capacity**
- **Reoccurrence of algae blooms possible**
- **Nutrient levels in groundwater mostly consistent with expected values**

- **Stormwater nitrogen levels not substantially higher than expected**
- **Stormwater phosphorous levels substantially higher than expected, likely due to surface geology**
- **Stormwater runoff probably most important loading source**
- **Fecal coliform bacteria very high in stormwater samples, additional testing not indicative of humans as primary source**

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Recommendations for Additional Efforts

- Monitoring program which includes quantitative criteria designed to trigger various levels of management attention
  - Quarterly:
    - Water quality sampling: nitrogen, phosphorus and chlorophyll-a
    - Sediment phytoplankton taxonomy
  - Annual:
    - Assessment of presence or absence of algal bloom associated with the lake bottom
    - Sediment phytoplankton taxonomy

Recommendations for Additional Efforts

- "Walk the WBID" to identify and quantify potential sources of bacteria
  - Document presence or absence of wildlife, pet wastes, rotting vegetation associated with stormwater conveyance systems
  - Quantify abundance of potential bacteria sources
- Replicated experiment
  - Soils, pet waste and rotting vegetations immersed in water-filled buckets to quantify abundance of fecal coliform bacteria over time
- Supplemental stormwater samples
  - Quantify fecal coliform bacteria before and after entering the concrete stormwater discharge pipe
- All information to be used to develop specific actions or programs to reduce the probability of a re-occurrence of the algal bloom